

Jan. 15, 1946.

G. F. VAN DISSEL

2,393,224

SECRET TELECOMMUNICATION

Filed Aug. 23, 1943

2 Sheets-Sheet 1

Fig. 1.

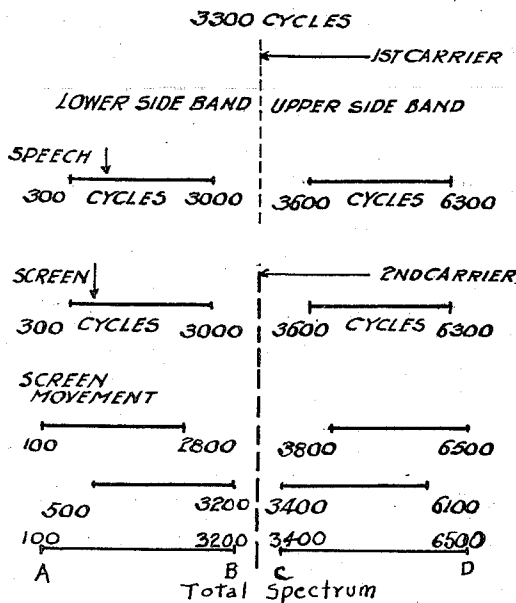


Fig. 2.

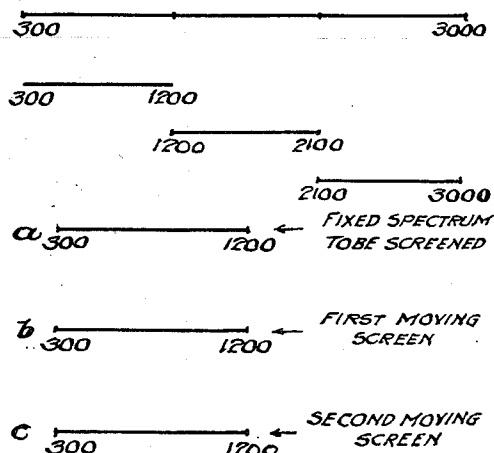


Fig. 3.

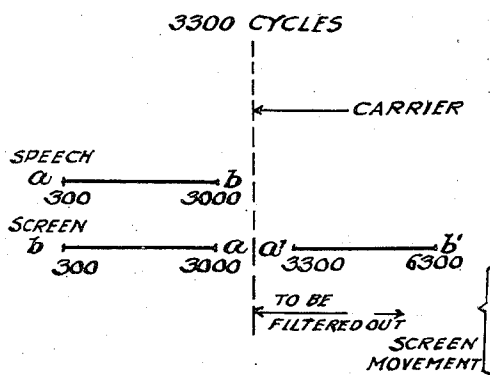
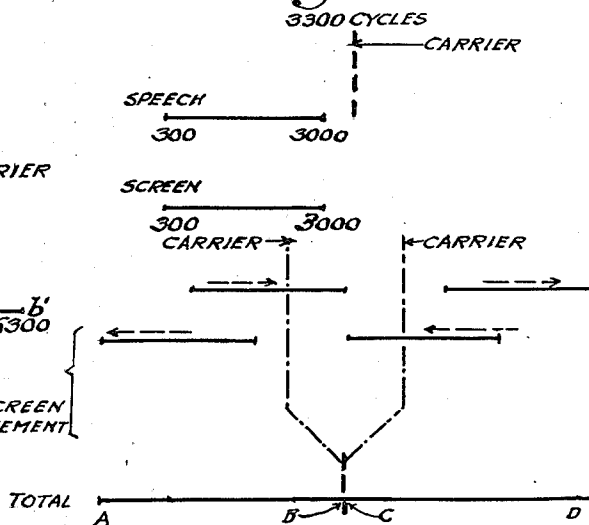


Fig. 4.



Inventor:
Gysbert Frans Van Dissel,
By *Bar. Broun & Fox*
Attorney.

Jan. 15, 1946.

