

Sept. 3, 1946.

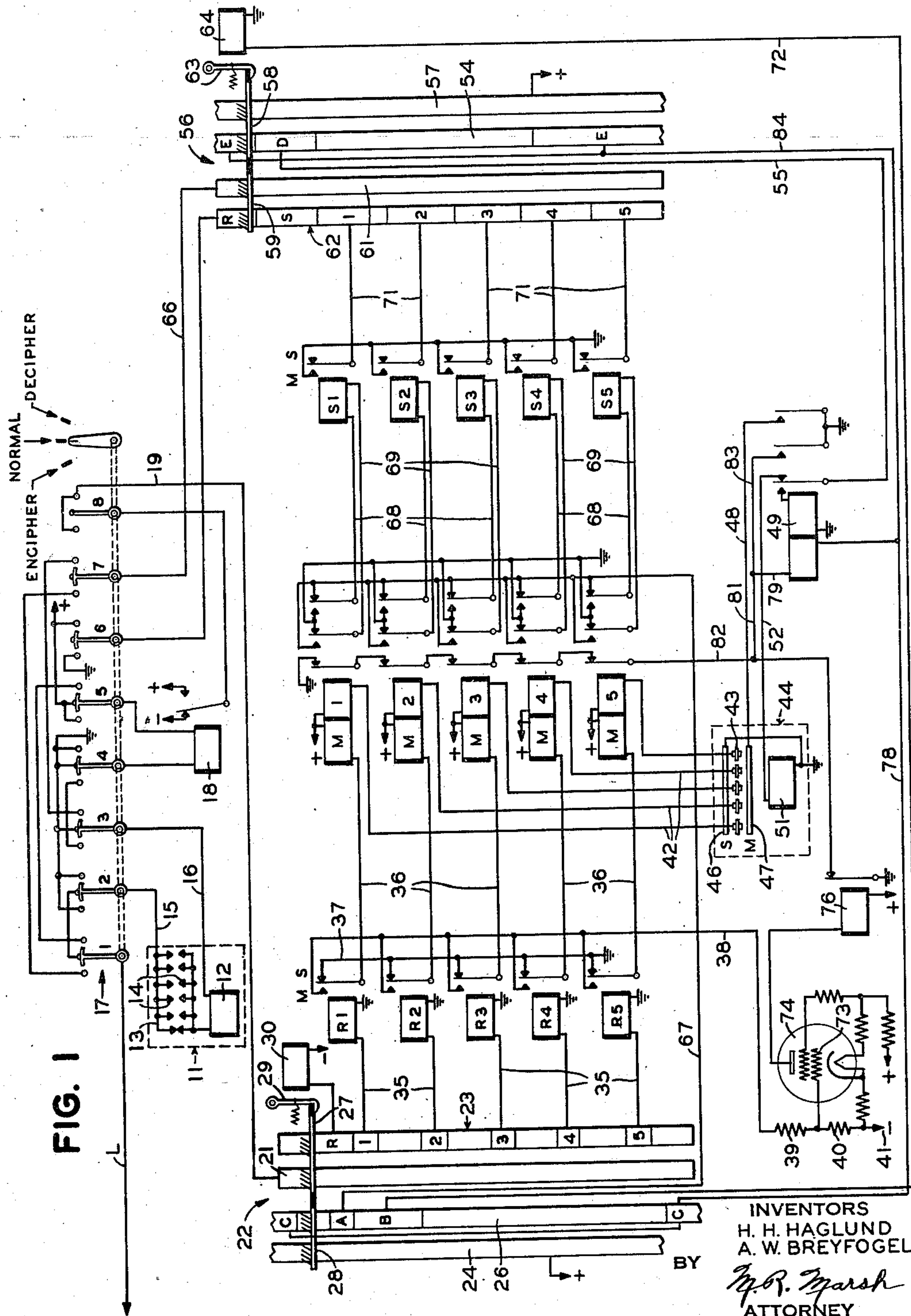
H. H. HAGLUND ET AL

2,406,829

TELEGRAPH SYSTEM

Filed June 27, 1942

2 Sheets-Sheet 1





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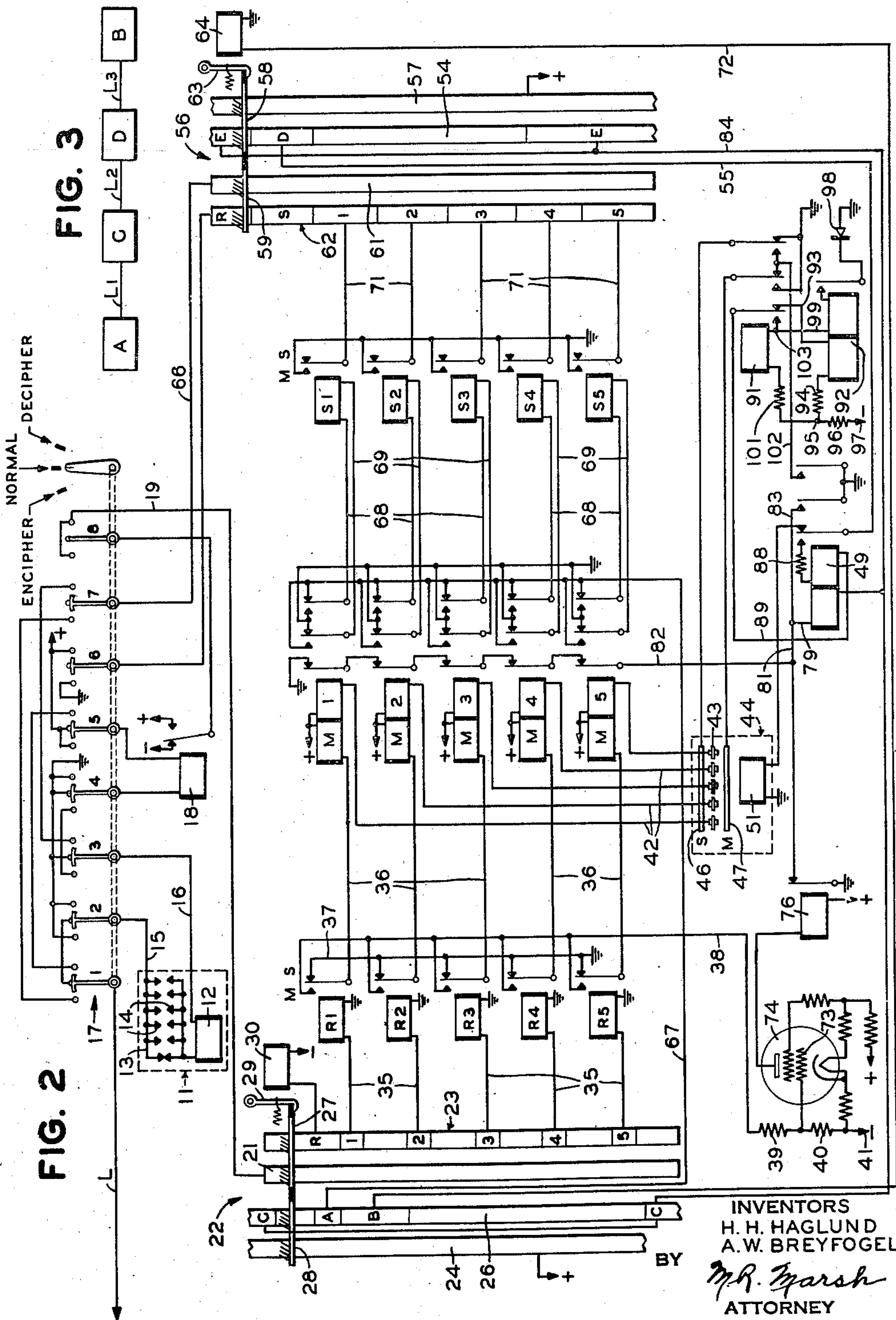
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## UNITED STATES PATENT OFFICE

2,406,829

## TELEGRAPH SYSTEM

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34 Claims. (Cl. 178—22)

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This invention relates primarily to a telegraph system and more particularly to a secret telegraph system and apparatus for enciphering and deciphering messages whereby secrecy of the message is assured from the time a message is automatically enciphered at a sending point until the same is automatically deciphered at the receiving point.

