June 4, 1946. W. B. MARTIN 2,401,494

SECRET SIGNALING SYSTEM

Filed Feb. 25, 1944 2 Sheets-Sheet 1

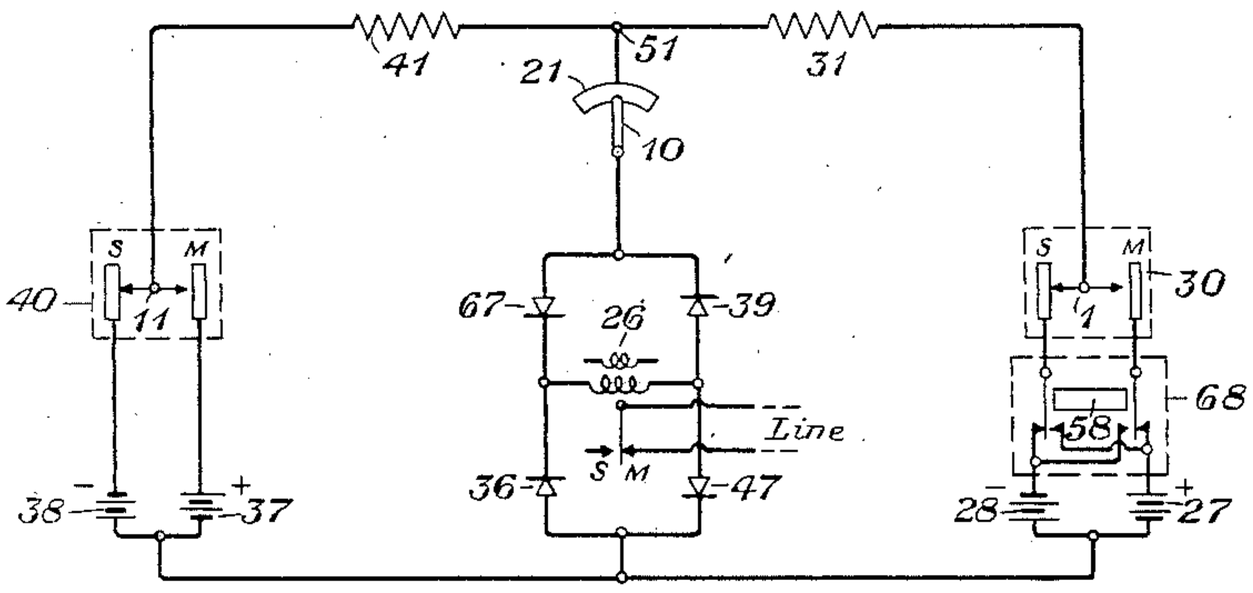

Fig. 1

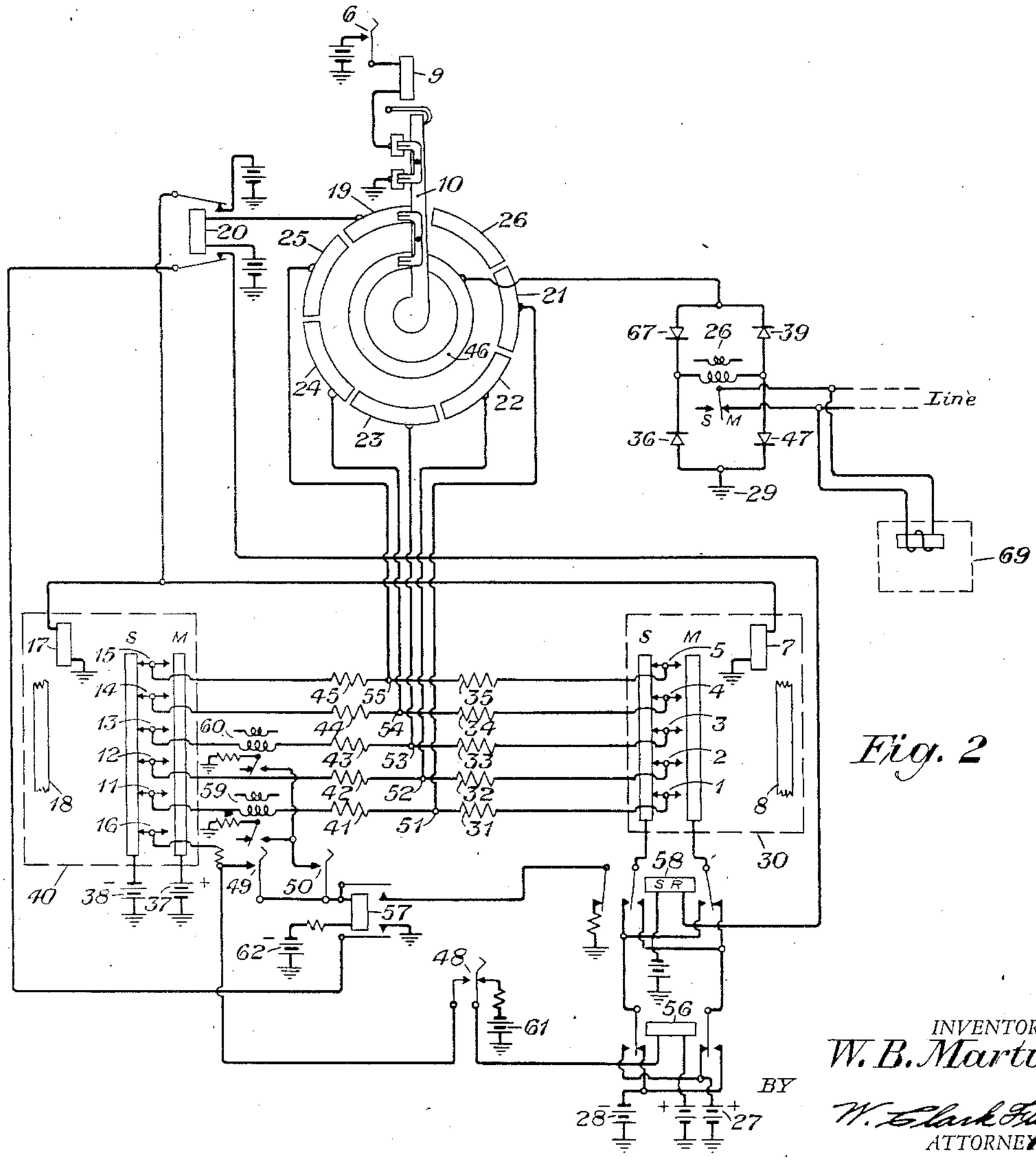

Fig. 2

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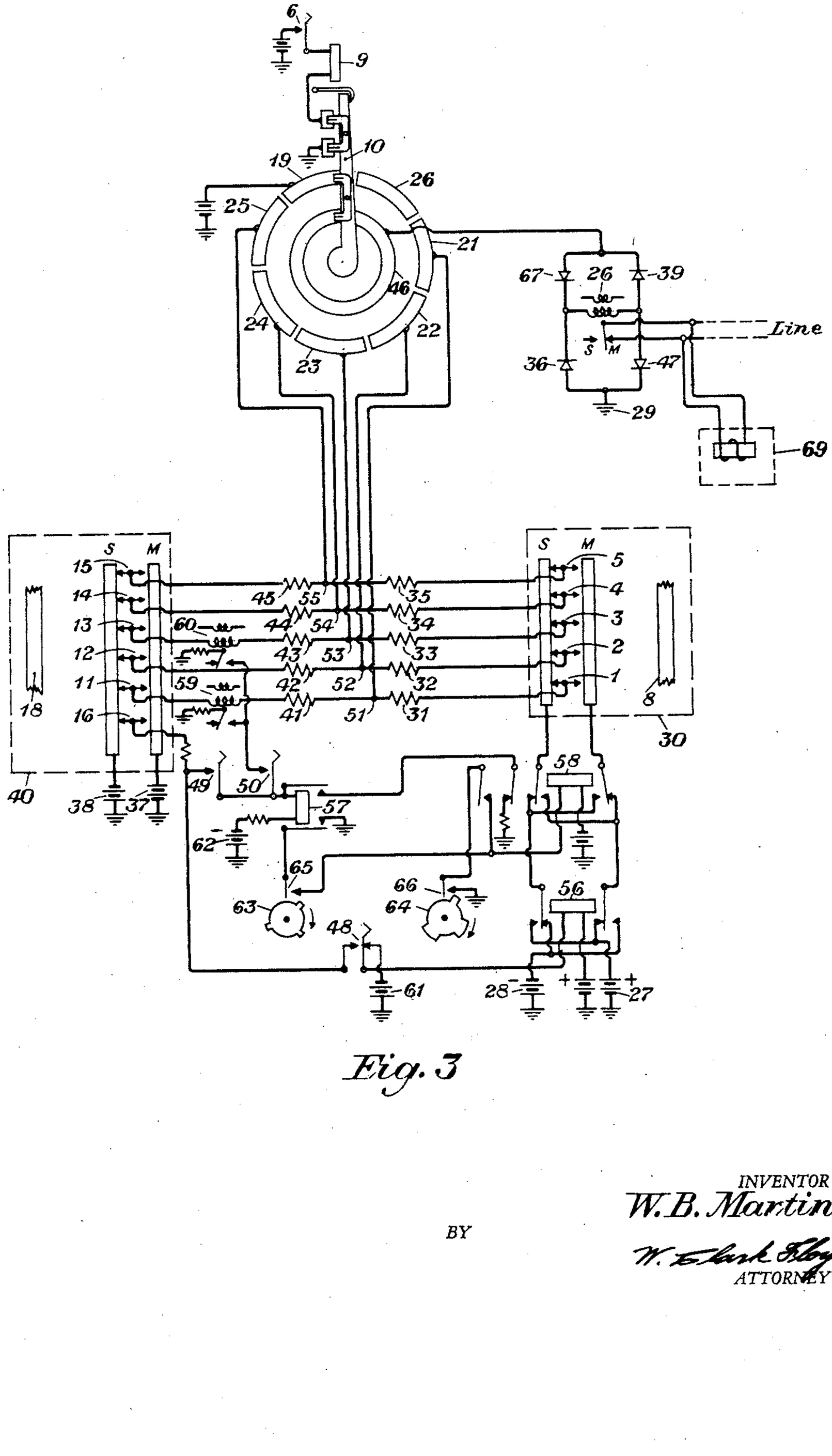

Fig. 3

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Patented June 4, 1946 2,401,494

UNITED STATES PATENT OFFICE

2,401,494

SECRET SIGNALING SYSTEM

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Application February 25, 1944, Serial No. 523,795

18 Claims. (Cl. 178—22)

This invention relates to electrical communication systems and more particularly to telegraph secrecy systems of the type wherein the code combinations representing the characters of the true message and of a secret code are in effect combined to form the enciphered message and wherein the enciphered message is deciphered by combining in a similar manner the code combinations representing its characters with those representing the characters of the same secret code.

