

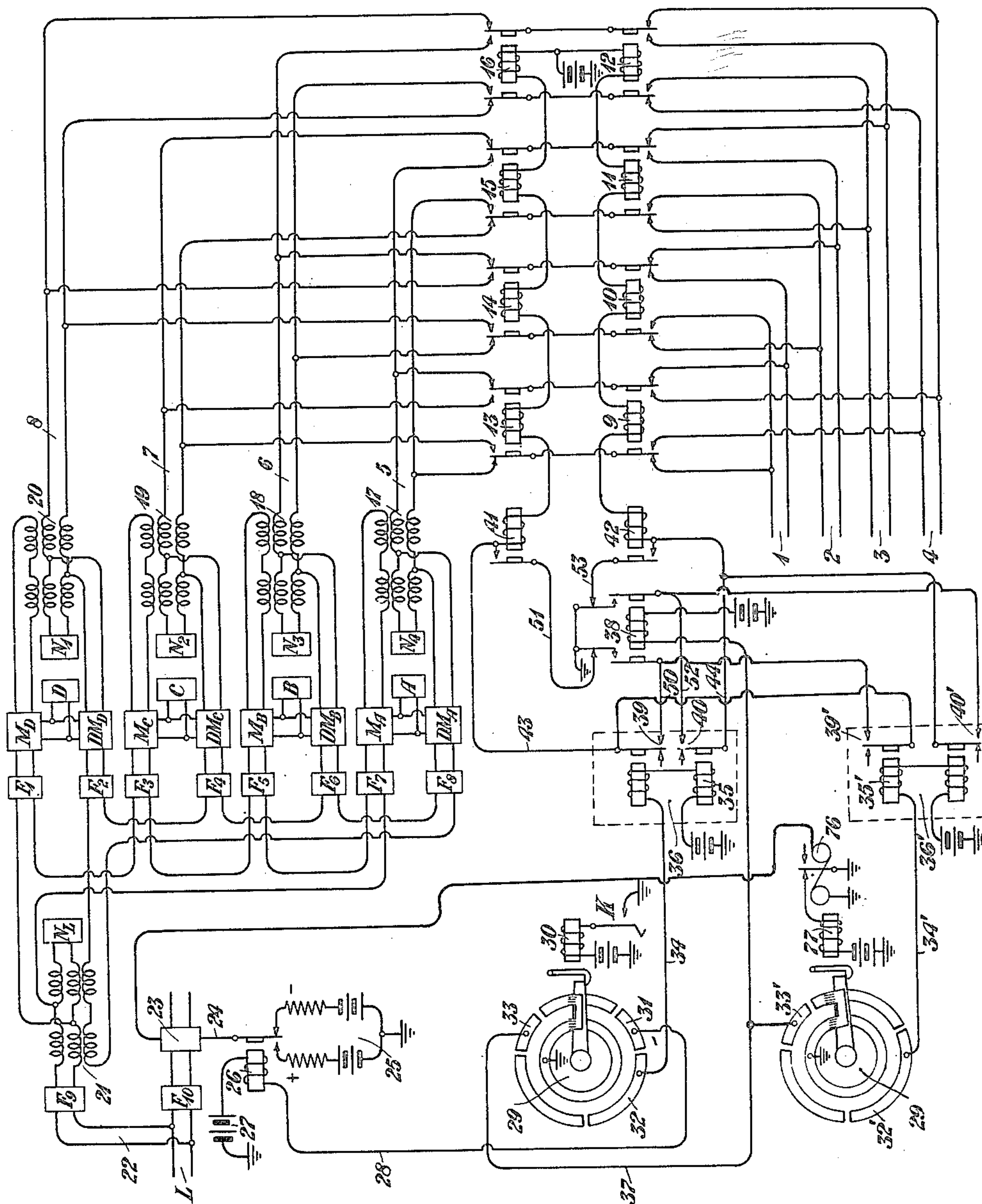
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SECRECY COMMUNICATION SYSTEM

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## UNITED STATES PATENT OFFICE.

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## SECRECY COMMUNICATION SYSTEM.

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This invention relates to a signaling system wherein signals are transmitted by the agency of a high frequency wave modulated in accordance with said signals, and more particularly to a signaling system employing a plurality of high frequency waves. It is the object of the invention to provide a system of communication whereby secret communications between stations may be had to the end that stations, other than those designed to receive, may not receive complete, intelligible signals.

