H. S. OSBORNE.

PLURAL DEMODULATION CIRCUITS.

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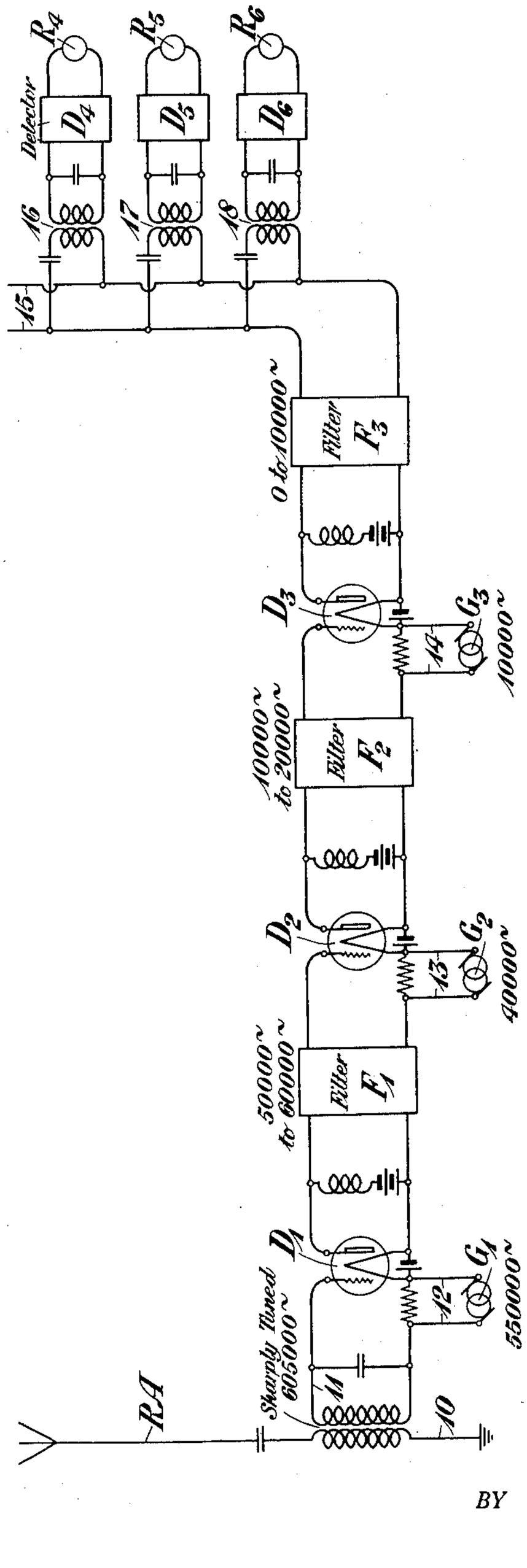
1,361,487. Patented Dec. 7, 1920.



INVENTOR.

H. S. Osborne

BY

ATTORNEY

UNITED STATES PATENT OFFICE.

HAROLD S. OSBORNE, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

PLURAL DEMODULATION-CIRCUITS.

1,361,487. Specification of Letters Patent. Patented Dec. 7, 1920.

Application filed January 6, 1920. Serial No. 349,738.

To all whom it may concern:

Be it known that I, HAROLD S. OSBORNE, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Plural Demodulation-Circuits, of which the following is a specification.

This invention relates to radio signaling and more particularly to methods of selecting desired frequencies.

One of the features of this invention relates to the provision of a method of separating a narrow band of frequencies for reception at a particular station, assuming that a large range of frequencies is in use and that only a small part of this range is to be selected.

Another feature of the invention resides in a method of selection which comprises receiving the desired band of frequencies, together with undesired frequencies, beating said frequencies with a frequency lower than the desired band, selecting from the resultant frequencies a band corresponding to the desired band lowered in the frequency spectrum and then successively stepping down the frequency of this band in a plurality of steps, to a frequency range sufficiently low for efficient selection of individual frequencies.

