Sept. 11, 1934. C. F. WOLCOTT, JR 1,972,964

COMMUNICATION SYSTEM

Filed Sept. 28, 1931 2 Sheets-Sheet 1

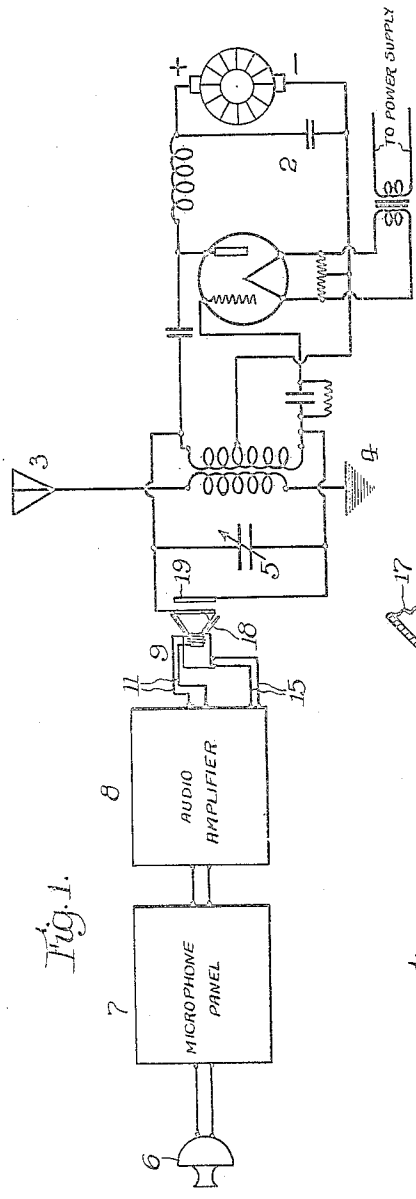


Fig. 1.

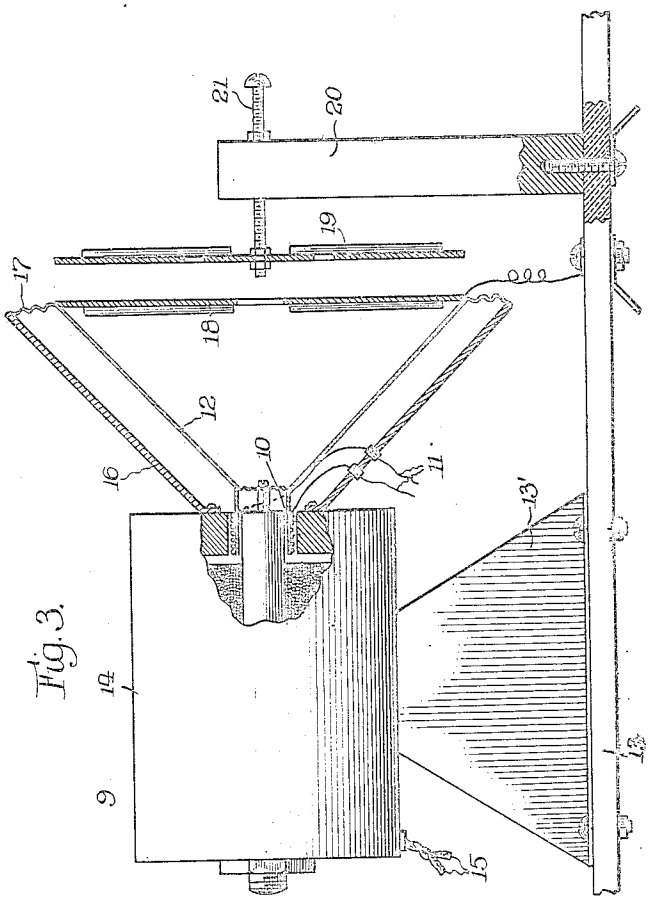


Fig. 3.