G. F. VAN DISSEL

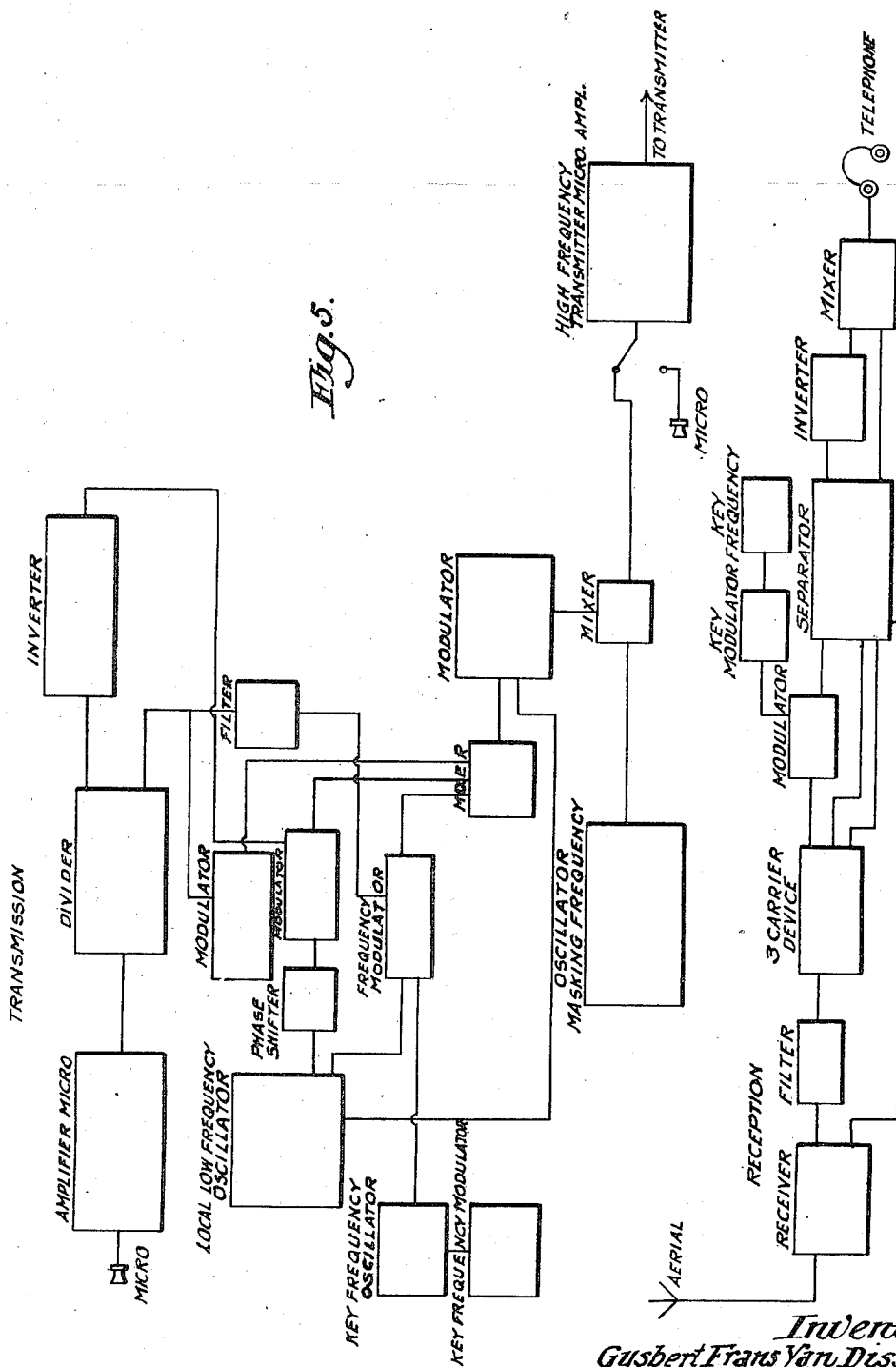
2,393,224

SECRET TELECOMMUNICATION

Filed Aug. 23, 1943

2 Sheets-Sheet 2

Fig. 5.