A still further feature of the invention resides in a method of selective receiving, which consists in impressing the desired band of frequencies, together with undesired frequencies, upon a circuit tuned to a frequency which is approximately a mean of the limiting frequencies of the desired band, beating the received frequencies with a locally supplied frequency as close as possible to the desired band, but sufficiently remote therefrom so that of the frequencies lying in a band corresponding to the desired band at a lower position in the frequency spectrum, those frequencies which resulted from the reaction of undesired frequencies with the locally supplied frequency will be of very small amplitude as compared with those frequencies resulting from the reaction of the frequencies in the desired received band with said locally supplied frequency.

Other features of the method involved in this invention will be clear from the following concrete statement of the method. Let it be assumed that at a given station it is desired to select all frequencies lying between 600,000 and 610,000 cycles and to exclude all frequencies lying outside of that range. If the selection were to be made by the ordinary methods of discrimination now practiced in the radio art this would involve excluding such frequencies as 599,500 and 610,500 cycles, which would be practically impossible. It is therefore proposed to impress the various received frequencies upon a circuit tuned sharply to about 605,000 cycles, which, it will be noted, is practically the mean of the limiting frequencies of the desired band. Since the desired band is relatively narrow as compared with the range of frequencies extending from zero up to the desired frequency, this step would give practically uniform reception for the frequencies between 600,000 and 610,000 cycles and decreasing reception for other frequencies. Such a circuit might, for example, give only ten per cent. reception of current of 550,000 cycles.

The next step of the method involves beating the various frequencies with a locally supplied frequency for the purpose of stepping down the frequency of the desired band. The locally supplied frequency should be chosen as close as possible to the desired band and should be sufficiently below said band, so that frequencies resulting from the reaction of the local frequency with the undesired frequencies will, if they fall within the limits of the band resulting from the reaction of the desired frequencies with the locally supplied frequency, be of practically negligible amplitude. For instance, assuming that a frequency of 550,000 cycles be used for beating the received frequencies, this would reduce the desired frequencies to a band between 50,000 and 60,000 cycles, which would be transmitted to the next circuit through a band filter. Although frequencies between 50,000 cycles and 60,000 cycles would also be produced by the reaction of the locally supplied 550,000 cycle currents with received currents in the range between 500,000 and 490,000 cycles, since the last mentioned band of frequencies is quite distant from the frequency to which the first circuit is tuned, the resultant frequencies between 50,000 and 60,000 cycles will be of very small amplitude as compared with frequencies within the same range resulting from the stepping down of the desired band of frequencies.

After stepping down the desired band of frequencies and filtering in the manner just described, the resultant band may be again stepped down by beating with locally supplied currents of a lower frequency which should be chosen with regard to the same considerations as stated in connection with the first step of lowering frequency. If it be assumed for purposes of illustration, that the second locally supplied frequency be 40,000 cycles, its reactance with the selected band would reduce the frequencies of said band to the range between 10,000 and 20,000 cycles. This range would then again be passed through a band filter.

The process may be continued as many times as may be necessary to pick out the high frequencies desired. In the case supposed, probably a third stepping down of the frequency would be sufficient. For instance, if the band between 10,000 and 20,000 cycles is beaten with a locally supplied frequency of 10,000 cycles, the currents will then lie in the frequency range from zero to 10,000 cycles and interfering currents would be eliminated.

One form of apparatus for carrying out the method may be understood from the following description when read in connection with the accompanying drawing, the figure of which illustrates apparatus of a radio receiving system.

Referring to the figure, RA designates a receiving antenna of ordinary construction, which is coupled through a transformer 10 with a tuned circuit 11. Where, for instance, the desired band of frequencies lies between 600,000 and 610,000 cycles, the antenna and the circuit 11 may both be tuned to 605,000 cycles. A vacuum tube demodulator D_1 of a well-known type, is arranged with its input circuit connected to the tuned circuit 11 and a local beating frequency may be impressed upon said input circuit by means of a connection 12 leading to a generator G_1 which supplies a frequency of 550,000 cycles, for instance. A demodulator of this type, as is well known, produces in its output circuit frequencies corresponding to the sums and differences of the frequencies applied to its input circuit, consequently a frequency band between 50,000 cycles and 60,000 cycles will appear in its output circuit, corresponding to the reaction of the locally supplied frequency of 550,000 cycles with the desired received frequency band ranging from 600,000 to 610,000 cycles.

