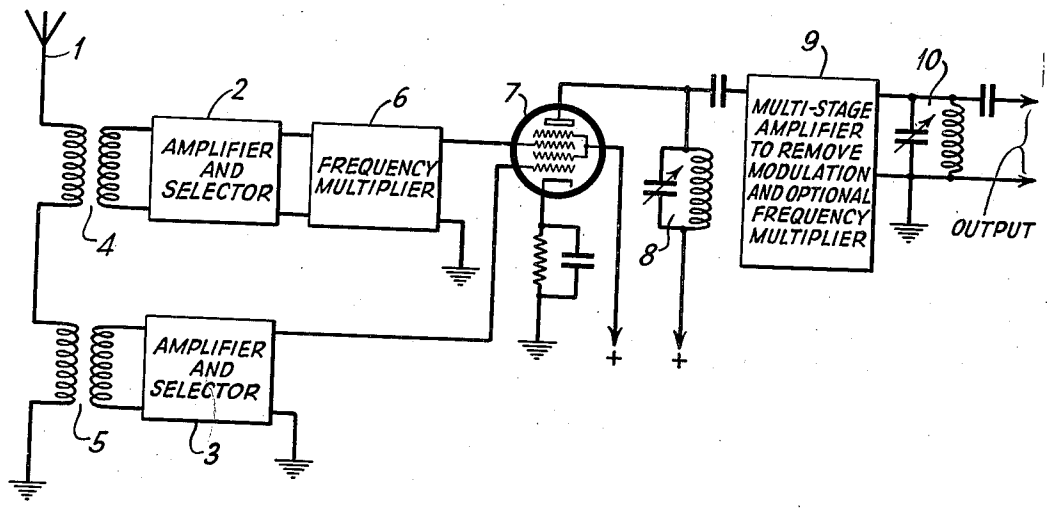
May 13, 1941. W. VAN B. ROBERTS 2,241,933

UTILIZATION OF BROADCAST WAVES FOR OBTAINING HIGH FREQUENCY CARRIER

Filed Dec. 1, 1938




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Patented May 13, 1941

2,241,933

# UNITED STATES PATENT OFFICE

2,241,933

## UTILIZATION OF BROADCAST WAVES FOR OBTAINING HIGH FREQUENCY CARRIER

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Application December 1, 1938, Serial No. 243,366

2 Claims. (Cl. 250—36)

The present invention provides a method of and means for obtaining a number of constant frequencies for use as carrier frequencies in the transmission of messages, without the need for a local oscillator. The invention finds particular application in the field of amateur transmitters, but is not limited thereto since frequencies outside the amateur band can be obtained by a similar process.

In accordance with the invention, the necessity for a local oscillator for the generation of a constant frequency for transmitting purposes is dispensed with by utilizing waves from broadcasting stations which are received and combined to produce any one of a number of frequencies within the desired band. More specifically, the method of the invention involves selecting two broadcasting stations which have suitable known frequencies, receiving the waves, passing the same through sharply selective circuits, and then impressing the same on a mixer or frequency converter tube from which the sum or difference frequency (i. e., the beat frequency) is derived. By properly multiplying the frequency of one of the received waves prior to impressing the same on the mixer or frequency converter tube, it is possible to obtain a large number of constant frequencies for use as carrier frequencies in the transmission of messages. Each of these large numbers of frequencies is linearly related to the original frequencies of the broadcast station; in other words, the beat frequency utilized as a carrier may be expressed as equal to $nf_1 \pm f_2$ where $f_1$ is one of the broadcast frequencies, $f_2$ is the other, and $n$ is the number of times frequency $f_1$ has been multiplied.

A better understanding of the invention may be had by referring to the following description, which is accompanied by a drawing whose single figure illustrates suitable radio receiving and frequency converting apparatus for achieving the results of the invention.

In the drawing, there is shown an antenna 1 for receiving the broadcast waves and for impressing the same on suitable amplifier and selector circuits 2 and 3, shown here in conventional box form. Transformers 4 and 5 serve to couple the antenna 1 to these amplifier and selector circuits. Both circuits 2 and 3 are preferably designed to discriminate somewhat against the side band frequencies of the selected stations so that the modulation of the voltage impressed on the subsequent stages is reduced to less than 100% at all times. In the output of amplifier and selector circuit 2 there is provided a frequency multiplier 6, preferably a frequency doubler, which feeds voltage of the multiplied frequency to one input grid of a mixer or frequency converter vacuum tube 7. The other input grid of tube 7 is fed by voltage of a different frequency obtained from amplifier and selector circuit 3. These two voltages of different frequency beat, or heterodyne, within mixer tube 7 to produce a plate current having, in addition to the frequencies of the input voltages, the sum and difference frequencies. The output circuit 8 of the mixer or converter tube 7 is tuned to select only one beat frequency, e. g., the frequency equal to the sum of the input frequencies; and the voltage developed in the plate circuit is passed on to a multistage amplifier 9 at least the final stage of which operates with saturation excitation so as to remove substantially all modulation. The term "limiter" can be used to designate the final stage having such a saturation characteristic. The output frequency of multistage amplifier 9, which may be resonated in tuned circuit 10, is then a known constant frequency available for transmitting purposes. In some cases the amplifier or frequency multiplier (doubler) stages of the apparatus will of itself be sufficient to remove the modulation. In order to remove modulation completely, however, it is necessary that the selection of the two voltages of different frequency applied to converter tube 7 should be sufficiently sharp so that neither voltage ever falls to zero during the modulation cycle.