It is one of the primary objects of the present invention to provide a novel system of automatically enciphering a message at an originating point and automatically deciphering the same at a receiving point in such a manner as to render it impossible or so difficult that, even if the transmitted message were copied and finally deciphered, the time required to decipher the same would be so great as to render the information contained in the message of little value to one copying the same.

In practicing the invention the general method of enciphering is to combine each character of the message with a key character and then transmit the combined result to a receiving point. At the receiving point the received enciphered character is deciphered by recombining it with a key character to give a character similar to that with which the key character was combined at the originating point. In the preferred embodiment of the invention the five-unit permutation signaling code is employed, and the method of combining the key characters with the message characters is such that like signaling elements or impulses are combined to give one line condition such as a spacing line condition, while unlike signaling impulses produce an opposite line condition such as a marking line condition.

Also in the preferred embodiment, the key characters are stored in the form of a perforated tape, and for obvious reasons the key tapes at the originating and receiving points must be identical. The message characters or signals may originate in a keyboard which is connected to the enciphering mechanism, or the message may be prepared in the form of a perforated tape and fed through a transmitter connected to the enciphering mechanism. At the receiving end the preferred embodiment is to have a printing telegraph receiver employed as the receiving instrument, but other types of receivers such as perforators could be employed.

In accordance with the above system of combining message characters with key characters, it is another object of the invention to prevent the advancement of the key tape at the transmitting point when a message character and a

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key character are such as to combine and form a blank signal, or one wherein all the signaling elements are of a spacing nature, and at such times to transmit the message character unchanged.

When a message character, as under the above conditions, is transmitted unchanged, the combination thereof with a key character at the receiving end similar to the key character at the sending end will obviously form a blank, and it is another object of the invention under such conditions to prevent the advancement of the key tape at the receiving end.

In accordance with the above, it is a still further object of the invention to provide in a modification thereof means operative to reverse the marking and spacing bus bars in the key transmitters when the characters therein combine with the message characters to form blank characters.

Another object of the invention is to prevent the advancement of the tape in the key transmitter when the message transmitting mechanism is idle.

The originating point of the message and the receiving point may be separated by considerable distances, and for such conditions it is necessary to repeat the signals at repeater points situated at various places along the line. These repeaters, which may be of the type disclosed in a patent to Noxon, No. 2,014,908, operate in such a manner as to fortuitously insert blank code groups in the signal code groups repeated, and if suitable means were not provided, these inserted blank code groups would prevent the proper use of the enciphering apparatus, as such blank code groups would effect stepping of the key tape at the receiving point when the key tape at the originating point was not stepped. As it is necessary for the key tapes at both points to be kept in synchronism, such a fortuitous condition would render the system inoperative.

Accordingly, it is another object of the invention to provide an enciphering and deciphering telegraph system which will operate over a circuit with repeaters therein which may fortuitously insert blank code groups into the signal code groups repeated.

A more specific object of the invention is to provide an enciphering and deciphering telegraph system wherein the receipt of blank code groups or code groups of predetermined character at the receiving point prevents the advancement of the key tape thereat.

Another object of the invention is to provide a control switch for the ciphering mechanism



whereby it may be used in an enciphering or deciphering capacity or removed from operative association with the transmitting circuit.

In connection with the above, it is a further object of the invention to maintain the transmitting circuit in closed condition on operation of the switch control means.

The above and further objects of the invention will be more apparent when taken in conjunction with the following detailed description of the preferred embodiment of the invention and the accompanying drawings, in the latter of which:

Fig. 1 is a circuit diagram showing the electrical connections of a ciphering mechanism arranged to operate as hereinafter described;

Fig. 2 is a circuit diagram of a modification of the invention; and

Fig. 3 is a schematic illustration of a telegraph circuit connecting a plurality of stations.