In printing telegraph systems of this type, a tape on which are perforated the code combinations of the true message and a tape on which are perforated the code combinations of the secret code, preferably in the form of a jumble of characters, are run simultaneously and in synchronism through two tape transmitters. Generally, the polarity of the potential impressed on the corresponding contact of the two transmitters in accordance with the code combinations above the sensing pins thereof determines whether the respective signals forming the code combination representing each character of the enciphered message are marking or spacing signals. For example, a system may be so designed that a marking signal is transmitted over the line whenever potentials of opposite polarity are impressed on the corresponding contacts of the two transmitters and a spacing signal whenever potentials of the same polarity are impressed thereon. To effect this the systems heretofore developed employed a series of "cipher relays", one connected in series between each pair of the corresponding contacts of the cipher and the message transmitters. When potentials of the same polarity were impressed on both the contacts of a pair, the cipher relay connected in series therewith would remain unoperated and a spacing signal would be transmitted. When potentials of opposite polarities were impressed on said contacts, the cipher relay would operate and cause a potential to be impressed on the corresponding segment of the distributor so that a marking signal would be transmitted.

In telegraph secrecy systems in general, the less frequently the same series of conditions occur which determine the characters of the enciphered message or the greater the number of factors determining said characters, the more difficult it becomes for an unauthorized person to decipher the enciphered message. For example, if each code combination perforated on the key tape were the same, the message could be deciphered with little difficulty whereas if such code combinations were all different and hence never repeated, it would be impossible to decipher the message. To increase the difficulty of deciphering by an unauthorized person the systems of the past employed a plurality of cipher transmitters, cipher relays and key tapes. In these systems the code combinations in two of the cipher transmitters were combined and the resulting combination was then combined with the code combination in another cipher transmitter, and so on, the final such combination being combined with the code combination in the message transmitter.

One of the objects of the present invention is to provide a simple and inexpensive but highly efficient telegraph secrecy system of the general type described above in which the code combinations are combined in an improved manner without the necessity of employing cipher relays. Another object is to provide such a system in which only a single enciphering operation is necessary to make the unauthorized deciphering of the message well-nigh impossible. Other objects of the invention will become apparent from the description hereinafter following.

Figure 1 of the drawings is a simplified schematic illustration of the invention as applied to the transmitting or enciphering end of a printing telegraph system; Figs. 2 and 3 illustrate schematically and more in detail particular embodiments of the invention as applied to such a system.

Upon comparing Fig. 1 with Figs. 2 and 3 it will be seen that, for the cake of simplicity, there is shown in Fig. 1 the apparatus and circuits for combining only the first impulse of the respective code combinations above the sensing pins of the cipher and message transmitters. As shown, contact 1 of message transmitter 30 and contact 11 of cipher transmitter 40 are connected at juncture point 51 to each other and to the lead extending to distributor segment 21 and line relay 26. Resistances 31 and 41 are of equal magnitude and are connected at points intermediate juncture point 51 and contacts 1 and 11, respectively. It can be seen, therefore, that the arrangement constitutes a balanced circuit arrangement with one of the balanced arms or branches including the contact of the message transmitter and its associated resistance 31 and potential sources 27 and 28, with the other balanced arm or branch including the contact of the cipher transmitter and its associated resistance 41 and potential sources 37 and 38, and with the line relay bridged across said arms or branches at their juncture points. When potentials of the same polarity are impressed on said contacts (e. g., when both said contacts are against their spacing or their marking bus bars), currents of equal magnitude flow through said arms, combine at the juncture point of the arms and flow in the same direction through the operating winding of the line relay to cause a marking signal to be transmitted over the line.

When potentials of opposite polarity are impressed on said contacts (e. g., when the contact of the cipher transmitter is against its marking bus bar and that of the message transmitter is against its spacing bus bar or vice versa), the juncture points of said arms between which points the line relay is bridged are of equal potentials and no current flows through said relay, with the result that a spacing signal is transmitted.

The rectifier network associated with the line relay and including rectifiers 67, 39, 36 and 47 is so arranged as to cause the current impulses to flow only in one direction through the operating winding of said relay regardless of the polarity of the potential impressed on distributor segment 21 and thus permits the use of a biased polar relay as the line relay. The polarity reversing apparatus is shown schematically at 68. As will be described more fully in connection with Figs. 2 and 3, this apparatus is controlled by the code combinations of the secret code or jointly by such code combinations and those of the message being enciphered and serves to multiply the factors which determine the characters of the enciphered message, and hence to increase the difficulty of any unauthorized deciphering thereof.

In Fig. 2 the message transmitter is indicated at 30, the message tape at 8, the cipher transmitter at 40, and the key tape at 18. Receiving apparatus, which may be a reperforator or a printer, is shown schematically at 69. Its function is to make a record of the enciphered message at the transmitting station. In the manner described in connection with Fig. 1, contacts 1—5 of the message transmitter are connected at juncture points 51—55 with contacts 11—15 of the cipher transmitter. The magnitude of the resistance in each of the arms to the left of the juncture points is equal to that in each of the arms to the right thereof. During each revolution of distributor arm 10, line relay 26 is adapted to be connected successively through said arm and distributor segments 21—25 to each of said juncture points. As can be seen the circuit of each pair of corresponding contacts is fundamentally the same as that shown in Fig. 1.

As shown in Fig. 2, a six-pulse transmitter is employed as cipher transmitter 40. Where such a transmitter is used a sixth perforation is added to certain of the code combintaions on key tape 18 and the impulses resulting therefrom are employed to reverse the polarity of the potentials impressed on the bus bars of message transmitter 30. While the use of a six-pulse transmitter and key tape is not necessarily essential to the invention it is advantageous in that it introduces an additional factor in the enciphering operation and increases the number of possible code combinations in the key tape. When switch 48 is operated to its left contact, the reversal occurs as soon as the sensing pins are presented if the sixth impulse is marking, and the change in the enciphering operation becomes effective with respect to the code combinations then above the sensing pins of the two transmitters. When switch 49 is operated, the reversal does not occur until after the combined signal resulting from the code combinations then above the sensing pins has been transmitted and hence a change in the enciphering operation becomes effective with respect to the next succeeding code combinations rather than with respect to those then above the sensing pins.