Inventor:
Gysbert Frans Van Dissel,
By Cam. Boudry & Co.
Attorney.

UNITED STATES PATENT OFFICE

2,393,224

SECRET TELECOMMUNICATION

Gysbert Frans Van Dissel, New York, N. Y.

Application August 23, 1943, Serial No. 499,662

21 Claims. (Cl. 179-1.5)

The present invention relates to communicating systems and more particularly to secret telecommunication systems.

The field of secret telecommunications may be divided into three groups, of which the first consists of systems which make the transmitted communication (telephone or telegraphic) unintelligible to those persons possessing the ordinary receiving sets constructed to receive normal telecommunication, but easily transformable into intelligent communication with the help of some simple technical equipment. For example, inversion of the speech by means of a modulation on a low frequency carrier. The second group consists of systems transmitting unintelligible communications which can be made intelligible only by means of complicated manipulations requiring special technical equipment, plus considerable engineering skill. For example, breaking up of the speech frequency band in parts by means of filters and shifting these parts by means of a modulation on a low frequency carrier. The third group comprehends the use of a selected secret key with either of the first and second groups, so that the transformation of the transmission into intelligent speech will not only require considerable technical equipment and engineering skill, but also the knowledge of the selected key, which latter may be fixed or variable. This key can be so mixed up in the communication as to make the finding of it practically impossible. For example, superposing of the speech frequency band by other bands masking or screening the speech and separating these superposed bands at the reception by means of special devices.

Some of the objects of the present invention are to provide an improved system of telecommunication; to provide such a system wherein the transmitted communication is unintelligible except to those for whom it is intended; to provide a system of telecommunication wherein a secret key not only renders the speech or message unintelligible to all except those having knowledge of the key, but is such as to make the finding of the key practically impossible to anyone; to provide a secret transmission system wherein a novel screening method using movable screening frequency bands is used; to provide a telecommunicating system wherein the secrecy of the transmitted message is made possible by the moving of screening bands in accordance with a predetermined selected pattern; to provide a secret telecommunication system wherein the secret controlling key has two possible variables, namely, (a) the frequency of modulation of the screen spectrum, and (b) the pattern of the change in frequency; to provide a telecommunication system wherein the secrecy is obtained by using a plurality of moving screens;

and to provide other improvements as will hereinafter appear.

In the accompanying drawings, Fig. 1 is a schematic showing of the speech and screen spectrums and related frequencies according to one method of the invention; Fig. 2 is a schematic showing of the separation of the speech band into a plurality of components in conjunction with a method employing two moving screens; Fig. 3 is a schematic showing of another method of the invention wherein a reversed speech band forms the screening medium; Fig. 4 is a schematic showing of another method of the invention wherein the screening spectrum is formed by oppositely moving screens according to a predetermined rhythm; and Fig. 5 is a diagram illustrating one form of transmitting and receiving stations for sending and receiving the locally produced low frequency carrier on a high frequency carrier masked or screened in accordance with the method of the invention.

Referring to Fig. 1 of the drawings, it is assumed that the speech frequency band to be screened covers from 300 to 3000 cycles per second while the low frequency carrier is taken as 3300 cycles per second. This carrier is represented by the upper light broken line. When the speech frequency is modulated on this carrier, a speech spectrum will appear with two side bands covering frequencies of 300 to 3000 cycles per second for the lower side band and 3600 to 6300 cycles per second for the higher side band. The modulated carrier is now passed through a suitable filter and the carrier filtered out so that only the two side bands remain. Obviously, wherever "speech" is mentioned it will be understood to comprise any form of communication, whether signals or speech, although for ease and speed of transmission and reception actual speech is preferred.

