

June 17, 1930.

R. BOWN

1,763,751

RADIO RECEIVING SYSTEM

Filed Nov. 17, 1925

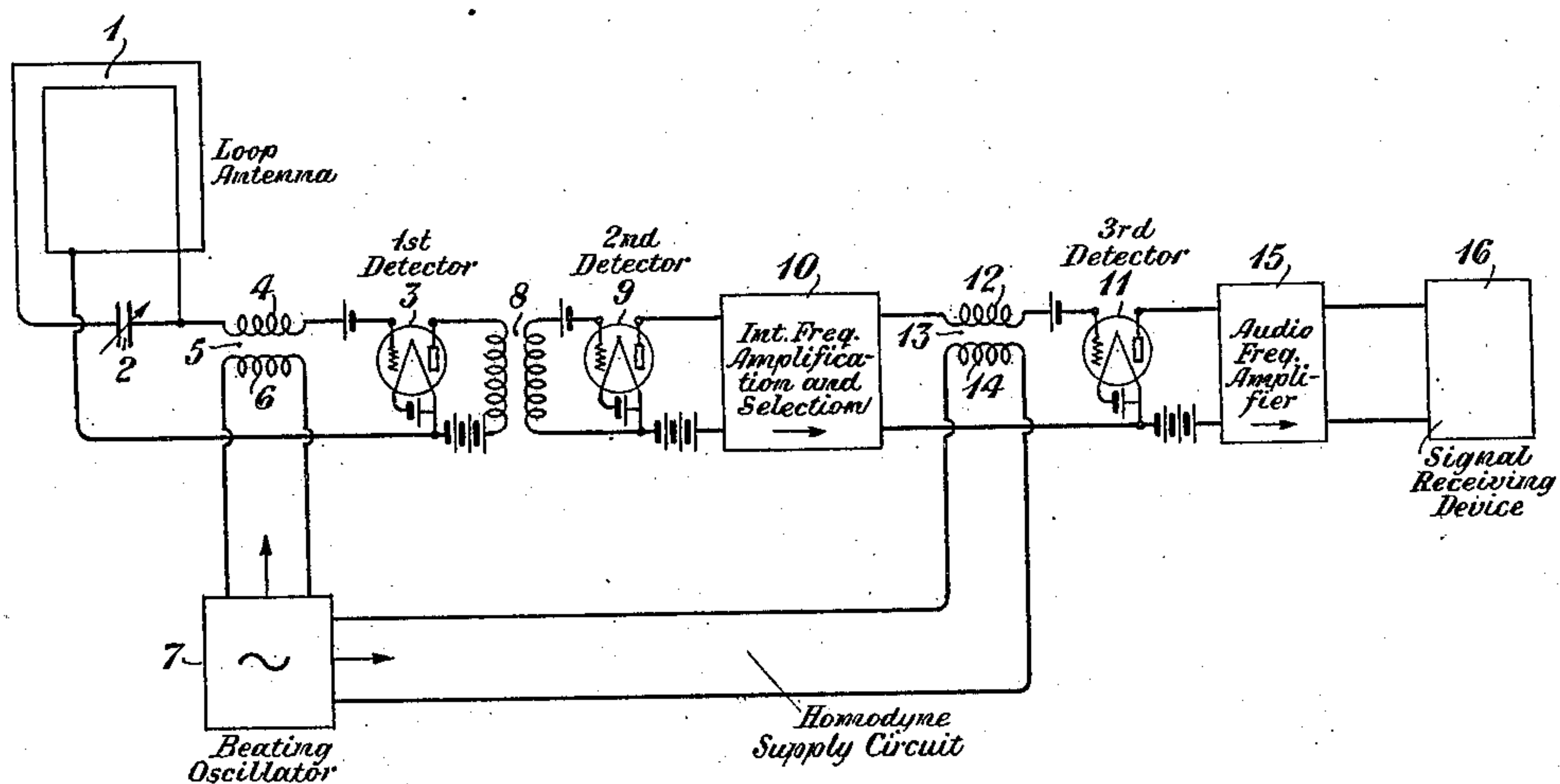


Fig. 1

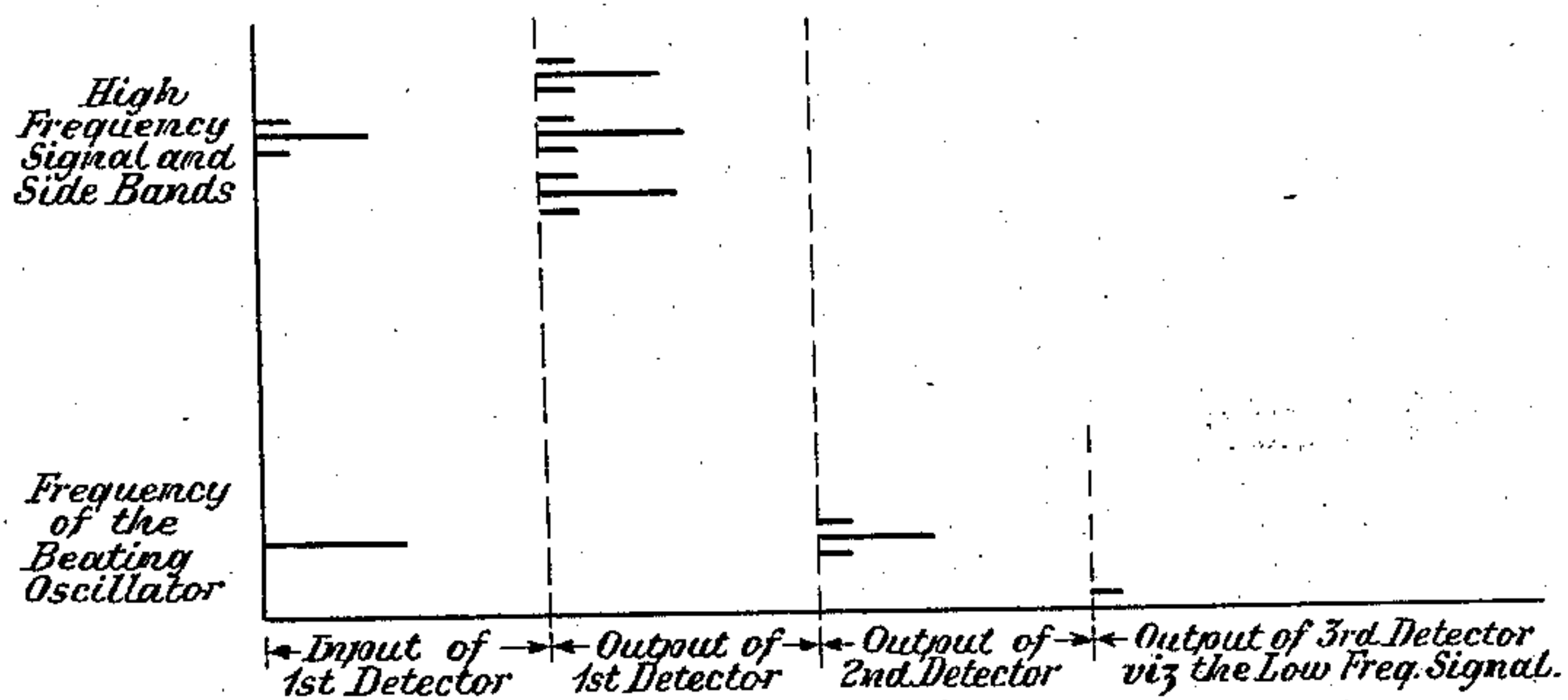


Fig. 2

INVENTOR
R. Bown

BY

gc 702
ATTORNEY

UNITED STATES PATENT OFFICE

RALPH BOWN, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE
AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

RADIO RECEIVING SYSTEM

Application filed November 17, 1925. Serial No. 69,693.

This invention relates to radio signaling systems and particularly to a system characterized by triple detection of the incoming signal, the detecting method employing a system of homodyning in which positive synchronism between the incoming carrier frequency and the local homodyning frequency is automatically obtained.

In radio receiving systems, employing double detection and intermediate frequency amplification and selection, the incoming carrier frequency upon which the signal is superimposed is beaten with a locally generated carrier frequency in order to step down the incoming frequency to an intermediate frequency at which it can be efficiently amplified. This beating down constitutes the first detecting operation. The intermediate frequency upon which the signal is superimposed is then beaten with a homodyning frequency equal to the said intermediate frequency, and subsequently detected, thereby producing the audible signal. The operation of such a system is relatively difficult inasmuch as it requires accurate adjustment of the first beating frequency in order to bring the intermediate frequency within the range of frequencies that will pass through the filter associated with the intermediate frequency amplifier; and, furthermore, it requires very accurate adjustment of the second beating frequency, that is, the homodyning frequency, in order to clearly detect the signal superimposed upon the intermediate frequency.