In accordance with the invention, and as shown in Fig. 1, the system includes a ciphering mechanism to which is connected, through a manually operable switch, a teleprinter and a send-receive line circuit. The ciphering mechanism in the preferred embodiment of the invention is adapted under the control of the switch to encipher a message for transmission or to decipher a received message.

The teleprinter employed in the preferred embodiment of the invention may be of any one of the well-known types and is diagrammatically represented by the rectangle 11. The teleprinter 11 is of the type which includes a plurality of keylevers (not shown), the actuation of which causes representative code groups of impulses to be transmitted, and a selector magnet 12 which responds to the transmitted and received signals to effect recording of characters representative of the transmitted and received signal code groups. The teleprinter 11 also includes a normally closed rest impulse transmitting contact 13 and a plurality of normally open code impulse transmitting contacts 14, usually five in number. The teleprinter 11 operates on the open and closed line type of signals, and in its normal or non-operative condition the rest contacts 13 are closed to transmit a closed line condition. On the actuation of the keylevers in the teleprinter, the rest impulse transmitting contact 13 is opened, and selected ones of the transmitting contacts 14 are sequentially closed to effect transmission of open and closed line conditions representing according to a predetermined plan the actuated ones of the keylevers.

Whether or not the ciphering mechanism functions in enciphering or deciphering capacity, or whether it is disconnected from the line circuit and teleprinter entirely, is controlled by the operation of a switch, indicated in general by reference numeral 17. The switch 17 is of the multiple level type and includes a plurality of movable arms which are adapted to be brought into contact with associated studs. The movable arms of the switch 17 are arranged for simultaneous movement.

The line L is connected to the first arm from the left of the switch 17 and over the line L are received signals from a distant point which may represent an enciphered message or an unciphered message. The line L may in the usual simplex manner have signals transmitted thereover in the opposite direction.

Conductors 15 and 16 connect the teleprinter 11 to the second and third arms, respectively, from

the left of the switch 17, and with the switch arms in their normal or mid-position, as shown in the drawings, the interconnections to the studs of the switch are such that the teleprinter 11 is in series with the line L to ground. Hence, with the switch 17 in its normal position, the teleprinter 11 responds to signals received over the line to record the same and also may be employed to transmit signals representative of the actuated keylevers directly to the line L. A line relay 18 is connected to the fourth and fifth arms of the switch 17, and with the switch in its normal position a circuit from ground to positive potential is completed through the line relay.

For reasons hereinafter apparent, some of the arms of the switch 17 are of the so-called make-before-break type, or those of the type which, in moving from one stud to another, contact a second stud before breaking the circuit to the stud upon which it was set.

The mechanism will first be described as employed in enciphering a message and transmitting the same over the line L. In order to accomplish this function, the switch 17 is positioned so that the movable arms thereof contact their associated left hand studs. With the switch 17 in this position, the coil of the line relay 18 is connected from positive potential in series with the teleprinter 11 to ground and accordingly will respond to all signals transmitted from the teleprinter. The tongue of the line relay 18 is connected to the eighth arm of the switch 17, and the associated break and make stops have positive and negative potential applied thereto. Accordingly, as the line relay 18 responds to the signals received from the teleprinter 11, impulses of negative and positive potential are applied through the eighth arm of the switch 17 over a conductor 19 to a solid ring 21 of a start-stop distributor mechanism, indicated in general by reference numeral 22.

The distributor 22 includes beside the solid ring 21 an associated segmented ring 23 and a second solid ring 24 with an associated segmented ring 26. A pair of brushes 27 and 28 are adapted to bridge the solid rings 21 and 24 with their associated segmented rings 23 and 26, respectively. The brushes are frictionally driven and are normally held at rest in a normal position by a latch 29 in operative relation with a start magnet 30.