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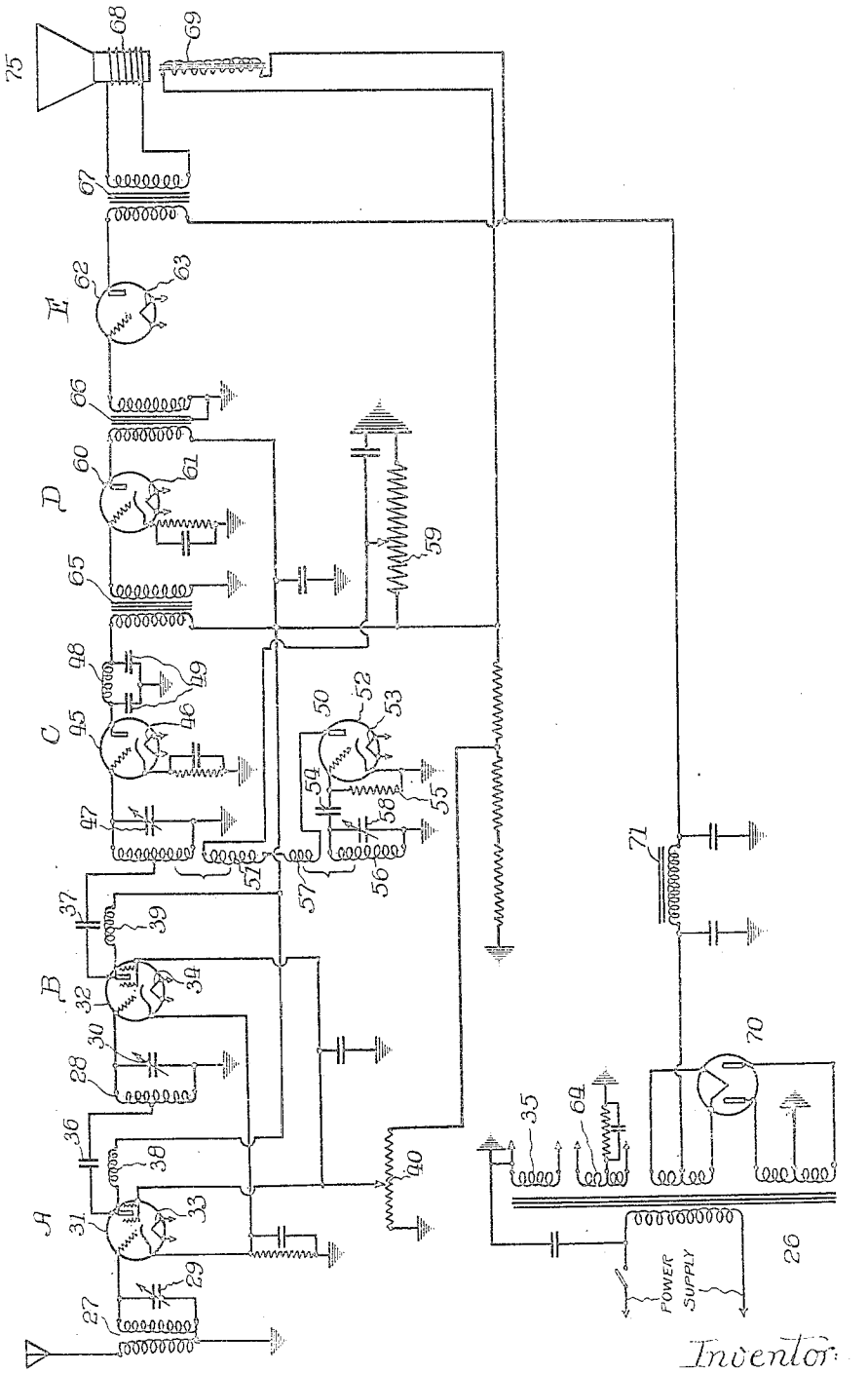


Fig. 2.

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UNITED STATES PATENT OFFICE

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COMMUNICATION SYSTEM

Carl Frederick Wolcott, Jr., Wilmette, Ill.

Application September 28, 1931, Serial No. 565,465

5 Claims. (Cl. 250—20)

This invention relates generally to a system of communication and more particularly to a system for communicating signals by means of variable frequency oscillations.

In present day practice broadcasting transmitters radiate a wave constant in frequency and variable in amplitude and require a channel 10 kc. (10,000 cycles) wide, this being due to a side-band which must not be suppressed or cut off if fidelity of tone is to be preserved. This limits the number of services available in a given spectrum to one for every 10 kc. In present day practice a type of receiver is used which amplifies the incoming signal and rectifies or detects it. This signal has then reassumed the form of that impressed upon the modulators at the transmitting station and may be further amplified at audio frequency if desired. Furthermore, if receivers for such broadcasting are selective to the point of admitting less than the required 10 kc. band, serious distortion will result at the detector. This is commonly known as "cutting side-bands."

