June 17 , 1924. 1,497,714

L. ESPENSCHIED

SECRET COMMUNICATION SYSTEM

Filed Jan. 28 , 1921

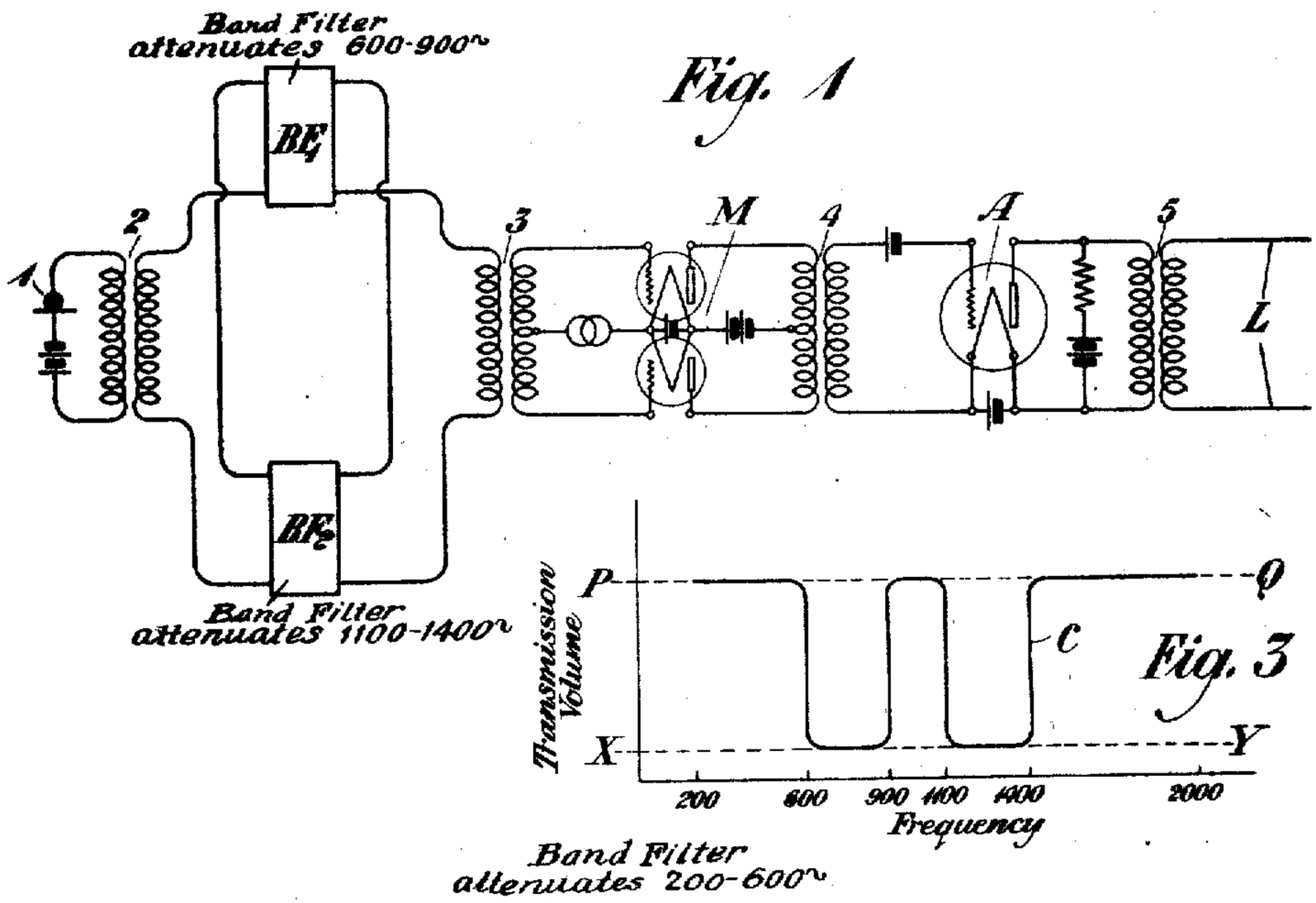

Fig. 1

Fig. 3

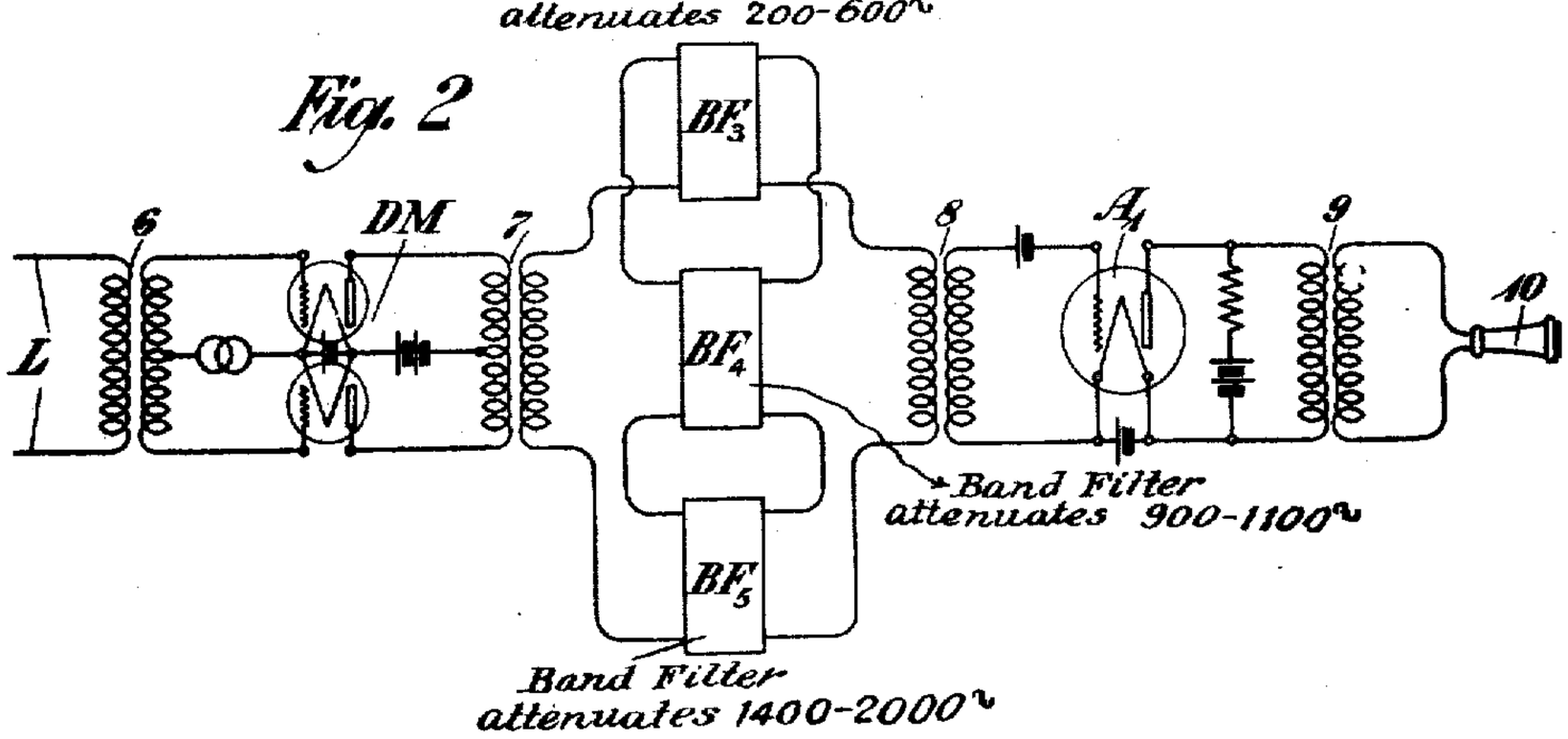

Fig. 2

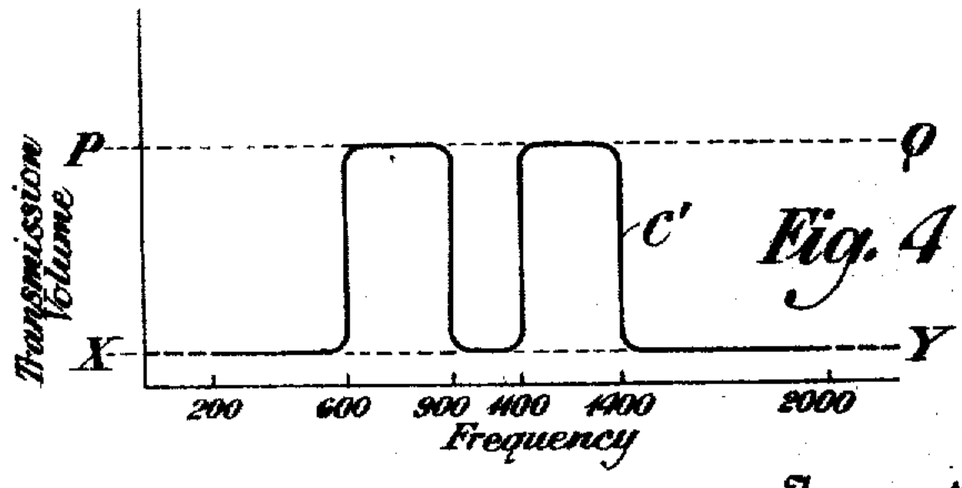

Fig. 4

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By his Attorney

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UNITED STATES PATENT OFFICE.

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SECRET-COMMUNICATION SYSTEM.

Application filed January 28, 1921. Serial No. 440,679.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Queens, in the county of Queens and State of New York, have invented certain Improvements in Secret-Communication Systems, of which the following is a specification.

This invention relates to systems of communication and more particularly to arrangements for providing secrecy in the transmission of messages over said systems.

In the arrangements of this invention secrecy is obtained by dividing the message frequency band into a plurality of sub-bands and subjecting said sub-bands to different degrees of attenuation before transmission. Accordingly when the message frequency band is thus transmitted it will be so distorted that it will be practically unintelligible to anyone who might have unauthorized access to the medium through or over which the message was being transmitted. To render the message intelligible at the receiving station the sub-bands of the message frequency band are again subjected to unequal degrees of attenuation, so that all of the sub-bands will be attenuated to the same degree and the distortion thus removed. The message frequency band may then be amplified and transmitted to receiving arrangements in intelligible form.