In the following, certain of the terms used are defined as follows: a "speech band" is to be understood as a frequency band containing the audible frequencies and is assumed as limited to a band from 300 to 3000 cycles per second; a "speech spectrum" is to be understood as a speech band modulated on a carrier producing next to the carrier two side bands; a "screen band" is to be understood as a frequency band containing audible frequencies destined to cover or screen a speech band, and such screen band may be smaller than, equal to, or larger than, the speech band; and a "screen spectrum" is to be understood as a screen band modulated on a carrier producing next to the carrier two side bands.

In order to produce a screening spectrum, it is assumed that a carrier of 3300 cycles per second is taken which is the same frequency as the carrier chosen for the speech spectrum. The screening band to be modulated on this carrier may be

from 300 to 3000 cycles per second. When this screening band is modulated on the carrier of 3300 cycles per second, indicated by the lower heavy broken line, the result will be a screen spectrum consisting of the carrier and two side bands respectively of 300 to 3000 cycles per second and 3600 to 6300 cycles per second which when superposed on the two speech side bands will cover and screen both and render the speech unintelligible to the unprepared auditor.

For the purpose of making the speech undecipherable as well as initially unintelligible, the carrier frequency of the screen spectrum is given an oscillation or swing which illustratively may cause it to vary between 3100 and 3500 cycles per second. The degree of swing is one of the variants contributing to the modus or pattern of movement, while the rate of swing or oscillation and the actual wave form followed by the swing or movement is another variant contributing to the modus or pattern of movement. Generally speaking, the wave form itself is the major factor in establishing impenetrability of the screen. Assuming the swing of 200 cycles per second on each side of the carrier frequency of 3300 cycles per second mentioned, then the two side bands respectively will have an oscillatory movement between 100 and 2800 cycles per second and between 500 and 3200 cycles per second for the lower side, and between 3800 and 6500 cycles per second and 3400 and 6100 cycles per second for the higher side. The result will be a totally covered band from 100 to 6500 cycles per second with a gap of 200 cycles per second between 3200 and 3400 cycles per second in which no speech or screen band frequencies exist. When this moving screen is superposed on the side bands of the speech remaining after filtering out the speech carrier, the speech becomes thereby both unintelligible and undecipherable.

From the foregoing, it will be evident that while the total spectrum may be transmitted in any manner, as by wire or cable, and through the ether by means of a high frequency carrier, and in all cases can be restored at the reception with a normal receiver, an uninformed or even a partially but incompletely prepared and informed observer will be unable to decipher the transmitted speech message, even though the observer may know the separating mechanism by which the screened speech is separated from the screen. In the system just described, there are three elements necessary for an observer to know with exactness in order to effectuate the separation; namely, (1) the carrier frequency of the speech, (2) the carrier frequency of the screen, and (3) the modus of the movement of the screen. For example, from the symmetrical aspect of the spectrum the observer might draw the conclusion that the first carrier frequency is in the middle of the gap 3200 to 3400 or 3300 cycles. The observer might even suppose that the second carrier frequency is separated from the first by a difference of only 200 cycles per second, and thus try out all the possible frequencies within those limits. However, there still remains unknown the modus of the movement of the screen and this the specifically uninformed observer or auditor cannot find by any analysis of the received spectrum.

As a modification of the foregoing method, the screening spectrum may be produced by a carrier frequency which is out of phase with the carrier frequency of the speech spectrum, and this out of phase frequency may be caused to swing or oscillate in a predetermined manner.

