Jan. 6, 1925.

1,522,044

R. BOWN

SECRET COMMUNICATION SYSTEM

Filed Nov. 8, 1921

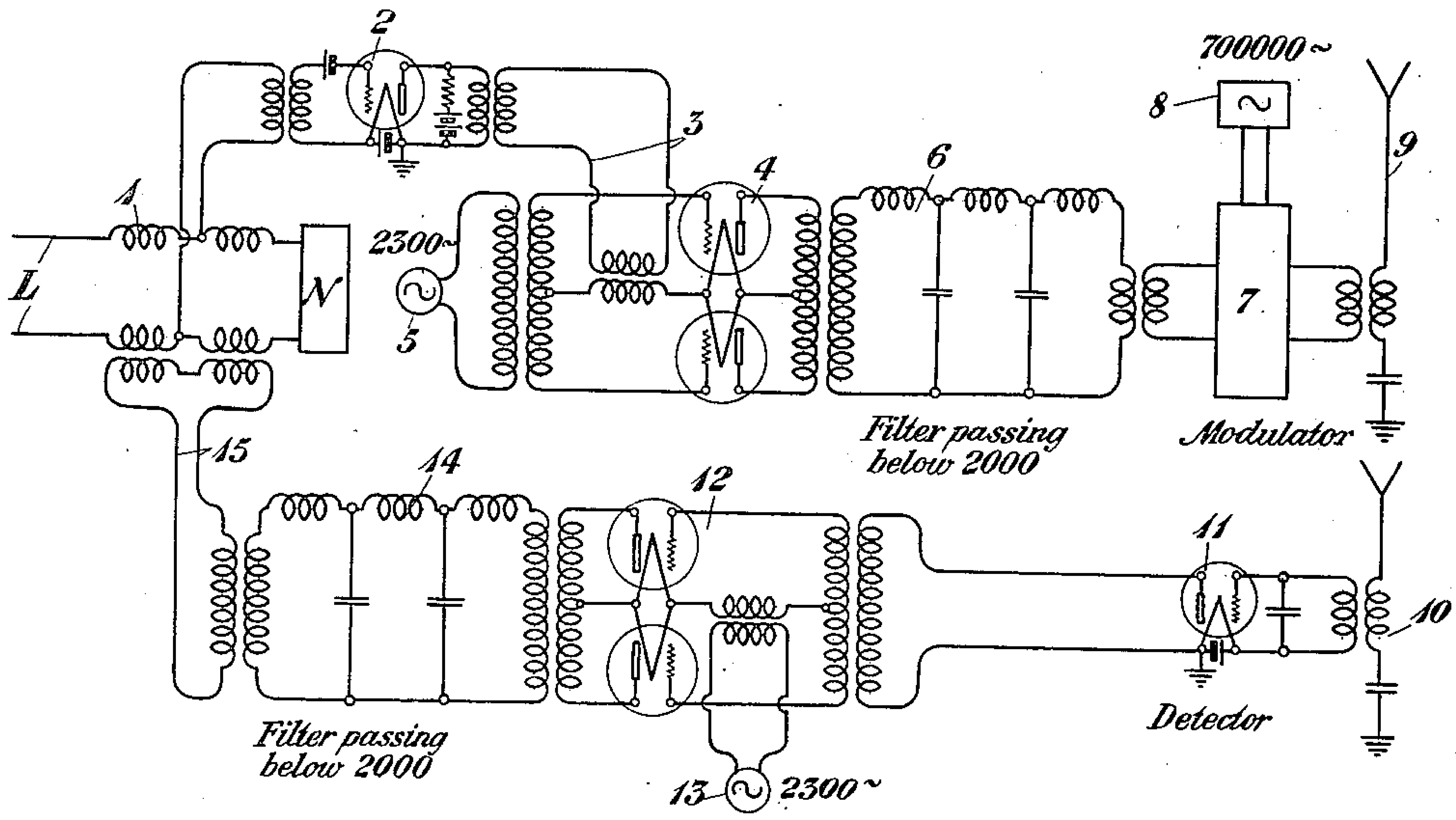

Fig. 1

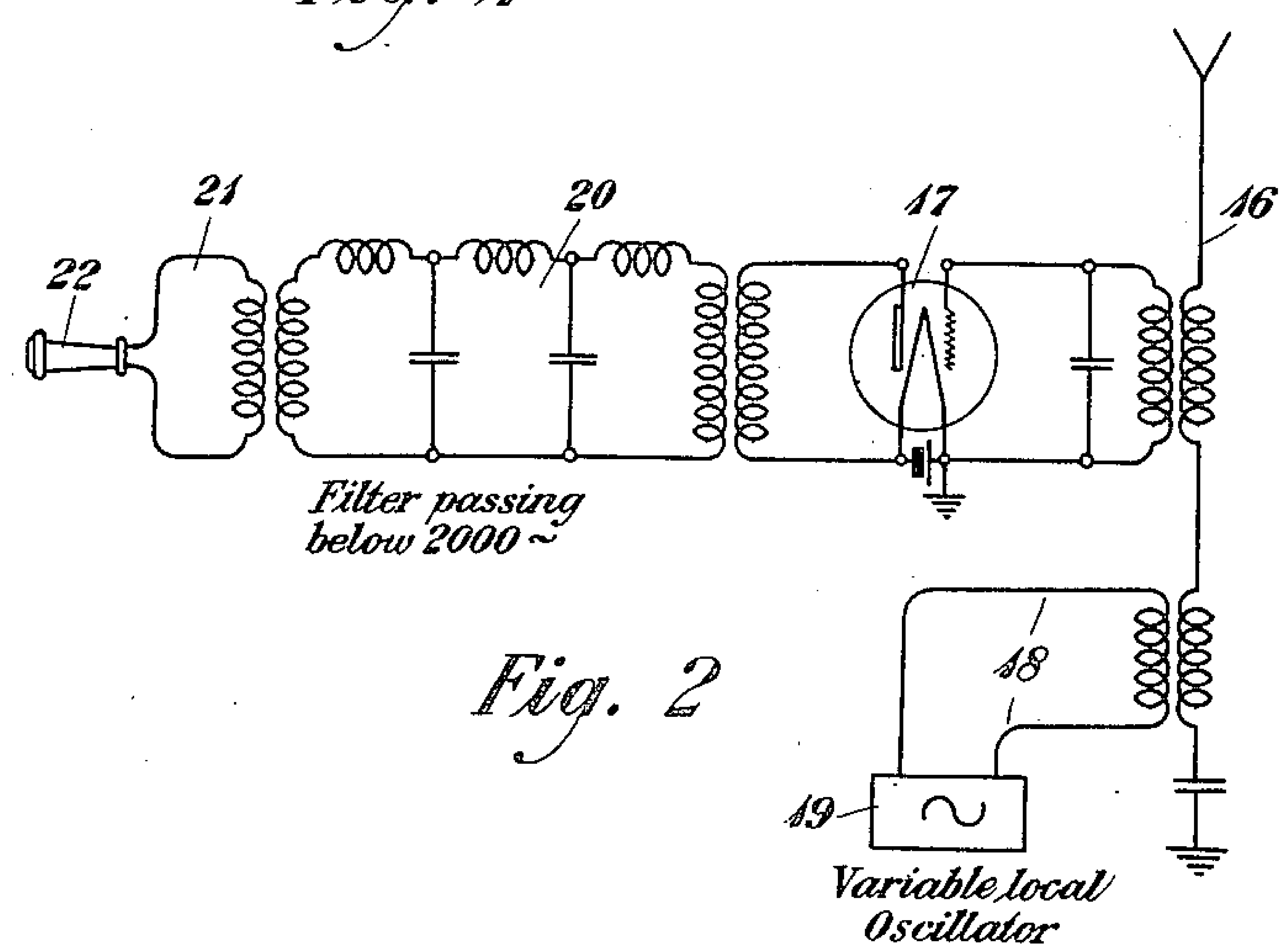

Fig. 2

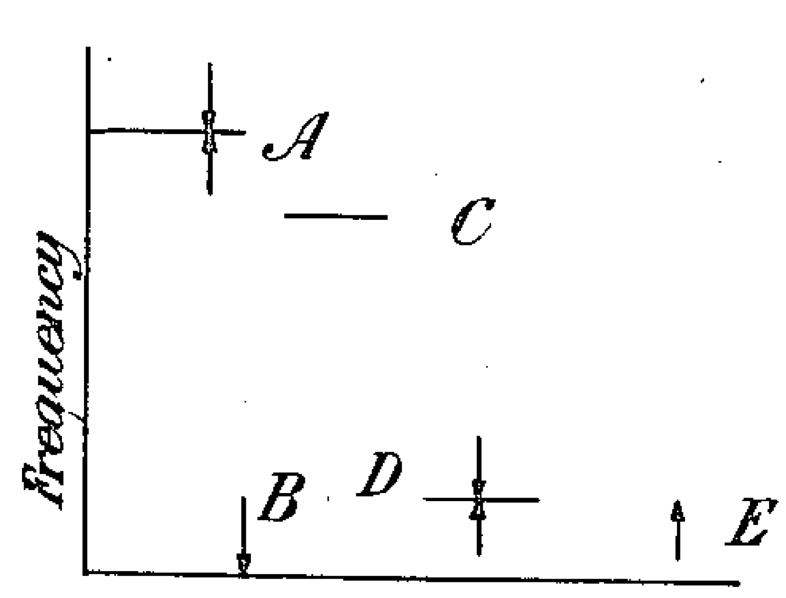

Fig. 3

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UNITED STATES PATENT OFFICE.

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

SECRET-COMMUNICATION SYSTEM.

Application filed November 8, 1921. Serial No. 513,.

To all whom it may concern:

Be it known that I, Ralph Bown, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Secret-Communication Systems, of which the following is a specification.

This invention relates to systems of communication and especially to those in which secrecy in the transmission of messages is involved, and one of the cardinal features of the invention consists in providing improved and simplified receiving arrangements for systems of this character.

One of the methods heretofore utilized in providing for secrecy in the transmission of messages, such as telephone messages, has been to invert the speech frequency band at the sending station and to transmit the band in its inverted and hence unintelligible shape and to provide at the receiving station apparatus for reinverting the speech band to render