Heretofore in certain types of signaling systems, in which a high frequency wave is utilized as the agency for transmitting the signals, the signals have been transmitted by electromagnetic waves of a definite high frequency or wave length and any station tuned to said wave length might be capable of receiving said signals. In the present invention secrecy is obtained by the transmission of signals on a plurality of waves of different frequencies, successive portions of a message being transmitted on waves of different frequencies whereby a station tuned to one of said waves receives only a partial and therefore unintelligible disclosure of the communication. The arrangements of this invention present the additional secrecy feature that the shifting of the low frequency signals or portions of the message, to the various high frequency waves or channels is not accomplished in a cyclic order but rather in a random and variable manner. To this effect printing telegraph apparatus and key tapes are utilized to shift the low frequency signals in a variable manner to the high frequency channels, the shifting being controlled in accordance with the perforations and setting of the key tape utilized. With this arrangement the messages would be unintelligible to unauthorized persons, who might have access to the medium through or over which the messages are transmitted, unless such persons should be provided with the key tapes utilized at the sending station in addition to other information. Other objects and features of the invention will ap-

pear more fully from the detailed description hereinafter given.

The arrangements of the invention are illustrated in the accompanying drawing, in the figure of which is shown a sending station of a system embodying the invention.

In the arrangements of the drawing are shown four low frequency channels 1, 2, 3 and 4 from which the low frequency signals, such as four telephone messages, may be transmitted through modulating apparatus out over a transmission line L. The modulating apparatus is shown schematically and includes the modulators  $M_a$ ,  $M_b$ ,  $M_c$  and  $M_d$ , with which are associated the high frequency sources A, B, C, and D, which are of suitable different frequencies. These modulators may be of the duplex vacuum bulb type illustrated in the U. S. Patent #1,343,307, dated June 15, 1920, in the name of John R. Carson, although other types of modulators may be used. These modulating devices are associated with the low frequency channels 1, 2, 3, and 4, by means of the hybrid coils 17, 18, 19 and 20, the conductors 5, 6, 7 and 8, and over the contacts of a plurality of series of relays, such as the relays 13, 14, 15 and 16, and the relays 9, 10, 11 and 12. Associated with the above mentioned hybrid coils are the balancing networks  $N_1$ ,  $N_2$ ,  $N_3$  and  $N_4$ . Included in output circuits of the modulators are the band filters  $F_1$ ,  $F_3$ ,  $F_5$  and  $F_7$  which readily transmit the band of high frequencies of the order of the particular high frequency source associated with each modulator but which attenuate and practically extinguish frequencies outside of said band. These filters may be of the type illustrated in the U. S. Patents No. 1,227,113 and No. 1,227,114 to G. A. Campbell. The output circuits of the modulators are associated with the line L through the hybrid coil 21, the conductors 22 and the high pass filter  $F_9$ . The filter  $F_9$  readily allows the transmission of the high frequency carrier currents utilized but attenuates and extinguishes the low frequency currents transmitted over the line L, such as of the nor-



mal speech or telegraphic frequencies. In order that the messages coming in over line L may be received over the lines 1, 2, 3 and 4, there is associated with the high frequency sources A, B, C and D, the demodulating devices  $DM_a$ ,  $DM_b$ ,  $DM_c$  and  $DM_d$ , which may be of the duplex vacuum bulb type illustrated in the U. S. Patent No. 1,343,308, dated June 15, 1920, to J. R. Carson. Included in the input circuits of the demodulators are the band filters  $F_2$ ,  $F_4$ ,  $F_6$  and  $F_8$ , adapted to readily transmit bands of frequencies respectively such as those from the sources D, C, B and A and to attenuate and extinguish frequencies outside of said bands. The output circuits of the demodulators are associated with the lines 1, 2, 3 and 4, by means of the hybrid windings 17, 18, 19 and 20, conductors 5, 6, 7 and 8, and over the contacts of the series of relays, such as relays 13, 14, 15 and 16, and relays 9, 10, 11, and 12. The operation of the series of relays, such as relays 9, 10, 11 and 12, and relays 13, 14, 15 and 16, is controlled by the printing telegraph transmitter 36, the contacts 39 and 40 of which are controlled by a perforated key tape, not shown. Associated with the tape transmitter is the distributor 29 for timing the sequence of operation of the arrangements. The distributor 29 is associated with a relay 26 and the pole changing apparatus 25, which in turn is associated with the usual type of composite set 23 associated with the line L. Associated with composite set 23 is the low pass filter  $F_{10}$  which readily allows the transmission of the low frequency currents, such as the telegraph currents and the currents from the pole changing apparatus 25, but which shuts out the high frequency carrier currents.