Relays such as those indicated at 59 and 60 may also be employed to introduce additional factors in the enciphering operation and increase the difficulty of any unauthorized deciphering of the enciphered message. When switch 50 is operated, the operation of either of these relays causes a reversal of the polarity of the potentials impressed on the bus bars of the message transmitter. The operation of the relays, and hence the occurrence of the reversals, is dependent upon the coincidence of certain characteristics of certain impulses of the code combinations of both the secret code and the message to be enciphered. For example, if the first impulses of a cipher code combination and of a message code combination are both marking impulses (i. e., of positive polarity), relay 59 operates against its right contact and sets the polarity reversing apparatus into operation. Substantially the same result follows when said cipher impulse is marking and said message impulse is spacing (i. e., of positive and negative polarities, respectively). Similar results follow upon the coincidence of the same condition with respect to the third impulses of said code combinations and may be caused to follow upon the coincidence of the same conditions with respect to other such impulses by associating such relays with other contacts. Since the occurrence of the reversals depend not only on the cipher code but also on the message to be enciphered and since each reversal introduces changes in the enciphering operation to produce an enciphered character different from that which would normally be produced, the determination of the cipher code from the enciphered message is wellnigh impossible.

The operation of the system will now be described in detail. Let it be supposed that the code combination representing the letter M (i. e., S—S—M—M—M or − − + + +) is above the sensing pins of message transmitter 30 and that representing the letter S (i. e., M—S—M—S—S or + − + − −) is above the sensing pins of cipher transmitter 40. The closure of switch 6 to set the system into operation causes the operation of relay 9 and the release of distributor arm 10 in the well known manner. As arm 10 moves off stop segment 19 and onto start segment 26, relay 20 releases, line relay 26 operates to its spacing contact to transmit a spacing signal over the line and the sensing pins of the transmitters are presented. The release of relay 20 causes the release of individual tape stepping magnets 7 and 17. When the sensing pins are presented, the potentials impressed on contacts 1 to 5 of the message transmitter becomes − − + + +, respectively, and those impressed on contacts 11 to 15 of the cipher transmitter become + − + − −, respectively. Equal and unlike potentials are impressed on juncture points 51, 54 and 55 while equal and like potentials are impressed on juncture points 52 and 53. As a result, zero potentials are impressed on segments 21, 24 and 25, while a negative potential is impressed on segment 22 and a positive potential on segment 23. As arm 10 moves over segment 21, the armature of line relay 26 remains on its spacing contact since during said interval its operating winding is connected between points of equal potential on the circuit including grounded battery 37, contact 11, resistances 41 and 31, contact 1 and grounded battery 28. Substantially the same thing occurs as arm 10 moves over segments 24 and 25. As a result a spacing signal is transmitted over the line during each such interval. As arm 10 moves over segment 22 on which a negative potential is impressed, current is established from ground 29,

through rectifier 36, the operating winding of line relay 26, rectifier 39, distributor ring 46, segment 22 to juncture point 52, and thence through resistances 32 and 42, contacts 2 and 12 to grounded batteries 28 and 38. As a result, line relay 26 operates to its marking contact and transmits a marking impulse over the line. As arm 10 moves over segment 23 on which a positive potential is impressed, current is established through grounded batteries 27 and 37, through contacts 3 and 13, resistances 33 and 43, juncture point 53, segment 23, distributor arm 10, distributor ring 46, rectifier 67, the operating winding of line relay 26, rectifier 47 to ground 29. As a result the line relay operates to its marking contact and transmits a marking impulse over the line. As arm 10 moves to stop segment 19 and comes to rest at the end of its revolution, the sensing pins are withdrawn and relay 20 reoperates. Upon the withdrawal of the sensing pins, the potentials impressed on all the contacts of both transmitters again become negative. The re-operation of relay 20 causes the operation of stepping magnets 7 and 17 to advance both tapes. As can be seen from the above described cycle of operations, a code combination comprising a spacing impulse, two successive marking impulses and two successive spacing impulses, or the letter I, is transmitted over the line.

When the system is operated with switch 48 on its left contact, battery 38 is substituted for battery 61 in the circuit of relay 56. Since it is of the same polarity, relay 56 remains unoperated. If the sixth impulse of the cipher character is marking, battery 37 will be substituted for battery 38 as soon as arm 10 moves to the start segment and the sensing pins are presented. Relay 56 operates immediately and reverses the polarity of the potentials impressed on the bus bars of the message transmitter. The method of operation of the system in transmitting the code combinations above the sensing pins is the same as before, except that due to the reversed polarities impressed on the bus bars of the message transmitter, "reversed" signals will be transmitted over the line, i. e., like impulses will result in a spacing signal being transmitted and unlike impulses will result in a marking signal. If the code combination representing the letter M (i. e., S—S—M—M—M) is above the sensing pins of the message transmitter, positive potential will be impressed on contacts 1 and 2 and negative potential on contacts 3 to 5, and if the code combination representing the letter S (i. e., M—S—M—S—S) is above the sensing pins of the cipher transmitter, positive potential will be impressed on contacts 11 and 13, and negative potential on contacts 12, 14 and 15 as before. As a result, positive potential will be impressed on segment 21, negative potential on segments 24 and 25, and zero potential on segments 22 and 23. Consequently, the transmitted combination will be M—S—S—M—M or the letter B, instead of S—M—M—S—S or the letter I as before.