It is the general object of the invention to provide a new and improved system of communication.

Another object is to provide a new and improved system of communication which will reduce the wave-band now deemed necessary for transmission of constant frequency variable amplitude signals, and which will utilize substantially constant amplitude variable frequency oscillations and thereby greatly improve the quality of such transmission.

Another object is to provide a new and improved system of communication in which the quality of transmission is improved by reducing or completely eliminating extraneous noises which have heretofore been picked up by the receiver.

Another object is to provide a receiver for variable frequency oscillations in which constant frequency oscillations, generated within the receiver, are superimposed upon the received wave for the purpose of creating a beat or resultant whose amplitude will vary with the frequency variation of the incoming signal and whose period will be determined by the period of the received oscillations with respect to their fundamental frequency.

Another object is to provide an improved system of communication which includes a circuit or stage in which a received signal of variable frequency and constant amplitude, and a constant frequency constant amplitude oscillation are present, so as to form a means for demodulating the received oscillation.

Further objects and advantages of the invention will be readily apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of a transmitter.

Fig. 2 is a diagrammatic representation of a receiver.

Fig. 3 is an elevation, partly in section of one form of converter.

In the exemplary form of my system of communication as disclosed herein, the transmitter radiates a wave constant in amplitude and variable in frequency. Such a wave may be obtained by producing a carrier wave of a predetermined fundamental frequency and varying the frequency in accordance with variable amplitude impulses fed to the transmitter. These frequency variations need not be large with the result that more services are made available in a given spectrum. Furthermore the receiver selectivity may be made greater without any possible effect of distortion, and frequencies beyond 10 kc. may be utilized, enhancing the tone quality, without the possibility of "cutting side-bands" or necessitating the revision of broadcasting channels to permit each station to use a wider band as would be necessary with present day systems using variable amplitude constant frequency signals.

For purposes of disclosure I have shown in the drawings and shall herein describe in detail a preferred form of the invention as applied to radio telephony, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring particularly to Fig. 1, which illustrates diagrammatically a transmitter adapted for use in the system for transmitting audible signals by radio, 2 represents an oscillator of a well-known form coupled to an aerial 3 and a ground 4 and embodying a variable condenser 5 by means of which the circuit may be tuned for providing a carrier wave of a predetermined normal or fundamental frequency of oscillation. The oscillator is arranged to be fed by means of a microphone 6 connected through a suitable microphone panel 7 and an audio amplifier 8, but instead of superimposing the variable amplitude audio frequency impulses on the radio frequency carrier wave, means is provided intermediate the microphone and oscillator for utilizing the variable amplitude impulses to produce substan-

tially constant amplitude variable frequency oscillations for transmission. As illustrated herein this means is shown in the form of a converter 9 (Figs. 1 and 2) having an operating coil 10 connected to the amplifier 8 by means of wires 11, and a movable or vibratory member 12 operable by said coil.

In the form chosen for purposes of disclosure the converter comprises a base 13 of insulating material on which are mounted parts of a conventional dynamic speaker. Thus the field coil 14 is mounted on a support 13' on the base and is provided with a pair of leads 15 so that it may be connected to a suitable source of excitation. A conical metal support 16 is secured to the end of the field coil housing and has the conical vibrating member 12 positioned therein and carried on a suitable flexible ring 17. The actuating or voice coil 10 is mounted on a tubular portion of the vibrating member 12 and is positioned intermediate the poles S and N of the field coil core. The ends of the voice coil are connected to the amplifier leads 11.

Preferably the movements of the member 12 are utilized to vary the value of a variable in the oscillator circuit and thereby vary the frequency thereof with respect to the fundamental frequency. As illustrated herein a variable in the form of a condenser is shunted across the variable condenser 5 although it will be evident that other variables such as resistance or inductance may be used in the circuit as an equivalent for varying the frequency of the oscillator. The condenser is shown with a movable metal plate 18 mechanically connected to the movable member 12 of the converter so as to be actuated thereby. A stationary plate 19 is mounted on a post 20 by means of a screw device 21 so as to be adjustable relatively to the normal position of the movable plate for the purpose of obtaining a suitable relation with the condenser 5. One or both of the plates are preferably perforated so as to relieve the air pressure therebetween, and are also preferably ribbed so as to prevent vibration in the plates themselves.