As a means for even hiding the carrier frequency of the speech spectrum and the carrier frequency of the screening spectrum, it is technically possible to make the total spectrum dissymmetrical in relation to the carriers of the screened and screening spectrums, assuming that one and the same frequency is used for both with a phase difference. This can be done by adding to the speech spectrum and the screening spectrum, a third spectrum, a so-called "decentering spectrum" which extends one of the side bands with respect to the other. The same decentering result may also be obtained by choosing for the carrier frequency of the screening spectrum a frequency differing considerably from the frequency of the screened spectrum. The total result of both methods will be a decentering spectrum. It will become extremely difficult for an uninformed observer to find out the frequencies of the carriers. To add to the difficulties of such an observer, a third variable may be added; namely, the varying of the phase difference between the carrier of the speech or screened spectrum and the carrier of the screening spectrum. Furthermore, the position of the screened and the screening spectrum may be inverted, whereby the speech spectrum will then become the moving spectrum and the screening spectrum the fixed spectrum, while all other conditions remain the same. The screening spectrum may also be smaller or larger than the screened spectrum and may be derived from the screened spectrum itself or may be of extraneous origin.

In order that the low frequency carriers of screened and screening spectrums can be reproduced at the receiving station, means such as twin crystals are provided to synchronise the signal from the transmitter to the receiver.

While in the foregoing a single screen has been described and emphasized, the quantity of screens may be more than one, the total being limited only by practical conditions. In using different frequencies for the carriers of the screened and screening spectrums the maximum is also limited by practical considerations. The movement of these different screens may be linked up in one way or another electrically or may be completely independent. For instance, when two screens are applied it may be assumed that they move in the same rhythm but in opposite directions, or simply with a phase difference using the same pattern, or moved by two independent and unrelated different patterns.

The pattern itself may consist in any form of oscillation or periodical or aperiodical function conceivable, from the pure sinusoidal oscillation to the most arbitrary form, e. g., square, triangle, zig-zag, relaxation forms containing harmonics, etc. These periodical or analogous functions may be derived directly from the high frequency transmission carrier or from an extraneous source. In the last case provisions must be taken for a synchronising signal from transmitter to receiver. The carrier and the synchronizing signal or only the carrier and only the synchronous signal may be transmitted in the gap between the two side bands, symmetrical or dissymmetrical, and may in their turn be masked or screened by a great quantity of other frequencies at a minimum distance.

In such a case, the unprepared and specifically unknowing observer will be aware of a gap containing a plurality of waves out of which he has to choose a combination of at least two waves,

one being the low frequency carrier, the other the synchronising signal for the screen movements.

It may be clear that the increase of screens will increase the possible combinations. However, it is of more importance to have a gap sufficiently wide as to be able to contain a considerable amount of masking frequencies masking the low frequency carrier and the synchronising signal for the screened frequency.

It must be repeated here, however, that the finding of the synchronous signal will only give the frequency of the movement, but does not give any element of the form of the movement. This element of form cannot be selected by analysis of the transmitted spectrum.

The above described methods require a total frequency band which may be greater than the two side bands and the gap, as the movement of the screens may extend the side bands. This means in practice for instance, a total band of about 7000 cycles per second, assuming the respective side bands have a width of 3000 cycles per second, or about 6000 cycles per second, with respective side bands from 300 to 2700 cycles per second.

Actually, most transmitters permit the transmission of side bands of a width of 300 to 7000 cycles per second. However, in the case that the side bands may not be larger than 3000 cycles, the following systems may be used. The original speech band will be broken in two or three parts, equal or unequal, by means of filters, e. g., with a spectrum 300 to 3000 cycles per second. For instance, from 300 to 1200, 1200 to 2100, 2100 to 3100 cycles per second, as shown in Fig. 2.

By means of a modulation of a low frequency carrier of 2400 cycles per second, the band from 1200 to 2100 cycles per second can be reversed and reduced to 300 to 1200 cycles per second. The same can be done with the band from 2100 to 3000 cycles per second using a low frequency carrier of 3300 cycles per second. See Fig. 2. Thus, the total speech spectrum by transposition, comprises three different spectrums, each from 300 to 1200 cycles per second, and comprising, illustratively

- a. Fixed spectrum to be screened
- b. First screen
- c. Second screen

Each of the carriers of the two screens will be given a movement, which movements may be linked up electrically or may be completely independent.