This invention resides in a radio receiving system involving triple detection which may be tuned by a single frequency control source, and in which positive synchronism between the incoming carrier frequency and the local homodyning frequency is automatically obtained.

This invention will be clearly understood from the following description when read in connection with the attached drawing in which Figure 1 shows schematically a form of the invention, and Fig. 2 shows graphically the frequencies present in various parts of the circuit of Fig. 1.

In Fig. 1, the loop antenna 1 is tuned by the

variable condenser 2. The outer terminals of the antenna are connected with the grid of the first detector tube 3, the connection including the winding 4 of the transformer 5 by which a beating frequency is applied to the grid circuit. The midpoint of the antenna 1 is connected with the filament of the said tube. Another winding 6 of the transformer 5 is connected with a source of beating oscillations 7, which may be of any well known type, although the vacuum tube oscillator is probably most desirable. The output circuit of the first detector tube 3 is connected by the transformer 8 with the input circuit of the second detector tube 9. The output circuit of this detector tube is connected with an intermediate frequency amplifier and a selective network, represented diagrammatically by the rectangle 10. The output side of the said amplifier and selective network 10 is connected with the input side of the third detector tube 11, the connection including the winding 12 of the transformer 13. The other winding 14 of this transformer is connected with the source of beating oscillations 7, which, as stated, is also connected by the transformer 5 with the input side of the first detector tube. The output side of the detector 11 is connected with an audio frequency circuit, which may include an amplifier 15, and a signal receiving device 16.

The manner in which the system operates for the reception and detection of signals which is illustrated graphically by Fig. 2, may, perhaps, be best described by assuming specific frequencies for such illustration. It is to be understood, however, that the invention is not limited to such frequencies but may be as readily used with other frequencies. Let it be assumed that an incoming wave of 700 kilocycles, having a signal frequency superimposed thereon, is impressed upon the antenna 1. Let it further be assumed that the local source of beating frequency 7 is adjusted to produce 50 kilocycles. Accordingly, the incoming wave of 700 kilocycles plus the signal is impressed upon the first detector tube together with the beating frequency of 50 kilocycles. Owing to the modulating action of this tube there will be pres-

55

60

65

70

75

80

85

90

95

100

ent in the output circuit thereof three frequencies, i. e., 700 kilocycles, 750 kilocycles and 650 kilocycles, each of which would have the signal superimposed thereon. These
 5 three frequencies are impressed by the transformer 8 upon the second detector tube 9 and as the result of the modulating action of this tube there appears in the output side thereof the sum and difference frequencies resulting
 10 from the modulation of each of the said basic frequencies with each other. The sum frequencies are relatively so high as not to cause any concern, but the difference frequencies, i. e., 50 kilocycles and 100 kilocycles are with-
 15 in the limits requiring further attention. By setting the filters of the device 10 to pass 50 kilocycles and to suppress all frequencies above that, any tendency on the part of the 100 kilocycle frequency to interfere is elimi-
 20 nated. It will be seen, therefore, that the remaining frequency, which is amplified and impressed upon the third detector tube 11 is the same frequency produced by the oscillator 7, i. e., 50 kilocycles plus the signal. This
 25 signal will be detected by homodyning the carrier frequency with the same frequency, viz, 50 kilocycles produced by the oscillator 7. The signal, when amplified by the amplifier 15, will be impressed upon the signal re-
 30 ceiving device 16.

The important feature, inherent in this invention, is that the frequency resulting from the second detecting operation is always equal to the frequency of the beating oscillator 7.
 35 This is true irrespective of the frequency of the incoming signal. Accordingly, the frequency of the beating oscillator need not be varied in order to effect detection of the signal superimposed upon a carrier frequency differ-
 40 ing from that assumed hereinbefore. The only tuning adjustment necessary is that of the high frequency selective networks associated with the antenna, which, in the case of a loop antenna, as illustrated, means sim-
 45 ply the adjustment of the variable condenser 2. Since the frequency resulting from the second detecting operation is exactly the same frequency as the beating oscillator it is possible to use the beating oscillator to
 50 homodyne the signal at such intermediate frequency, thereby building up the carrier amplitude and thus improving the efficiency of detection in a manner well understood by those skilled in the art.