The invention may be more fully understood from the following description, when read in connection with the accompanying drawing, in the Figures 1, 2, 3 and 4 of which are illustrated arrangements embodying a preferred form of the invention. In Figs. 1 and 2 respectively are shown the transmitting and receiving arrangements of the invention, while in Figs. 3 and 4 are shown graphical representations of the transmission frequency characteristics of the message frequency band as produced by the transmitting and receiving arrangements of the invention.

In the transmitting arrangements of Fig. 1 there is shown a circuit including a transmitter 1. This transmitter is coupled through the transformer 2 to a circuit including the band filters BF_1 and BF_2. These band filters may be of the type illustrated in an article entitled "Theory and design of uniform and composite electric wave filters" by O. J. Zobel, published in the Bell System Technical Journal, January, 1923, Volume II, No. 1. These filters are adapted to readily pass or transmit certain bands of frequencies and to attenuate other frequency bands. For example, assuming the message frequency band to comprise a telephonic range of frequencies as from 200 to 2000 cycles, the band filter BF_1 might be designed to attenuate a band of frequencies from 600 to 900 cycles and to readily transmit other bands of frequencies, while the band filter BF_2 might attenuate a band of frequencies from 1100 to 1400 and readily transmit other frequencies. With this arrangement it will be seen that certain of