At the reception, the *abc* spectrums can be separated and built up again in the reverse way, for spectrum *b*, with a modulation on a carrier of 2400 cycles per second will become again 1200 to 2100 cycles per second, the spectrum *c* with a modulation on a carrier of 3300 cycles per second will become 2100 to 3000 cycles per second. *b* and *c* together with *a* give the spectrum extending from 300 to 3000 cycles per second in the rearranged and reconstituted speech.

Fig. 3 represents the simplest form of device and system in which a speech band from 300 to 3000 cycles per second is impressed upon a carrier of 3300 cycles per second while the moving screen comprises the modulation of a moving carrier of 3300 cycles per second by an inversion of the speech band of 300 to 3000 cycles per second.

In the form of invention of Fig. 4, a low frequency carrier of say 3300 cycles modulated with the speech band, 300 to 3000 cycles per second forms the speech spectrum, while the screen band

consists of the reversed speech band of 300 to 3000 cycles per second. This screen band is modulated on a low frequency carrier of 3300 cycles per second having the same frequency as the carrier of the speech spectrum but a phase difference of $+90^\circ$. A second screen spectrum is formed by modulating the same screen band on a carrier having the same frequency as the carrier of the speech spectrum but with a phase difference of -90° . The key to the opposite movements of the screening spectra may be taken as 412.5 cycles per second which is the 8th sub-harmonic of the carrier 3300 cycles per second. This is only by way of example, as any other harmonic may be used as the modus key. By prearrangement, the key for a certain time interval can be one harmonic, for instance, which automatically changes to another harmonic with the ending of the said time interval. The intervals may be by hours or sub-divisions thereof or by days or sub-divisions thereof, according to necessities. These three modulated carriers are mixed giving the total spectrum. The resulting movement of the frequencies of the lower and upper side bands is in opposite directions because the impressed screen is on two carriers with a phase difference of 180° and having oppositely moving directions. The two side bands AB and CD are transmitted with the low frequency carrier or modulated on a high frequency transmitting carrier. At the reception the low frequency band ABCD with carrier 3000 cycles per second is first restored and the moving screen and fixed speech screen separated. It is understood that in all cases mentioned such a separation can be effected by means of devices enabling the separation of two or more modulated waves having the same carrier frequency but different phases, such as Carsons balanced demodulator, or other balanced arrangements constituted of copper-oxide or cupersulfide cells or selenium rectifiers, or by means of one of the devices described in the patents to Dr. Leonide Gabrilovitch, No. 2,240,500 and No. 2,295,207. These devices also permit the utilization of two or more modulated carriers of different frequencies so close together that their sidebands overlap each other.

In order to obtain more and more adequate protection, the following means are proposed:

(1-a) A second screen making the side bands unsymmetrical by extending one of them.

(1-b) Masking or screening the low frequency carrier by means of a plurality of waves in the gap differing in frequency the practical minimum necessary for their separation.

(1-c) Giving the movement a frequency independent of the low frequency carrier.

(1-d) Giving the movement a special pattern.

An example of a system may be given as follows:

(a) A speech frequency band of 300 to 2700 cycles per second has to be transmitted.

(b) This speech spectrum is first divided in two equal parts, 300 to 1500 and 1500 to 2700 cycles per second.

(c) One of these, the part 1500 to 2700 cycles per second, is reversed by means of modulation on a carrier of 3000 cycles per second. This produces two side bands of 300 to 1500 and 4500 to 5700 cycles per second. The 300 to 1500 cycles per second band is filtered out, being the reversed 1500 to 2700 cycles per second band of *b*.

(d) A carrier of 1500 cycles per second is produced. This carrier may be derived from the high frequency carrier mentioned under "j" mentioned

hereinafter, or it may be transmitted on that high frequency carrier with a masking spectrum, produced by means of twin crystals or a synchronizing signal.

(e) This low frequency carrier is first divided in three parts

- (1) The same carrier with phase a° .
- (2) The same carrier with phase $a^\circ + 90^\circ$.
- (3) The same carrier frequency modulated with a frequency variation of 200 cycles per second or less.