When the system is operated with switch 49 closed, battery 38 is connected to relay 57 and, battery 62 being connected to the other terminal of the relay, it will remain unoperated. If the sixth impulse of the cipher character is marking, relay 57 will operate and lock up over its upper armature and contact and the outer left armature and rear contact of relay 58 when the sensing pins are presented, i. e., when arm 10 moves to the start segment. The operation of relay 57 also connects ground to its lower armature, which merely prepares the operating circuit of relay 58 since at this time arm 10 has moved off the stop segment and caused the release of relay 20 which opens said operating circuit at its lower armature and contact. Hence no polarity reversal occurs until arm 10 rotates to the stop segment, and during this revolution "normally combined" signals will be transmitted over the line, i. e., like impulses in the cipher and message characters will cause the transmission of marking signals and unlike impulses will cause the transmission of spacing signals. In other words, if the code combinations representing the letters M and S are above the sensing pins of the message and cipher transmitters, respectively, the code combination representing the letter I will be transmitted. When arm 10 moves to the stop segment at the end of this revolution, the sensing pins are withdrawn and relay 20 operates. The later relay at its lower armature and contact closes the operating circuit of relay 58 and at its upper armature and contact closes the operating circuit of tape stepping magnets 7 and 17 to advance the tape. The operation of relay 58 reverses the polarity of the voltage impressed on the bus bars of the message transmitter and since said relay is a slow release relay adapted to remain operated for approximately one revolution of the distributor, the reversed polarity remains impressed on said bus bars during the transmission of the signals of the next character. The operation of relay 58 also opens the locking circuit of relay 57, which releases. When the distributor arm sweeps over the segments during the transmission of the next character, "reversed" signals will be transmitted over the line. In other words, if the code combinations above the sensing pins are again those representing the letters M and S, the transmitted signals this time will be M—S—S—M—M, i. e., those representing the letter B. When arm 10 leaves segment 25 the sensing pins are withdrawn, which releases relay 57 in case it is operated—as it would be if the sixth impulse of this next code combination were marking. When the distributor arm reaches stop segment 19, relay 20 operates and causes stepping magnets 7 and 17 to advance the tape as before. At the same time relay 58, since its operating circuit has been opened at the lower armature and contact of the relay 57, releases and restores the polarity of the potentials on the bus bar of the message transmitter 30 to normal. It can be seen from the above description of the operation of the system that when the sixth impulse of a cipher character is marking, the transmitted signals resulting from the combination of the cipher and message characters then above the sensing pins are "normally combined" signals, that the transmitted signals resulting from the next succeeding combination will be "reversed" signals, and that the transmitted signals resulting from the third combination following that in which the sixth impulse is marking will again be "normally combined" signals regardless of whether the sixth impulse of the second combination is marking or spacing.

When the system is operated with switch 50 closed, the operation of the system is very similar to its operation when switch 49 is closed. In this case, if contacts 11 and 1 or contacts 13 and 3 are marking and spacing, respectively, relay 59 or relay 60 operates to its right contact when the sensing pins are presented and causes the operation of relay 57 which locks up as before.

At the end of this revolution of the distributor arm relay 58 operates to reverse the polarity of the potentials on the bus bars of the message transmitter and keeps it reversed during the next succeeding revolution, at the end of which said relay releases and restores the polarity to normal. If contacts 11 and 1 or 13 and 3 are both marking, the operation is the same except that relay 59 or 60 operates and causes relay 57 to operate and lock up when arm 10 passes over segment 21 or 23 rather than when the sensing pins are presented.

Relays such as 59 and 60 may be associated, as desired, with any one or any combination of contacts of the cipher transmitter or the message transmitter or of both. Likewise the operating circuit of relay 57 may be associated with any two or more such relays in such manner that it will operate and lock up only when certain predetermined combinations of such relays as 59 and 60 are operated.

Fig. 3 shows a system in which relay 58 is an ordinary rather than a slow release relay and is controlled in its operation by a pair of cams 63 and 64 which rotate in synchronism with arm 10. With an arrangement such as that shown in this embodiment, predetermined combinations of cipher and message characters may cause the reversal of the polarities of the potentials on the bus bars of the message transmitter during the same revolution of the distributor arm required to transmit the code combination resulting from said predetermined combinations (in contradistinction to causing the reversal at the beginning of the next succeeding revolution) and may also cause several reversals during each such revolution.

For the purpose of illustration, the cams are shown as being so constructed and positioned and relays 59 and 60 are shown as being associated with such contacts that the second and fourth signals of the transmitted code combination will be "reversed" signals, while the other transmitted signals will be "normally combined" signals.