the sub-bands of the message frequency band, such as sub-bands 600 to 900 and 1100 to 1400, will be subjected to a greater degree of attenuation than the other sub-bands of the message. It will be seen from Fig. 3 that the transmission-volume-frequency characteristics of the message, which if the band filters were omitted would be along dotted line PQ, will assume the form of the curve C, when the aforementioned sub-bands are attenuated by the filters to the dotted line XY. Accordingly by thus subjecting certain of the sub-bands to a greater degree of attenuation than others, the message frequency band may be so distorted before transmission as to render it unintelligible. The circuit including the band filters is coupled through transformer 3 to a circuit including a modulating device M whereby the message frequency may be impressed on a high frequency carrier wave. Any desirable form of modulating arrangement may be utilized in this connection, the arrangement herein shown being the well known duplex vacuum bulb modulator illustrated in the U. S. Patent No. 1,343,307, issued June 15, 1920, to J. R. Carson. The output circuit of the modulator M may be coupled through a transformer 4 to a circuit including an amplifying device. The amplifier A, herein illustrated, is of the well known vacuum bulb type and no further description thereof will be given. The output circuit of the amplifier A may be coupled through a transformer 5 to a transmitting channel L, from which the message may be transmitted over a wire line or may be modulated upon a high frequency carrier, if desired, and then transmitted either by wire or radio. Obviously other