it intelligible. This may be accomplished by modulating an oscillation current at the sending station in accordance with the signal wave and selecting the lower side band of the modulated wave which will be the signal wave with the frequency relation inverted i. e. the frequency conjugate of the signal wave. This lower side band may then be utilized to modulate a carrier wave which will be transmitted to the receiving station. At the receiving station the carrier wave would first be detected and eliminated thus leaving the lower side band of the modulated signal wave. This lower side band, or inverted frequency band, would then be utilized to modulate an oscillation current similar to that used at the sending station and the lower side band resulting therefrom would be selected. This band would be the signal wave reinverted and restored to its original intelligible condition. The above method has been described in detail in the U. S. application, Serial No. 210,868, filed January 8, 1918, in the name of Hendrik J. Van Der Bijl, and reference may be had thereto for a more detailed description of its operation.

The method of receiving in the above described system, it will be seen, comprises at least two distinct steps, first the detecting of the carrier waves to receive the inverted speech band, and secondly the reinverting by modulation of the inverted speech band so as to restore it to intelligible form. The receiving arrangements of this invention accomplish both of these steps by one single operation. This is accomplished by utilizing a heterodyne receiver in place of the detector and the reinverting modulator of former arrangements. The oscillator of the heterodyne receiver should be adjusted to a frequency equal to the difference between the carrier frequency and the inverting oscillation current frequency utilized at the sending station. The arrangements of the invention accordingly provide a simpler method of operation and result in a saving in equipment over former arrangements. The invention may be more fully understood from the following description of its operation together with the accompanying drawing.

In the drawing, Figure 1 illustrates the arrangements heretofore used for secret transmission of messages by inverting the frequency. Fig. 2 illustrates the improved receiving arrangements of this invention adapted for use with a system employing the transmitting arrangements of Fig. 1. While in Fig. 3 is shown a graphic representation of the principles of operation of the receiving device of the invention.