In the operation of the invention, let us assume that it is desired to obtain a known carrier frequency for transmission in the 80 meter band which extends from 3500 to 4000 kilocycles. A broadcast station of about 1400 kilocycles will be selected in amplifier and selector circuit 2, amplified therein, and impressed upon a frequency doubler 6 so as to provide a frequency of 2800 kilocycles on one of the input grids of the mixer or converter tube 7. This amplifier circuit 2 is preferably so selective as to discriminate against the side band frequencies of the selected station so that modulation of the voltage impressed upon the frequency doubler 6 is reduced to less than 100% at all times. At the same time, the other amplifier and selector circuit 3, having similarly sharp selective properties, is operated to pick up any broadcast station in the range from 700 kilocycles to 1200 kilocycles, and to impress this selected voltage upon the other input grid of the converter 7. Since

the output 8 of the frequency converter tube 7 will contain a frequency equal to the sum of the two frequencies impressed upon the two input grids, it will be obvious that any broadcast station within the range from 700 kilocycles to 1200 kilocycles selected by circuit 3 will produce in the plate circuit of the converter tube 7 a frequency lying between 3500 kilocycles and 4000 kilocycles; namely the sum of the doubled or multiplied frequency derived from 6 (in this case 2800 kilocycles) and the selected frequency obtained in the range from 700 kilocycles to 1200 kilocycles. Since the selected frequency in the output of converter tube 7 lying between 3500 kilocycles and 4000 kilocycles is in the 80 meter band, this frequency, after all modulation is completely removed by amplifier 9, can be employed either immediately or after frequency multiplication for use as a carrier frequency in a suitable amateur transmitter. While the adjustments hereinabove described are sufficient to obtain a number of frequencies within the range of 3500 kilocycles to 4000 kilocycles, it is also possible to obtain frequencies in the lowest frequency amateur band, namely, from 1700 kilocycles to 2000 kilocycles by tuning the plate circuit of the converter tube 7 to accept the difference between the two frequencies impressed on its two grids. In this case, a range of broadcasting stations from 800 kilocycles to 1100 kilocycles derived from amplifier circuit 3 will combine with the output of the frequency doubler 6 to produce in the output of tube 7 difference frequencies running from 1700 to 2000 kilocycles.

Inasmuch as it may be difficult to provide ordinary tuned circuits of sufficient sharpness to discriminate appreciably against the side-bands of broadcast stations, it is advisable to utilize a certain amount of regeneration in each of the broadcast frequency amplifiers 2, 3 so as to sharpen the response of the respective selecting systems.

It will be understood that it is not necessary to select, in amplifier circuit 2, for frequency doubling, a station of exactly 1400 kilocycles, the multiplied frequency of which is to be applied to #3 grid of the converter tube, as a considerable departure in either direction from this value is permissible, provided a slightly different portion of the broadcast band is utilized in amplifier circuit 3 for application to the #1 input grid of the frequency converter tube. If, however, there is no strong broadcast signal available at approximately 1400 kilocycles, it is possible to select a station in the vicinity of 930 kilocycles, provided that a frequency tripler is employed in place of the frequency doubler 6. Similarly, a station in the vicinity of 700 kilocycles might be utilized for amplification by circuit 2 if followed by a frequency quadrupler. In each of these cases, the frequency impressed upon the second input or control grid (#3 grid) of the converter tube will be in the neighborhood of 2800 kilocycles and hence the operation of the system, whether for obtaining frequencies in the 3500 to 4000 range, or in the 1700 to 2000 range, is unaltered.

Once an assortment of frequencies in the range from 3500 to 4000 has been made available as above described, these frequencies may be successively doubled, as is well known in amateur practice, to obtain a corresponding number of frequencies in any of the higher frequency amateur bands, since these higher frequency bands comprise only such frequencies as may be obtained by multiplying the frequencies in the 80 meter band by a suitable power of two.

What is claimed is:

1. The method of obtaining a substantially unmodulated radio frequency current of accurately known frequency and high frequency stability which comprises receiving modulated carrier waves of different known frequencies from two broadcast transmitting stations, sharply selecting each of said carrier waves to substantially reduce the received effective modulations thereof, multiplying the frequency of one of said received waves, producing from said selected and multiplied waves a new radio frequency wave of a frequency which is linearly related to the frequencies of said broadcast waves of known frequencies, selecting and amplifying said new frequency and substantially eliminating the modulation thereof to produce a current of stable frequency and substantially constant amplitude.

2. High frequency apparatus for generating a constant unmodulated frequency comprising a pair of selective amplifier circuits each tuned to pass a different modulated carrier frequency and to reduce the effective modulation thereof to substantially less than the received amount of modulation, an antenna system coupled to said pair of selective amplifier circuits for impressing thereon modulated waves of different carrier frequencies from two broadcast stations, said waves being of frequencies corresponding to those to which said selective amplifier circuits are tuned, means for frequency multiplying one of said waves, a frequency converter tube coupled to the outputs of said amplifying and frequency multiplying circuits and receiving therefrom waves of different frequencies, said frequency converter tube having a tuned output circuit which is tuned to a beat frequency of the frequencies impressed on said tube, means for deriving said beat frequency from said tuned output circuit and for suppressing therefrom residual modulations present on said broadcast waves.

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