It will be readily apparent that impulses of variable amplitude in the voice coil will cause movements of the plate 18 of the condenser and will thereby change the capacity of the condenser and vary the frequency of the oscillator 2 above and below its fundamental frequency. A substantially constant amplitude wave is thus created which has its frequency governed by the volume of the incoming signal to the converter and the period at which the amplitude changes take place will determine the number of times the oscillator frequency passes through its normal or fundamental frequency. Thus the wave will have a period with respect to its fundamental governed by the frequency applied to the converter. Although the impulses fed to the converter are herein referred to as of constant frequency and variable amplitude, it will of course be understood that the impulses may be complex in form, as in the case of orchestral music.

It is intended that the variable frequency wave radiated by the transmitter will be reconverted at the receiving station by a receiver arranged to reproduce the original impulses. By transmitting the signals by means of a variable frequency wave of substantially constant amplitude it is possible to materially reduce the wave-band which is now deemed necessary for the transmission of satisfactory signals by means of a constant frequency variable amplitude wave. This is of value not only in radio telephony, but also in other forms of radio communication such as television transmission and reception wherein even wider wave-bands are generally used in connection with constant frequency variable amplitude signals and in communication systems other than radio. Furthermore by the use of my system the effects of extraneous noises, such as the static ordinarily picked up by the receiver, are greatly reduced or completely eliminated as they are by nature of relatively constant frequency and varying amplitude which is opposite in nature to the type of wave herein used.

In Fig. 2 there is illustrated diagrammatically a receiver arranged for the reception of the signals transmitted from the transmitter illustrated in Fig. 1 and which is operable to modify or demodulate the incoming signals and reconvert them into impulses which are substantially reproductions of the original impulses. Since the receiver may embody receiving circuits of various forms, I have included a somewhat standard circuit embodying tuned radio frequency amplifier stages A and B, a stage C which is ordinarily used as a detector, and audio amplifier stages D and E, together with a dynamic speaker 25, a power transformer 26, and suitable connections therebetween.

Stages A and B comprise generally radio frequency transformers 27 and 28, variable condensers 29 and 30, vacuum tubes 31 and 32 having filaments 33 and 34 arranged to be connected to the secondary coil 35 of the power transformer, coupling condensers 36 and 37, and radio frequency chokes 38 and 39. The amplification is arranged to be controlled by means of a volume control resister 40.

Stage C, which is modified so as to function as a demodulator for the variable frequency oscillations, comprises a tube 45, the filament 46 of which is also adapted to be connected to the coil 35 of the transformer 26. This stage is arranged to be tuned by means of a variable condenser 47, a radio frequency choke 48 and by-pass condensers 49 being provided in the plate circuit. As illustrated herein an oscillator 50 is coupled to the grid circuit of stage C by means of an inductive coupling 51. The oscillator shown in the drawings comprises a tube 52 have a filament 53 also adapted to be connected to the coil 35 of the power transformer, a grid condenser 54, a grid leak 55, a grid inductance 56, coupled to a plate coil 57, and a variable condenser 58.

Stage C is preferably arranged so as to modify or demodulate the incoming variable frequency oscillations and produce a variable frequency beat the amplitude of which varies in accordance with the frequency of the incoming oscillations and whose frequency is determined by the period of said oscillations with respect to the fundamental frequency thereof. By coupling the oscillator 33 to the grid circuit of stage C and making its effective frequency equal to the fundamental frequency of the signal to which it beats, the desired result may be obtained. Preferably the variable condensers in stages A, B and C and the oscillator 50 are arranged to be adjusted simultaneously for tuning purposes. Various means may be provided for controlling the amplitude of the oscillations which are generated within the receiver for the purpose of demodulating the received signal. As illustrated in Fig. 2 the amplitude of the oscillations produced by the oscillator 50 may be varied by means of a variable resistance 59.

The audio frequency stages D and E are of somewhat conventional form, the stage D embodying a tube 60 having a filament 61 arranged for connection to the power transformer coil 35 and the stage E having a tube 62 provided with a filament 63 adapted for connection to a coil 64 of the power transformer. Audio frequency transformers 65 and 66 are provided intermediate the stages C, D and E, and an output transformer 67 for stage E is connected to the voice coil 68 of the speaker 30. The field coil 69 of the speaker is connected to the output side of the rectifier 70, which is embodied in the power transformer 26, through a filter choke 71.