Operation of the sending arrangements of the invention is as follows:

The perforated key tape will be inserted in the tape transmitter 36 and the key K thrown. The throwing of key K will close a circuit for the relay 30. This will release the latch and allow the brush of the distributor to start rotating. When the brush of the distributor crosses segment 31, the following circuit will be closed; from ground, brush of distributor, segment 31, conductor 28, winding of relay 26, to battery and ground. This will operate relay 26 which controls the pole changer 25, whereby impulses of either polarity may be transmitted over the line L to the distant station to control a distributor thereat, to time the sequence of operation of the receiving arrangements as will be pointed out later. When the brush of the distributor crosses segment 32, a circuit will be closed over conductor 34, magnet 35, to battery and ground, thereby operating magnet 35. The operation of magnet 35 will allow the contacts 39 and 40 of the

transmitter to be pulled down and will step the perforated key tape ahead. When the brush passes off of segment 32 the magnet 35 will be released and the contacts of the transmitter will be pressed against the key tape. If there are no holes in the perforated key tape, the contacts 39 and 40 will remain open as shown. Under such conditions none of the relays 9, 10, 11 and 12, or the relays 13, 14, 15 and 16, will be operated. Under these conditions, line 1 will be connected to the modulator  $M_A$  over the back contacts of relays 9 and 13, over conductors 5, and through hybrid coil 17. The line 2 will be connected to the modulator  $M_B$  over the back contacts of relays 10 and 14, conductors 6 and the hybrid coil 18. Line 3 will be connected to the modulator  $M_C$  over the back contacts of relays 11 and 15, conductors 7 and the hybrid coil 19. Line 4 will be connected to the modulator  $M_D$  over the back contacts of relays 12 and 16, conductors 8 and the hybrid coil 20. It is pointed out that under such conditions the low frequency signals from the lines 1, 2, 3, and 4 will be impressed on different high frequency waves from the sources A, B, C, and D, and will then be transmitted out over the line L in a well known manner. When the brush of the distributor crosses segment 33, a circuit will be closed over conductor 37 and through the winding of relay 38, to battery and ground, thereby energizing relay 38. However this will have no effect at this time as neither of the contacts 39 and 40 were operated and none of the relays 9, 10, 11, and 12 and 13, 14, 15, and 16 were previously operated. When the brush of the distributor again crosses segment 31, the relay 26 and the pole changing device 25 will operate as previously pointed out to transmit an impulse to the distributor at the receiving station. When the brush now crosses segment 32, the magnet 35 will again be operated and will pull down the contacts and will step the key tape ahead. For purposes of illustration let us assume that the perforations in the tape are now so arranged that contact 39 may be closed and contact 40 may remain open when the brush now leaves segment 32 and the magnet 35 is again released. When the brush now crosses segment 33, the relay 38 will be operated. The operation of relay 38 and the contact 39 will close the following circuit; from ground and battery, through the windings in series of the relays 16, 15, 14, 13, and 41, conductor 43, contact 39, conductor 50, armature and contact of relay 38, to ground. The closing of this circuit will operate the relays 16, 15, 14, 13, and 41. When the brush passes off of segment 33, the relay 38 will be released. However, the relays 13, 14, 15, and 16, and the relay 41 will remain locked up as a locking circuit will be closed over the contact and armature of relay 41, conductor 51, break contact of