55 While this invention has been disclosed in a particular form it is apparent that such form is purely schematic, and that it is capable of embodiment in other and different forms within the spirit and scope of the ap-
 60 pended claims.

What is claimed is:

1. In a high frequency signaling system, the combination with a receiving circuit hav-
 65 ing impressed thereon a carrier frequency modulated by a signal frequency of a detector

connected therewith, a source of beating os-
 cillations of a frequency differing from the
 said carrier frequency connected with the said
 detector, a second detector having its input
 connected with the output of the said first
 detector to beat together the products of the
 first step of detection, means to select the band
 of signal frequencies based upon the carrier
 having the same frequency as the beating os-
 70 cillations, a third detector upon which the
 selected band is impressed, means coupling
 the latter detector with the said source of
 beating oscillations so as to homodyne the
 signaling frequency superimposed upon the
 selected carrier and means connected with
 80 the output side of the third detector to indi-
 cate the signal.

2. A receiving system comprising a local
 source of oscillations of a single frequency
 differing from incoming waves, means to com-
 85 bine incoming waves with oscillations from
 said source, means to beat together the result-
 ant composite waves from the said first com-
 bining means, means to select from the com-
 posite waves resulting from the said beating
 90 means a wave having present therein the same
 frequency as that of the local source, and
 means for combining oscillations from said
 source with the said selected frequency.

3. The combination with a plurality of
 95 frequency changing devices, of means for
 impressing thereon incoming waves to be
 changed to a lower frequency through an in-
 termediate stage, a local source of generated
 oscillations, means to impress oscillations of
 100 the same frequency from the said source upon
 the first and last of said frequency changing
 devices to change the frequency of the waves
 impressed thereon, the intermediate fre-
 105 quency changing device being arranged to
 beat together only those frequencies present
 in the output of the first frequency changing
 device, filtering means connected with the
 output of the said intermediate frequency de-
 110 vice to pass the band of frequencies based
 upon a carrier having the same frequency as
 the oscillations from the local source, and
 means connected with the output of the last
 frequency changing device to observe the
 waves of changed frequency. 115

4. The method of automatically homodyn-
 ing, which consists in beating a received ra-
 dio signal comprising a modulated carrier
 frequency with oscillations differing in fre-
 120 quency from the carrier, then beating togeth-
 er the frequencies resulting from the first
 beating operation to produce a plurality of
 bands thereby and selecting one of the bands
 resulting from the said beating operation,
 beating the selected band with oscillations
 125 of the same frequency and from the same
 source as the first beating operation, and
 transmitting the resultant signal.

5. A method of receiving signals which
 comprises producing locally generated oscil- 130

lations of a single frequency different from that of incoming waves, combining incoming waves with a portion of the locally generated oscillations to produce composite waves, beating together the composite waves produced by the said combining step, and selecting therefrom the wave based upon the same frequency as that produced locally, then combining the selected wave with another portion of the locally generated oscillations.

6. A method of receiving signals which comprises combining incoming waves with locally generated oscillations of frequency differing from the said waves, beating together the resultant waves of the first combining step, selecting from the product of the said beating operation the wave based upon that carrier having the same frequency as that locally generated, combining other locally generated oscillations of the same frequency as the first mentioned locally generated oscillation with the selected wave, and producing an indication of the resultant combination.

7. A method of receiving signals which comprises combining incoming waves with oscillations supplied by a local source of frequency different from said waves, beating together the waves resulting from the said first combining step, selecting that wave based upon a carrier having the same frequency as the locally generated oscillations, combining the selected wave with other locally generated oscillations of the same frequency as those employed in the first combining step, and producing an indication of the resultant wave.

8. The method of detecting radio signals in a system comprising three steps of detection and intermediate amplification, which consists in receiving a signal modulated carrier frequency, beating the said signal modulated carrier with a locally generated frequency to produce a plurality of frequencies thereby, beating together the frequencies resulting from the first beating operation, selecting from the products of the second beating operation that frequency corresponding to the modulation of the locally generated frequency by the said signal, amplifying the selected frequency, beating the selected and amplified frequency by the locally generated frequency and detecting the signal resulting therefrom.

In testimony whereof, I have signed my name to this specification this 16th day of November, 1925.

RALPH BOWN.