In Fig. 1 is shown a line L with which may be associated the usual type of telephone transmitter and receiver. The line L includes the windings of a hybrid coil 1 and also a balancing network N. Associated with the hybrid coil is an output circuit for the speech currents which may include a vacuum bulb amplifier 2. The output of the amplifier 2 is coupled with a circuit 3 which in turn is coupled to a vacuum bulb modulating device 4, which is well known in the art. Associated with the modulator 4 is a source 5 of current which may be of the nature of 2,300 cycles in frequency. The output of the modulator 4 is associated with a band filter 6 of the type illustrated in the U. S. Patent, #1,227,113, to G. A. Campbell. The band filter is designed to cut off and extinguish frequencies above a certain limit, such as 2000, and hence will allow the lower side band of the modulated wave to be transmitted therethrough. Associated with the filter 6 is a modulator 7 of any well known type and a source 8 of carrier frequency upon which will be superposed the aforementioned lower side band. The output of modulator 7 is coupled with a radiating antenna 9. The receiving apparatus comprises an antenna 10 with which is coupled a detector 11, which is well known in the art. The detector is connected to a modulating device 12 similar to 4. The modulator 12 is coupled with a band filter 14 similar to 6 and the circuit of filter 14 is connected through a circuit 15 to the hybrid coil 1 and to line L.

The arrangements of Fig. 1 operate in the following manner:

The speech band will be transmitted from line L through the amplifier 2 to the modulator 4. The speech band will then modulate the current from the source 5 of 2300 cycles and the upper and lower side bands will be transmitted to the filter 6. The upper side band and the carrier frequency of 2300 will be shut out by the filter and only the lower side band will be transmitted on. This lower side band consists of the difference between the frequency components of the speech band and the carrier frequency of 2300 and is the ordinary speech band in inverted form. This lower side band will then modulate a carrier frequency, such as 700,000 cycles, at the modulator 7 and there will be radiated from the antenna 9 the carrier frequency of 700,000 and the upper and lower side band resulting from modulation by the original lower side band. If we assume the speech band to have arbitrary limits such as a and b and let $a=300$ and $b=2000$ then upon modulating 2300 by the speech band we will get

$$\left.\begin{matrix} b=4300 \\ a=2600 \end{matrix}\right\} \text{upper side band}$$
$$2300$$
$$\left.\begin{matrix} b=300 \\ a=2000 \end{matrix}\right\} \text{lower side band or inverted speech band.}$$

The band alter 6 will cut off all except the lower side band and we will now modulate the carrier of 700,000 with the lower side band values of $b=300$ and $a=2000$ and we will get

$$\begin{matrix} a=702{,}000 \\ b=700{,}300 \\ 700{,}000 \\ b=699{,}700 \\ a=698{,}000 \end{matrix}$$

When these values which are radiated from the antenna 9 are detected by detector 11, we will get

$$\begin{matrix} b=300 \\ a=2000 \end{matrix}$$

which is again the original lower side band or the speech band in its inverted shape. The inverted speech band is then used at the modulator 12 to modulate the 2300 cycle current from source 13 and we get

$$\begin{matrix} b=2600 \\ a=4300 \\ 2300 \\ a=300 \\ b=2000 \end{matrix}$$

The upper side band and the 2300 are then eliminated by the band filter 14 and the lower side band of $a=300$ and $b=2000$ is transmitted to line L. This lower side band is the original speech band, reinverted and restored to its original shape.

In Fig. 2 are shown the receiving arrangements of the invention which consists of a receiving antenna 16 to which is coupled a detector of the well known heterodyne type comprising a vacuum bulb detector 17 and a circuit 18 connected to a source 19 of oscillations. The source 19 may be arranged so that the frequency may be varied as desired. Associated with the output of detector 17 is the band filter 20 which is similar to filters 6 and 14 heretofore mentioned and designed to cut off and eliminate frequencies above a limit, such as 2000 cycles. Associated with filter 20 is a receiving circuit 21 and a telephone receiver 22.