When the system is operated with switch 49 closed and when the sixth impulse of the cipher character above the sensing pins is marking, relay 57 operates and locks up when the sensing pins are presented, i. e., when arm 10 moves from stop segment 19 to start segment 26. The operation of relay 57 prepares, at its lower armature and contact, the operating circuit of relay 58. As arm 10 moves over segment 21, the transmitted signal will be a "normally combined" signal. As arm 10 moves from segment 21 to segment 22, the raised portions of cams 63 and 64 close contacts 65 and 66, the former closing the operating circuit of relay 58 and the latter preparing its locking circuit. Relay 58, in operating, reverses the polarity of the voltage impressed on the bus bars of the message transmitter and locks itself up through its outer left armature and contact and contact 66. This also opens the locking circuit of relay 57 but it remains operated due to the fact that contact 16 remains against its marking bus bar. When arm 10 reaches segment 22, the raised portion of cam 63 moves from under contact 65 and permits it to open. The raised portion of cam 64, however, keeps contact 66 closed and relay 58 operated during the entire time required for arm 10 to pass over segment 22. Hence the second transmitted signal will be a "reversed" signal. As arm 10 moves from segment 22 to segment 23, the raised portion of cam 64 passes from under contact 66 and opens the

locking circuit of relay 58. Contact 65 being open at this time, relay 58 releases and restores the polarities of the potentials on the bus bars of the message transmitter to normal. As arm 10 moves from its last-mentioned position to the end of segment 25, a "normally combined" signal, a "reversed" signal and a "normally combined" signal are successively transmitted in the manner described above. As arm 10 moves from segment 25 to stop segment 19, the sensing pins are withdrawn and the third raised portions of the cams cause relay 58 to operate and lock up, which in turn causes relay 57 to release. Due to the shortness of the third raised portion of cam 64, contact 66 opens and relay 58 releases when arm 10 passes over approximately one-half of segment 19 and thus restores the apparatus to its initial condition. If during the above described cycle of operations the code combinations representing the letters M and S had been above the sensing pins of the message and cipher transmitters, respectively, the transmitted signal would have been S—S—M—M—S or the letter N.

When the system is operated with switch 50 closed and when contacts 11 and 1 or 13 and 3 are marking and spacing, respectively, or when both of said pairs of contacts are marking and spacing, respectively, the operation is the same as that described in the preceding paragraph due to the operation of relay 59 or 60 or both. If contacts 11 and 1 are both marking, only one reversal will occur and only the second transmitted signal will be a "reversed" signal. In the latter case relay 57 does not operate and lock up until arm 10 passes onto segment 21. As said arm rotates from this segment to segment 22, the cams close contacts 65 and 66 as before and cause the operation of relay 58, which in turn reverses the polarity, locks itself up and opens the locking circuit of relay 57. The latter relay releases and remains released during the remainder of the revolution of arm 10. Relay 58 remains operated until said arm leaves segment 22 when it releases due to the opening of contact 66 by cam 64. If in this case the characters representing the letters B (i. e., M—S—S—M—M) and S (i. e., M—S—M—S—S) should be above the sensing pins of the message and cipher transmitters, respectively, the transmitted signal would be M—S—S—S—S or the letter E, whereas if switch 50 had not been operated the transmitted signal would have been M—M—S—S—S or the letter A.

With switch 50 operated and contacts 13 and 3 both marking, the operation is the same as that described above with contacts 11 and 1 both marking, except that the above described operation and release of relays 57 and 58 occur when arm 10 passes over segments 23 and 24 which causes only the fourth transmitted signal to be a reversed signal. If in this case the characters representing the letters M and S are above the sensing pins of the message and cipher transmitters, respectively, the transmitted signal would be S—M—M—M—S or the letter C.

The enciphered message may be received at the receiving station on a re-perforator of any known type and then deciphered by combining it with the secret code by means of apparatus similar to that shown in Figs. 2 and 3. In such case, the tape bearing the enciphered message and the key tape would be run simultaneously and in synchronism through tape transmitters such as 30 and 40, respectively, and the combined signals (which would be the signals of the true message) received on a local printer or re-perforator such

as that shown at 69 rather than transmitted out over a line circuit. The enciphered message may also be received and deciphered at the receiving station in one operation by means of apparatus similar to that shown in Figs. 2 and 3. In this case, the selecting magnets of the receiving apparatus, rather than the perforations in the tape, would be caused to control the polarities impressed on the leads of contacts 1 to 5. In the latter case, the apparatus at the receiving station would, of course, be operated in synchronism with that at the transmitting station.

Although it is advantageous that the enciphering operation be accomplished in a single operation, the invention is not necessarily so limited. In other words, the method disclosed of combining the code combinations is applicable to systems employing a plurality of ciper transmitters and key tapes in which the code combinations in two the cipher transmitters are combined and the resulting combination then combined with the code combination in another cipher transmitter and so on, the final such combination being combined with the code combination in the message transmitter. Likewise, the invention is applicable to either wire or wireless transmission or to transmission through any known medium. In short, it will be obvious that it may be embodied in various forms and types of systems without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In an electrical signaling system, in combination, a transmitter, including a plurality of selecting elements, for transmitting electrical characters representing a message, a second transmitter, including a plurality of selecting elements corresponding to those of the message transmitter, for transmitting electrical characters representing a secret code, means for impressing potentials having different characteristics on the selecting elements of said transmitters in accordance with the message and the secret code, a circuit individually interconnecting each pair of the corresponding selecting elements of said transmitters and said potential means and including two balanced arms, current responsive means adapted to be associated with said circuits, and means for bridging said current responsive means successively across said circuits between the juncture points of said balanced arms during the transmission of the message and the secret code to cause said current responsive means to transmit signals of a character depending upon the coincidence of potentials of like characteristics and the coincidence of potentials of unlike characteristics at said juncture points.

2. In an electrical signaling system, in combination, a transmitter, including a plurality of selecting elements, for transmitting electrical characters representing a message, a second transmitter, including a plurality of selecting elements corresponding to those of the message transmitter, for transmitting electrical characters representing a secret code, a pair of interconnected leads connected to each pair of the corresponding selecting elements of said transmitters, means for impressing potentials of like characteristics and of unlike characteristics on the juncture points of said leads in accordance with the message and the secret code, current responsive means adapted to transmit signals, means for causing said current responsive means

to successively transmit signals of a character dependent upon the coincidence of potentials of like characteristics and the coincidence of potentials of unlike characteristics on the respective juncture points of said leads, and means controlled by predetermined characteristics of the secret code for altering the characteristics of the potentials normally impressed on said juncture points in accordance with the message.

3. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combinations of the true message and of a secret code, means for impressing on the contacts of said transmitters potentials of polarities determined by the code combinations of the message and secret codes, a circuit individually interconnecting each pair of the corresponding contacts of said transmitters and said potential means and including two balanced arms, relay means adapted to be associated with said circuits, and means for bridging said relay means successively across said circuits between the juncture points of said balanced arms during the transmission of the code combinations.

4. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combinations of the true message and of a secret code, means for impressing on the contacts of said transmitters potentials of polarities determined by the code combinations of the message and secret codes, a circuit individually interconnecting each pair of the corresponding contacts of said transmitters and said potential means and including two balanced arms, relay means adapted to be associated with said circuits, and means for bridging said relay means successively across said circuits between the juncture points of said balanced arms during the transmission of the code combinations, said juncture points being of equal potential when potentials of unlike polarity are impressed on the contacts corresponding thereto and being unequal potential when potentials of like polarity are impressed on said corresponding contacts.

5. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combinations of the true message and of a secret code, means for impressing on the contacts of said transmitters potentials of polarities determined by the code combinations of the message and secret codes, a circuit individually interconnecting each pair of the corresponding contacts of said transmitters and said potential means, each of said circuits being divided into two balanced arms of equal resistance, one arm including a contact of the message transmitter and the potential means associated therewith and the other including the corresponding contact of the cipher transmitter and the potential means associated therewith, relay means adapted to be associated with said circuits, and means for bridging said relay means successively across said circuits between the juncture points of said balanced arms during the transmission of the code combination.

6. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combinations of the true message and of a secret code, a plurality of potential sources for impressing on the contacts of the respective transmitters potentials of polarities determined by the code combinations of the message and secret codes, a circuit, in-

cluding a pair of resistance means of equal magnitude, individually interconnecting each pair of the corresponding contacts of said transmitters and said potential sources, each of said circuits being divided into two balanced arms, one arm including a contact of the message transmitter, the potential sources associated therewith and one of said pair of resistance means and the other arm including the corresponding contact of the cipher transmitter, the potential sources associated therewith and the other of said pair of resistance means, relay means adapted to be associated with said circuits, and means for bridging said relay means successively across said circuits between the juncture points of said balanced arms during the transmission of the code combinations.

7. In a telegraph secrecy system, in combination, a transmitter for transmitting impulses representing the code combinations of the true message, a second transmitter adapted to operate in synchronism with said message transmitter for transmitting impulses representing the code combinations of a secret code, means, including a plurality of potential sources, for impressing on the contacts of the respective transmitters potentials of equal magnitude and of polarities determined by the code combinations of the message and secret codes, a pair of interconnected leads connected to each pair of the corresponding contacts of said transmitters, resistance means connected in each of said leads, the magnitude of the resistance in one lead of each pair being substantially the same as that in its corresponding lead, polar relay means connected to said potential sources, distributor means for successively connecting said relay means to the juncture point of each of said pairs of interconnected leads to impress a potential on said relay means when potentials of like polarities are impressed on the corresponding contacts of said transmitters and to impress zero potential on said relay means when potentials of unlike polarities are impressed on said corresponding contacts, and a rectifier network associated with said relay means for directing the current through the operating winding thereof in only one direction regardless of the polarity of the potential impressed thereon.

8. The method of enciphering signals, which consists in producing potentials of different characteristics in accordance with the true message, producing potentials of different characteristics in accordance with a secret code, combining those potentials corresponding respectively to the message and the secret code which are of like characteristics, effectively neutralizing those potentials corresponding to the message and the secret code which are of unlike characteristics, producing enciphered messages corresponding to said combined potentials and said neutralized potentials, and altering upon the occurrence of predetermined code combinations of the secret code the characteristics of the potentials produced in accordance with the message to alter the character of the enciphered signals.

9. The method of enciphering signals, which consists in producing potentials of different characteristics in accordance with the code of the true message, producing potentials of different characteristics in accordance with a secret code, combining those potentials corresponding respectively to the message and secret codes which are of like characteristics, effectively neutralizing those potentials corresponding respectively to the message and secret codes which are of unlike characteristics, producing enciphered signals corresponding to said combined potentials and said neutralized potentials, and altering upon the coincidence of predetermined code combinations of the secret and the message codes the characteristics of the potentials produced in accordance with the message code to alter the character of the enciphered signals.

10. In a telegraph secrecy system, the method of producing and transmitting enciphered signals, which consists in producing impulses of equal potential and of different polarities in accordance with the code combinations of the true message and of a secret code, combining at a local point those impulses corresponding respectively to the message and secret codes which are of like polarity, diverting to an auxiliary path those impulses corresponding respectively to the message and secret codes which are of unlike polarities, transmitting said combined impulses to another local point, producing at said last mentioned point and transmitting to a distant point enciphered signals corresponding to said combined impulses and said diverted impulses, and reversing in accordance with predetermined code combinations of the secret code the polarities of the impulses produced in accordance with the code combinations of the message to alter the character of the enciphered signals normally produced and transmitted.