forms of transmitting circuits might be coupled to the band filter circuit rather than the one shown, which is illustrative only.

In the receiving arrangements of the invention illustrated in Fig. 2 the incoming portion of the transmitting channel L is shown coupled through a transformer 6 to a circuit including a demodulating device DM, which may be of the well known duplex vacuum type illustrated in the U. S. Patent, No. 1,343,308 issued June 15, 1920 to J. R. Carson. The output circuit of the demodulator DM is coupled through a transformer 7 to a circuit including the band filters BF_3, BF_4 and BF_5. These band filters may be of the type illustrated in the aforementioned article by O. J. Zobel. Band filters BF_3 may be adapted to attenuate a sub-band of frequencies between 200 and 600 cycles, while band filters BF_4 will attenuate a sub-band between 900 and 1100 and band filter BF_5 will attenuate a sub-band between 1400 and 2000 cycles. These band filters should be adjusted to subject these sub-bands to the same degree of attenuation as the band filters BF_1 and BF_2. It will be seen from Fig. 4 that the normal message frequency band, which would have an attenuation frequency characteristic indicated by the dotted line PQ, would when transmitted through the band filters BF_3, BF_4 and BF_5, have an attenuation frequency characteristic as shown by the curve C'. The component of the curve C of Fig. 3 and the curve C' of Fig. 4 would however be represented by the dotted line XY. In other words when the distorted message frequency band, which comes in over the channel L, is transmitted through the band filters BF_3, BF_4 and BF_5, all of the sub-bands will have been subjected to the same degree of attenuation and restored to the same, though lower, level in the attenuation scale. This will serve to remove the distortion from the message frequency band and to render it intelligible. The band filter circuit is coupled through a transformer to the circuit of an amplifier A_1 which may be of the well known vacuum bulb type. The amplifier A_1 is provided to counteract the combined attenuation effect of the band filters and to increase the volume of the message frequency band sufficiently so that it may be effectively transmitted through the transformer 9 to the circuit of a receiver 10.

While the invention has been disclosed in certain specific arrangements which are deemed desirable it is understood that the arrangements are illustrative only. The band filters, for example, might be increased in number and adjusted to operate with other sub-bands than those shown. Accordingly, it is understood that the arrangements of the invention are capable of embodiment in many other 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 transmission system including a sending station and a receiving station the method of maintaining secrecy in the transmision of messages between said stations which consists in distorting the outgoing message currents by subjecting certain of the frequency bands of said currents to a certain degree of attenuation, and in restoring the amplitude relation of the several frequency bands of said message currents to normal at the receiving station by subjecting otlier of the frequency bands of the incoming message currents to a similar degree of attenuation and amplifying all of said bands.

2. In a transmission system including a sending station and a receiving station the method of maintaining secrecy in the transmission of messages between said stations which consists in distorting the outgoing message currents by subjecting certain of the frequency bands of said currents to a certain degree of attenuation, and in restoring the relative amplitude relation of the several frequency bands of said message currents at the receiving station by subjecting other of the frequency bands of the incoming message currents to a similar degree of attenuation.

3. A transmission system including a sending station and a receiving station, a transmitting circuit at said sending station, means for selecting certain of the frequency bands transmitted over said circuit and for subjecting said selected bands to a greater degree of attenuation than the other of said bands, means for transmitting all of said frequency bands to said receiving station, means at said receiving station for subjecting the other of said bands to the same degree of attenuation as said selected bands, and means at said receiving station for amplifying all of said bands.

In testimony whereof, have signed name to this specification this 25th day of January 1921.

LLOYD ESPENSCHIED.