(f) For e-3 is used for modulation a part of 300 to 1500 cycles per second speech band (sub "b" above) being 500 to 1300 cycles per second.

(g) On carrier "e-1" is modulated the band 300 to 1500 cycles per second sub "b," not reversed.

On carrier "e-2" is modulated the band 300 to 1500 cycles per second sub "c," reversed.

On carrier "e-3" is modulated the band 500 to 1300 cycles per second sub "f," with a deviation to both sides of 200 cycles per second or less thus producing a band of 300 to 1500 cycles per second. The speed and form of the modulation form the key.

(h) The three modulated carriers sub "e-1," "e-2," "e-3," are then superposed and modulated together on a low frequency carrier of 1500 cycles per second (sub "d" above) producing two side bands of

- (1) 300 to 1500 cycles per second not reversed.
- (2) 2100 to 3300 cycles per second reversed.

(i) The gap of 1500 to 2100 cycles per second between side bands "h-1" and "h-2" may be filtered out in the case the low frequency carrier may be derived from the high frequency carrier sub "j" below, or be filled with a masking spectrum, covering the two frequency carriers of 1500 cycles per second.

(j) This total spectrum of "h-1" and "h-2" totalling 300 to 3300 cycles per second with or without gap is then modulated on a high frequency transmission carrier, for transmission.

(k) At the reception, which is normal, the total spectrum sub "j" is first reproduced.

(l) From the high frequency carrier or from masking spectrum or from synchronising signal, or twin crystals, the low frequency carrier of 1500 per second is reproduced.

(m) With this carrier the three carriers sub "e-1," "e-2," and "e-3" are reproduced.

(n) By means of these three carriers sub "m," and the separating device, the three bands with which they are modulated are separated.

(o) By means of filtering are separated the part 300 to 1500 cycles per second, non-reversed equal to 300 to 1500 cycles per second sub "b," or sub "h," and the part 2100 to 3300 cycles per second (reversed) equal to sub "h-2."

(p) Part 2100 to 3300 cycles per second is then reversed by modulating on a carrier of 4500 cycles per second, this gives a non-reversed band of 1500 to 2700 cycles per second.

(q) The two bands 300 to 1500 cycles non-reversed sub "o" and 1500 to 2700 cycles per second non-reversed sub "p," give together the normal speech band of 300 to 2700 cycles per second.

Fig. 5 graphically illustrates one arrangement of the apparatus for sending and receiving secret communications in accordance with the present invention, including the frequency producing means, filters, and modulation means.

Having thus described my invention, I claim:

1. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing one spectrum on the other to completely cover one spectrum with the other, and varying the position of one of the spectra in relation to the fixed position of the other.

2. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing one spectrum on the other to completely cover one spectrum with the other, and varying the position of the two spectra in relation to their original position.

3. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing the screen spectrum on and completely covering the speech spectrum, and varying the position of the screening spectrum in relation to the fixed position of the speech spectrum.

4. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing the screen spectrum on and completely covering the speech spectrum, and subjecting the position of the screening spectrum to a rhythmic movement of predetermined frequency.

5. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing the screen spectrum on and completely covering the speech spectrum, and subjecting the position of the screening spectrum to a rhythmic movement of predetermined frequency and pattern.

6. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing the screen spectrum on and completely covering the speech spectrum, and subjecting the position of the screening spectrum to a rhythmic movement of predetermined pattern.

7. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of the same frequency as the first carrier but differing in phase to form a screen spectrum, superposing the screen spectrum on and completely covering the speech spectrum, and varying the position of one of the spectra in relation to the fixed position of the other spectrum.

8. The method of transmitting secret telecommunications, which consists in modulating a carrier of predetermined frequency to form a fixed screening spectrum, modulating a second carrier of predetermined frequency to form a speech spectrum of the same frequency characteristics as the screen spectrum, superposing the one spectrum on the other spectrum, and subjecting the

position of the speech spectrum to a rhythmic movement of predetermined frequency.

9. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a fixed screening spectrum, modulating a second carrier of predetermined frequency to form a speech spectrum of the same frequency characteristics as the screen spectrum, superposing the one spectrum on the other spectrum, and subjecting the position of the speech spectrum to a rhythmic movement of predetermined frequency and pattern.

10. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a fixed screening spectrum, modulating a second carrier of predetermined frequency to form a speech spectrum of the same frequency characteristics as the screen spectrum, superposing the one spectrum on the other spectrum, and subjecting the position of the speech spectrum to a rhythmic movement of predetermined pattern.

11. The method of transmitting secret telecommunication, which consists in modulating a low frequency carrier to form a speech spectrum, filtering out the carrier to leave the upper and lower side bands of the speech spectrum, modulating a second carrier of low frequency to form a screening spectrum of the same frequency characteristics as the speech characteristics, varying the frequency of the carrier for one of the spectra, and superposing the moving spectrum on and rhythmically overlapping the upper and lower side bands of the fixed spectrum.

12. The method of transmitting secret telecommunication, which consists in modulating a low frequency carrier to form a speech spectrum of upper and lower side bands, filtering out the carrier and one of the side bands, modulating a second carrier to form a speech spectrum with one reversed speech band, varying the position of this spectrum, and superposing the reversed speech band of this spectrum on the remaining side band after having filtered out the carrier and the not reversed side band.

13. The method of transmitting secret telecommunication, which consists in modulating a low frequency carrier to form a speech spectrum, modulating simultaneously two different low frequency carriers, superposing the thus produced screen spectra upon and completely covering said speech spectrum, and imparting rhythmic movement to the two superposed screen spectra respectively in opposite directions to screen the speech spectrum.

14. The method of transmitting secret telecommunication, which consists in modulating a low frequency carrier to form a speech spectrum, modulating simultaneously two low frequency carriers of different phase, superposing the thus produced two screen spectra upon and completely covering said speech spectrum, and imparting a rhythmic movement to each of the last mentioned carriers in the same direction but differing in frequency.

15. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing one spectrum on the other

to completely cover one spectrum with the other, and varying the position of one of the spectra as a function of a sub-harmonic of one of the carriers.

16. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing one spectrum on the other to completely cover one spectrum with the other, varying the frequency of one of the carriers according to a key pattern, and impressing the total spectrum on a high frequency carrier comprising a harmonic function of one of said modulated carriers.

17. The method of transmitting secret telecommunication which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, filtering out one of said carriers, superposing one spectrum on the other, varying the frequency of the remaining carrier according to a predetermined pattern of oscillation, then impressing the total spectra on a transmission circuit.

18. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, in modulating a second carrier of predetermined frequency to form a first screen spectrum, in modulating a third carrier of predetermined frequency to form a second screen spectrum, in superposing all of the spectra, in varying the position of at least one spectrum according to a predetermined pattern, and in then transmitting the total spectra.

19. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing one spectrum on the other to completely cover one spectrum with the other, and varying the position of one of the spectra to cause the side bands thereof to substantially overlap to form a continuous spectrum having no gap.

20. The method of transmitting secret telecommunication, which consists in modulating a carrier of predetermined frequency to form a speech spectrum, modulating a second carrier of predetermined frequency to form a screen spectrum, superposing one spectrum on the other to completely cover one spectrum with the other, varying the position of one of the spectra, and causing the screening spectrum to be dissymmetrical so as effectively to extend one of the side bands of the speech spectrum more than the other so as to aid in confusing an auditor.

21. The method of transmitting secret telecommunication which consists in transmitting two superposed carrier waves of the same frequency but of different phase, modulating one carrier to form a speech spectrum, modulating the other carrier to form a screen spectrum, completely covering one spectrum with the other, and causing the screen spectrum to oscillate between predetermined frequency limits.

GYSBERT FRANS VAN DISSEL.