11. In a telegraph secrecy system the method of producing and transmitting enciphered signals, which consists in producing impulses of equal potential and of different polarities in accordance with the code combinations of the true message and of a secret code, combining at a local point those impulses corresponding respectively to the message and secret codes which are of like polarity, dissipating within a local circuit those impulses corresponding respectively to the message and secret codes which are of unlike polarities, transmitting said combined impulses to another local point, producing at said last mentioned local point and transmitting to a distant point enciphered signals corresponding to said combined impulses and said dissipated impulses, and reversing upon the coincidence of predetermined code combinations of the secret and the message codes the polarities of the impulse produced in accordance with the code combinations of the message to alter the character of the enciphered signals normally produced and transmitted.

12. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combinations of the true message and of a secret code, a pair of interconnected leads connected to each pair of the corresponding contacts of said transmitters, means for impressing impulses of like polarities and of unlike polarities on the juncture points of said leads in accordance with the message and secret codes, relay means adapted to transmit signals, means for causing said relay means to successively transmit signals of a character dependent upon the coincidence of potentials of like polarities and the coincidence of potentials of unlike polarities at the respective juncture points of said leads, and means controlled by predetermined characteristics of the secret code for reversing the polarities of the potentials normally impressed on said juncture points in accordance with the message code.

13. In a telegraph secrecy system, in combina-

tion, a transmitter for transmitting impulses representing the code combinations of the true message, a six-pulse tape transmitter for transmitting impulses representing the code combination of a secret code, a pair of interconnected leads connected to each pair of the corresponding contacts of said transmitters, means for impressing impulses of equal magnitude and like polarities and of equal magnitude and unlike polarities on the juncture points of said leads in accordance with the message and secret codes, relay means adapted to be associated with said juncture points, mans for connecting said relay means successively to said juncture points during the transmission of the code combinations to cause said relay means to transmit signals of a character dependent upon the coincidence of potentials of like polarities and the coincidence of potentials of unlike polarities at said juncture points, and means controlled by the sixth impulse of any code combination transmitted by the cipher transmitter for reversing polarities of the potentials normally impressed on said juncture points in accordance with the message code.

14. In a telegraph secrecy system, in combination, a transmitter for transmitting impulses representing the code combinations of the true message, a six-pulse tape transmitter for transmitting impulses representing the code combinations of a secret code, a plurality of potential sources for impressing on the contacts of the respective transmitters potentials of polarities determined by the code combinations of the message and secret codes, a circuit, including a pair of resistance means of equal magnitude, individually connecting each pair of the corresponding contacts of said transmitters with said potential sources, each of said circuits being divided into two balanced arms, one arm including a contact of the message transmitter, the potential sources associated therewith and one of said pair of resistance means and the other arm including the corresponding contacts of the cipher transmitter, the potential sources associated therewith and the other one of said pair of resistance means, relay means adapted to be associated with said circuits, means for bridging said relay means successively across said circuits between the juncture points of said balanced arms during the transmission of the code combinations, and means operative upon the occurrence of a sixth impulse of a predetermined polarity in any code combination transmitted by the cipher transmitter for reversing during the transmission of any such code combination the polarities of the potentials impressed on the contacts of said message transmitter.

15. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combination of the true message and of a secret code, a pair of interconnected leads connected to each pair of the corresponding contacts of said transmitters, means for impressing on the contacts of said transmitters potentials of polarities determined by the code combinations of the message and secret codes, relay means associated with certain of said leads and operative upon the coincidence of predetermined code combinations of the message and secret codes, current responsive means adapted to transmit signals, means for causing said current responsive means to successively transmit signals of a character dependent upon the coincidence of potentials of like polarities and the coincidence of potentials of unlike polarities

at the respective juncture points of said leads, and means controlled by the operation of said relay means for reversing the polarities of the potentials normally impressed on said juncture points in accordance with the message code.

16. In a telegraph secrecy system, in combination, a pair of transmitters for transmitting impulses representing the code combinations of the true message and of a secret code, a plurality of potential sources for impressing on the contacts of the respective transmitters potentials of polarities determined by the code combinations of the message and secret codes, a pair of interconnected leads connected to each pair of the corresponding contacts of said transmitters, resistance means connected in each of said leads, relay means associated with certain of said leads and operative upon the coincidence of predetermined code combinations of the message and secret codes, each pair of said leads forming part of a circuit divided into two balanced arms of equal resistance, one arm including one of the leads of the pair, a contact of the message transmitter and the potentials associated therewith and the other arm including the other lead of the pair, the corresponding contact of the cipher transmitter and the potential sources associated therewith, current responsive means adapted to transmit signals, means for bridging said current responsive means successively across the juncture points of said balanced arms during the transmission of the code combinations, and means controlled by the operation of said relay means for reversing the polarities of the potentials normally impressed on the contacts of the message transmitter in accordance with the massage code.

17. The method of enciphering signals, which consists in producing potentials of different characteristics in accordance with the true message, producing potentials of different characteristics in accordance with a secret code, combining those potentials corresponding respectively to the message and the secret code which have certain predetermined characteristics, effectively neutralizing those potentials corresponding to the message and the secret code which have certain other predetermined characteristics, producing enciphered messages corresponding to said combined potentials and said neutralized potentials, and altering upon the occurrence of predetermined code combinations of the secret code the characteristics of the potentials produced in accordance with the message to alter the character of the enciphered signals.

18. The method of enciphering signals, which consists in producing potentials of different characteristics in accordance with the code of the true message, producing potentials of different characteristics in accordance with a secret code, combining those potentials corresponding respectively to the massage and secret codes which have certain predetermined characteristics, effectively neutralizing those potentials corresponding respectively to the message and secret codes which have certain other predetermined characteristics, producing enciphered signals corresponding to said combined potentials and said neutralized potentials, and altering upon the coincidence of predetermined code combinations of the secret and the message codes the characteristics of the potentials produced in accordance with the message code to alter the character of the enciphered signals.

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