relay 38, to ground. With the relays 13, 14, 15, and 16 operated, the line 1 will now be associated with the modulator  $M_C$  over the back contacts of relay 9 front contacts of relay 13, conductor 7 and hybrid coil 19. The line 2 will be associated with the modulator  $M_D$  over the back contacts of relay 10 front contacts of relay 14, conductor 8, winding of hybrid coil 20. The line 3 will be associated with the modulator  $M_A$  over the back contacts of relay 11 and front contacts of relay 15, conductors 5 and hybrid coil 17. The line 4 will be associated with the modulator  $M_B$  over the back contacts of relay 12 front contacts of relay 16, conductors 6 and winding of hybrid coil 18. When the brush again crosses segment 31, the pole changing apparatus 25 will again transmit an impulse to the distributor at the receiving station. When the brush now crosses segment 32, the magnet 35 will again be operated and present a new set of perforations to the contacts 39 and 40. Assume for purposes of illustration that the perforations of the key tape are this time so arranged that contact 40 will be closed and contact 39 will remain open. Accordingly when the brush now crosses segment 33 and again operates relay 38, the following circuit will be closed; from ground and battery through the windings in series of the relays 12, 11, 10, 9, and 42, conductor 44, contact 40, conductor 52, armature and contact of relay 38, to ground. This will operate the relays 12, 11, 10, 9, and 42. When the brush passes off of segment 33 and releases relay 38, a locking circuit will be closed over the contact and armature of relay 42, conductor 53, break contact of relay 38 to ground, and will thereby maintain the relays 42, 9, 10, 11 and 12 in an energized condition. It is pointed out that with the relays 9, 10, 11 and 12 operated, and the relays 13, 14, 15 and 16 unoperated, that the line 1 will be associated with the modulator  $M_B$  over the back contacts of relay 10, front contacts of relay 14, conductors 6, and winding of hybrid coil 18. The line 2 will be associated with the modulator  $M_C$  over the front contacts of relay 11, back contacts of relay 15, conductors 7, and winding of hybrid coil 19. The line 3 will be associated with the modulator  $M_D$  over the front contacts of relay 12, back contacts of relay 16, conductor 8, and hybrid coil 20. The line 4 will be associated with the modulator  $M_A$  over the front contacts of relay 9, back contacts of relay 13, conductors 5, and hybrid coil 17. It is pointed out that if the perforations in the key tape were such that both the contacts 39 and 40 should be operated, and both sets of relays such as the relays 9, 10, 11 and 12, and the relays 13, 14, 15 and 16 should be operated that under such conditions the line 1 would be associated with the modulator  $M_D$  over the front contacts of relays 10 and 14,

conductors 8, and hybrid coil 20. Line 2 would be associated with the modulator  $M_A$  over front contacts of relays 11 and 15, conductors 5, and the hybrid coil 17. The line 3 would be associated with the modulator  $M_B$  over the front contacts of relays 12 and 16, conductors 6, and winding of hybrid coil 18. Line 4 would be associated with the modulator  $M_C$  over the front contacts of relays 9 and 13, conductors 7, and the hybrid coil 19.

It will be seen that the low frequency signaling channels 1, 2, 3 and 4 may thus be superimposed on the different high frequency channels A, B, C and D, under the control of the key tape. In other words when there are no perforations in the key tape the channels 1, 2, 3 and 4 will be superimposed on the channels A, B, C, D respectively. When there is one perforation in the key tape, such that contact 39 will be closed, channels 1, 2, 3 and 4 will be superimposed on channels O, D, A and B respectively. When the perforations of the key tape are such that the other contact, such as contact 40 is closed, the channels 1, 2, 3 and 4 will be superimposed on the channels B, C, D and A respectively. When the perforations are such that both of the contacts are closed, the channels 1, 2, 3, and 4 will be superimposed on the channels D, A, B and C respectively. Accordingly fragments of each of the low frequency messages may be superimposed at will on different high frequency channels in a variable and random manner as controlled by the perforations of a key tape, so that anyone who might have access to the medium through or over which messages were being transmitted, and who might have a receiving instrument tuned to the respective high frequencies utilized, would only receive fragments of such messages, and these fragments would be so scrambled by the arrangements of this invention that they would be utterly unintelligible. While the arrangements of this invention have been shown as operating with four low frequency channels and four high frequency channels, it is pointed out that the arrangements are illustrative only and that by increasing the number of contacts, such as 39 and 40, the number of perforations of the key tape, and the series of relays, such as 9, 10, 11 and 12, and 13, 14, 15 and 16, that the invention is capable of operating with more or less low and high frequency channels as desired.