A band filter F_1 is connected with the output circuit of the demodulator D_1. This filter may be of the type disclosed in the U. S. patents to George A. Campbell, Nos. 1,227,113 and 1,227,114, issued May 22, 1917. The filter should be designed in accordance with the principles of said Campbell patents, so as to freely transmit frequencies lying between 50,000 and 60,000 cycles, while suppressing frequencies lying without these limits. This filter may obviously be replaced by ordinary tuned circuits.

A second demodulator D_2, similar in type to the demodulator D_1, has its input circuit associated with the filter F_1. Low beating oscillations may be supplied over a circuit 13 from a generator G_2 to the input circuit of the demodulator D_2. As a result of these connections the output circuit of the demodulator will supply a frequency band lying between 10,000 cycles and 20,000 cycles, said band corresponding to the band passed by the filter F_1 stepped down to a lower position in the frequency spectrum. A filter F_2, in general similar to the filter F_1, but having a free transmission range between 10,000 and 20,000 cycles, is associated with the output circuit of the demodulator D_2 for selecting this band of frequencies.

A third demodulator D_3 has its input circuit associated with the filter F_2 and is supplied over a circuit 14 with local oscillations from a generator G_3. The frequency of these oscillations may be, for instance, 10,000 cycles. The action of this demodulator will step the band passed by the filter F_2 down to a range from zero to 10,000 cycles in the frequency spectrum. A filter F_3 of the Campbell type may be provided for selecting this band to the exclusion of the other side band.

The desired band of frequencies now appears in the circuit 15 as a band lying between zero and 10,000 cycles. The desired individual frequencies or groups of frequencies may be selected from this band by tuned circuits such as 16, 17 and 18 and may be impressed upon the circuits of detectors such as D_4, D_5 and D_6 of any well known character. These detectors function to detect the selected frequencies so that they may actuate the receiving devices such as R_4, R_5 and R_6 of any well known type.

It will be understood that the frequencies hereinbefore described are merely illustrative and may be varied in practice as conditions may require.

It will also be understood that the details of the method herein set forth may be varied and that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. The method of radio signaling which consists in impressing a desired band of frequencies, together with undesired frequencies, upon a circuit tuned to a frequency which is substantially a mean of the limiting frequencies of the desired band, beating the received frequencies with a locally supplied

frequency which is as close as possible to the desired band, but sufficiently remote therefrom, so that of the frequencies in the resultant band corresponding to the desired band stepped down to a lower position in the frequency spectrum, those frequencies which are the result of the reaction of the locally supplied frequency with undesired frequencies will be of very small amplitude as compared with that of the other frequencies in the band, which are the result of the reaction of the locally supplied frequency with the desired received band of frequencies.

2. The method of radio signaling which consists in stepping received radio frequencies, including a desired band of frequencies and undesired frequencies, to a lower level in the frequency spectrum, selecting from the lowered range of frequencies the desired band, then successively stepping down the selected band to a low position in the frequency spectrum by a plurality of steps.

3. The method of radio signaling which consists in stepping received radio frequencies, including a desired band of frequencies and undesired frequencies to a lower level in the frequency spectrum, selecting from the lowered range of frequencies the desired band, then successively stepping down the selected band to a low position in the frequency spectrum by a plurality of steps, and selecting into different channels desired frequencies from the band thus stepped down.

4. The method of radio signaling which consists in receiving a desired band of radio frequencies together with undesired frequencies, beating the received frequencies with a frequency below the desired band, selecting from the resultant frequencies a band corresponding to the desired band lowered in the frequency spectrum, successively beating the selected band with a plurality of still lower frequencies and finally selecting the desired band in its resultant low position in the frequency spectrum.

In testimony whereof, I have signed my name to this specification this 3rd day of January 1920.

HAROLD S. OSBORNE.