The incoming radio frequency oscillations are introduced into the grid circuit of the stage C through the radio frequency amplifier and, when they reach the grid circuit of stage C, they have beating with them constant frequency, constant amplitude oscillations induced into the grid circuit by oscillator 50. A beat of varying frequency results whose intensity is governed partly by the amplitude of the incoming signal and partly by the amplitude of the oscillations from the oscillator (either one or both of which may be varied to produce the same result) and this variable frequency beat or resultant will cause a current variation in the plate circuit of stage C similar in character to the beat. It will be apparent that the plate current of stage C has its amplitude controlled by the variation of this resultant in its grid circuit, and has its frequency controlled by the period of the received signal with respect to the normal or fundamental frequency. This produces impulses in the speaker 25 essentially identical with the impulses received by the converter 9 in Fig. 1. This type of heterodyne beat or resultant is therefore utilized in an entirely different manner from the heterodyne beat which is constant in frequency and variable in amplitude, as in present practice.

It will be readily apparent that the system herein disclosed is adapted to reduce the wave-band now deemed necessary for the transmission of satisfactory signals and that not only does it permit a reduction in the wave-band, but at the same time greatly improves the quality of transmission by allowing the use of a much greater band of frequencies, without changing the width of band occupied by the carrier. The system is readily adapted for transmitting various types of signals. Not only is the system particularly adapted for broadcasting transmission and reception, but it may be utilized to great advantage in other forms of radio communication, such as television transmission and reception for the purpose of decreasing the wave-band necessary, so as to permit a greater number of services in a given spectrum and at the same time improve the fidelity of the reproduced signal. It has also been found that whereas in present day practice in which the carrier wave is modulated so as to be of variable amplitude the transmitting distance is cut down, the system herein disclosed maintains the strength of the carrier wave.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. A receiver for oscillations having a frequency variable in accordance with the amplitude of the transmitted impulses and a period with respect to its fundamental frequency determined by the frequency of said impulses having, in combination, an amplifier, an electron tube stage with a grid circuit for receiving the variable frequency oscillations through said amplifier, a reproducing device, an oscillator coupled to the grid circuit of said tube stage, means for tuning said oscillator, amplifier and tube stage to the fundamental frequency of the incoming oscillations, means for varying the intensity of the oscillations produced by said oscillator, and means for utilizing the resulting variable frequency beat for actuating said reproducer.

2. A receiver for oscillations having a frequency variable in accordance with the amplitude of the transmitted impulses and a period with respect to its fundamental frequency determined by the frequency of said impulses having, in combination, an amplifier, an electron tube stage with a grid circuit for receiving the variable frequency oscillations through said amplifier, a reproducing device, an oscillator coupled to the grid circuit of said tube stage, means for tuning said oscillator and tube stage to the fundamental frequency of the incoming oscillations, means for varying the amplitude of the resulting variable frequency beat, and means for utilizing the resulting variable frequency beat for actuating said reproducer.

3. A receiver for oscillations having a frequency variable in accordance with the amplitude of the transmitted impulses having, in combination, an amplifier, an electron tube stage with a grid circuit for receiving the variable frequency oscillations through said amplifier, a reproducing device, an oscillator coupled to the grid circuit of said tube stage, means for tuning said oscillator, amplifier and tube stage so as to create a variable frequency resultant having a frequency determined by the period of the incoming oscillations and an amplitude varying with the variations in the frequency of said oscillations, and means for utilizing the resulting variable frequency resultant for actuating said reproducer.

4. In a receiver for frequency modulated carrier oscillations, a circuit for receiving the frequency modulated carrier oscillations, a reproducing device, an oscillator coupled to the said circuit to superimpose on the incoming carrier constant frequency, constant amplitude oscillations of a frequency substantially equal to the fundamental frequency of the carrier to produce a directly rectifiable resultant, means for tuning said oscillator and circuit, means for varying the intensity of the oscillations produced by said oscillator, and means for utilizing the resultant for actuating said reproducer.

5. A receiver for oscillations having a frequency variable in accordance with the amplitude of the transmitted impulses and a period with respect to its fundamental frequency determined by the frequency of said impulses having, in combination, an electron tube stage with a grid circuit for receiving the variable frequency oscillations, a reproducing device, an oscillator coupled to the grid circuit of said tube stage for impressing thereon constant frequency oscillations of a frequency substantially equal to the fundamental frequency of the received oscillations, means for tuning said oscillator and tube stage, means for varying the intensity of the oscillations produced by said oscillator, and means for utilizing the rectified resultant.

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