The receiving arrangements consist of a distributor 29' and a tape transmitter 36' substantially similar to the distributor and tape transmitter used for sending. A relay 77 is provided which controls the latch whereby the distributor 29' may be started in operation. The relay 77 is included in a circuit over the contacts of a polar relay 76, which would in turn be connected to the transmission line L through the composite



set 23 as shown. The polar relay 76 is controlled by the impulses sent over the line L from a pole changer, similar to 25, at the distant station, which, as has been pointed out, is controlled by the distributor thereat. It is pointed out that the relay 76 of the receiving system is connected to the upper side of line L. The pole changer at the distant station which controls relay 76 would also be connected to the upper side of line L. The pole changer 25 is herein illustrated as connected to the lower side of line L, and it is understood that the receiving relay at the distant station would also be connected to the lower side of line L. With this arrangement there will be no interference between the pole changer and receiving relay at the same station. The distributor 29' will be used to control a tape transmitter 36', the contacts 39' and 40' of which will be wired similar to contacts 39 and 40 to control the relays, 9, 10, 11 and 12 and 13, 14, 15 and 16. Segment 33' of distributor 29' will, in a manner similar to segment 33 of distributor 29, be utilized to control relay 38. The key tape utilized at the receiving station will be similar to the one used at the sending station and will be inserted in the transmitter 36' in the same position with respect to its perforations as the key tape at the sending station. Accordingly when the perforations in the key tape at the distant sending station so control the arrangements that the low frequency channels similar to 1, 2, 3, and 4 are superimposed on the high frequency waves A, B, C and D respectively, as has been pointed out, the distributor 29' and transmitter 36' together with the key tape thereat will control the receiving arrangements so that the low frequency receiving channels 1, 2, 3 and 4, will be simultaneously connected with the demodulators associated with the high frequency waves A, B, C and D. When the low frequency channels at the transmitting station are now shifted to other of the high frequency waves a similar shifting will take place in the connection of the low frequency receiving channels with the demodulating arrangements at the receiving station.

It is pointed out furthermore that while the arrangements of the invention have been specifically shown as associated with a transmission line, such as L, that the messages might equally well be transmitted by wireless apparatus. In such event it would be desirable to substitute for the pole changing device 25, other apparatus and a separate radio frequency for maintaining synchronous operation between the distributors at the sending and receiving stations.

While the arrangements have been disclosed in certain specific arrangements which have been 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. A transmission system in which a plurality of high frequency channels are provided as the agency for transmitting low frequency messages over said system, an equal number of low frequency signaling lines, each of said low frequency lines being associated with one of said high frequency channels, and means for shifting in a random and variable manner each of said low frequency lines from the high frequency channel associated therewith to a high frequency channel previously associated with another of said low frequency lines.

2. A transmission system in which a plurality of high frequency channels are provided as the agency for transmitting low frequency messages over said system, a plurality of low frequency signaling lines, each of said low frequency lines being associated with one of said high frequency channels, a key tape, and means controlled by said key tape for shifting each of said low frequency lines to other of said high frequency channels.

3. A transmission system over which a plurality of low message frequencies may be simultaneously transmitted on different carrier frequencies, a printing telegraph transmitter, and means controlled thereby for changing the relations between said low message frequencies and said carrier frequencies over which said low message frequencies were previously transmitted so that said low message frequencies will be transmitted over different ones of said carrier frequencies than previously.

4. A sending station, a plurality of modulating devices thereat with which are associated different high frequency carrier currents, a plurality of low frequency transmitting circuits associated with said modulating devices, a printing telegraph transmitter, and means controlled thereby for changing the relation of said low frequency transmitting circuits with said modulating devices.

5. A sending station including a plurality of modulating devices with which are associated different high frequency carrier currents, a plurality of low frequency transmitting circuits associated with said modulating devices, a printing telegraph transmitter, means controlled thereby for changing the relation of said low frequency transmitting circuits with said modulating devices, and a receiving station including a plurality of demodulating devices with which are associated different high frequency currents of the same frequencies as said carrier currents at said sending station, a plurality of low frequency receiving cir-



uits associated with said demodulating devices, a printing telegraph transmitter operating synchronously with the transmitter at said sending station, and means controlled thereby for maintaining a change in the relationship between said low frequency receiving circuits and said demodulating devices similar to the changes in relation-

ship between said low frequency transmitting circuits and said modulating devices. 10

In testimony whereof, we have signed our names to this specification December 1, 1920, December 16, 1920, December 1, 1920.

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