The operation of the receiving arrangements of Fig. 2 is as follows:

If, as has already been pointed out, we assume arbitrary values for the speech band limits such as $a=300$ and $b=2000$ then the frequency components sent out from the transmitting station would be

$$\begin{matrix} a=702{,}000 \\ b=700{,}300 \\ 700{,}000 \\ b=699{,}700 \\ a=698{,}000 \end{matrix}$$

If these components were detected by an ordinary detector we would simply get $b=300$ and $a=2000$ which would be the inverted and unintelligible speech band. However in accordance with this invention there is impressed simultaneously upon the detector 17 a strong local frequency from the source 19. The frequency value of this local frequency should be adjusted to be equal to the difference between the carrier frequency, such as 700,000, and the local oscillation frequency from the source 5 at the sending station, such as 2300. In other words in this instance the frequency value from source 19 should be 697,700 cycles. This will act with the incoming signals in giving the following:

$$\left.\begin{array}{r} a=702{,}000 \\ b=700{,}300 \\ 700{,}000 \\ b=699{,}700 \\ a=698{,}000 \end{array}\right\} 697{,}700 \left\{\begin{array}{r} a=4300 \\ b=2600 \\ 2300 \\ b=2000 \\ a=300 \end{array}\right.$$

The band filter 20 will then eliminate the upper side band and the beat note of 2300 and will leave the band whose frequency limits are a=300 and b=2000. This, it will be seen is the original speech band reinverted and restored to its intelligible formation.

The principle of operation of the receiving arrangements of the invention may be further understood from reference to the frequency scale shown in Fig. 3. The frequency scale shows at A the carrier and the two inverted side bands, which are radiated from the transmitting antenna. This combination, if received in the ordinary way with a simple detector, results in the production of B, an inverted and unintelligible speech band. If, however, there is impressed simultaneously upon the detector a strong local frequency C, the action of this with the incoming signals will predominate and result in D, which consists of an intelligible speech band, a strong beat note at 2300 cycles and an inverted speech band—this placed upward into the range of 2600 to 4300 cycles. The intelligibility of the speech produced by this process is greatly hindered by the presence of the strong beat note and the higher frequency inverted speech band. The introduction into the detector output of an efficient low-pass filter, which cuts off frequencies above 2000 cycles, will largely eliminate the difficulty and leave only E, an intelligible speech band.

It is pointed out that the frequency values utilized herein are for purposes of illustration only and that the invention is not limited thereto. Furthermore, while the arrangements of the invention have been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that they are capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a signaling system in which messages are transmitted secretly by modulating an auxiliary carrier wave in accordance with a signal wave so as to obtain the frequency conjugate of said signal wave and by modulating a carrier wave in accordance with said frequency conjugate, the method of receiving said signals which comprises beating said carrier wave with a frequency equal to the frequency difference between said carrier wave and said auxiliary carrier wave.

2. In a signaling system a transmitting station comprising a source of talking current, a source of oscillating current, means for modulating said oscillating current in accordance with said talking current, means for selecting the components of said modulated oscillating current within a desired range of frequencies, means for modulating a carrier wave by said selected components, and a receiving station including a heterodyne receiver with a source of oscillations of a frequency equal to the frequency difference between said carrier frequency and the frequency of said first mentioned oscillation current.

3. The method of receiving signals transmitted as doubly modulated carrier waves which comprises modulating said waves as received with current of a frequency equal to the frequency difference of the carrier waves utilized for the double modulation.

4. A signaling system comprising a generator of carrier waves, means including a transmitter device for doubly modulating said carrier waves, and means for impressing said doubly modulated carrier waves upon a heterodyne receiver which includes a local source of oscillations of a frequency equal to the frequency difference of the carrier waves utilized for the double modulation whereby the carrier frequency component may be eliminated, and means for impressing the resultant waves on a filter to eliminate one of the modulation components.

In testimony whereof, I have signed my name to this specification this 7th day of November 1921.

RALPH BOWN.