The start impulse preceding each code group transmitted from the teleprinter 11 is effective to operate the line relay 18 so that the tongue thereof engages its break stop and applies positive potential to the solid ring 21 of the distributor 22. In its normal stop position, the brush 27 contacts the rest segment R of the segmented ring 23, to which is connected one terminal of the start magnet 30, the other terminal of which is connected to negative potential. The application of the positive potential to the solid ring 21 effects energization of the magnet 30 to release the brushes 27 and 28. During the rotation of the brush 27, the latter bridges the segments numbered 1 to 5 of the ring 23 with the solid ring 21 in timed relation to the operation of the line relay 18 as controlled by the intelligence impulses of the code group transmitted from the teleprinter 11. The segments numbered 1 to 5 of the ring 23 are connected by individual conductors 35 through the coils of polar receiving storing relays R1 to R5 to ground. Accordingly, the receiving storing relays R1 to R5 have positive and negative potentials applied thereto in a combination representative of a coded group of intelligence impulses transmitted from



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the teleprinter 11. If it is assumed that the polarized receiving storing relays R1 to R5 are so connected that a negative impulse therethrough moves the associated tongues to their marking or left hand stops, and positive impulse through the coils of the relays moves the associated tongues to their right or spacing stops, then the tongues of the relays assume positions representative of the intelligence impulses transmitted from the teleprinter. Thus, a character representative of an actuated keylever in the teleprinter is transferred to and stored in the receiving storing relays R1 to R5.

The tongues of the receiving storing relays R1 to R5 are each individually connected by individual conductors 36 through the left hand coils of so-called mixing relays M1 to M5 to positive potential. The right hand or spacing stops of the relays R1 to R5 are connected by a conductor 37 to ground, while the left hand or marking stops are connected by a conductor 38 through a first resistance 39 and a second resistance 40 to negative potential at 41. With the tongue of a receiving relay R on its right hand or spacing side, ground is applied through the left hand coil of its associated mixing relay to positive potential to effect energization of the coil. With the tongue of a receiving storing relay on its marking or left hand stop, a circuit from positive to negative potential is applied through the left hand coil of its associated mixing relay, but the resistances 39 and 40 are such as to limit the amount of current to such a small value that the coil of the mixing relay is not sufficiently energized to operate its associated tongues. The purpose of the resistances 39 and 40 is to enable the reading of normal characters in the relays R1 to R5 in a manner hereinafter pointed out.

One of the terminals of each of the right hand coils of the mixing relays M1 to M5 is connected to positive potential, and the other terminals of each of the right hand coils are connected by individual conductors 42 to associated tongues 43 of a so-called key tape transmitter, indicated generally by reference numeral 44. The tape transmitter 44 is adapted to have the key tape control the same in a manner hereinafter described to transmit impulses representing key characters to the right hand coils of the mixing relays M1 to M5. The key tape transmitter 44 includes a spacing bus bar 46, which is grounded, and a marking bus bar 47 connected by a conductor 48 to the make stop of the outer tongue of a double coil blank reading relay 49. One side of the operating magnet 51 of the key tape transmitter 44 is grounded, and the other side is connected over a conductor 52 to the break stop of the left hand or inner tongue of the blank reading relay 49. The left hand or inner tongue of the blank reading relay 49 is connected over a conductor 55 to a segment D of a local ring 54 on a sending distributor, indicated generally by reference numeral 56. A solid ring 57 is associated with the segmented ring 54 and is arranged to be bridged by a brush 58. A second brush 59 cooperates with another solid ring 61 and a segmented ring 62. The brushes 58 and 59 successively bridge the segments of their associated segmented rings with their solid rings and are normally held in their normal rest position by a latch 63 adapted to be operated by a magnet 64. The solid ring 57 of the distributor 56 is connected to positive potential, while the other solid ring 61 is connected by a conductor 66 to the seventh arm of the multiple level

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switch 17. With the switch 17 in its enciphering position, the circuit from the solid ring 61 is continued through the switch to the line L.

The tongues 43 of the key tape transmitter 44 will in the usual manner contact the marking and spacing bus bars 47 and 46 in a combination representative of a character perforation in the associated key tape. With a tongue 43 in contact with the spacing bus bar 46, ground is applied through the right hand coil of its associated mixing relay M to positive potential and energizes the coil, whereas with a tongue 43 in contact with the marking bus bar 47, the associated right hand coil of a mixing relay is open, as under normal conditions the relay 49 is deenergized, which opens the circuit from the marking bus bar of the key tape transmitter to the outer grounded tongue of the relay 49. Accordingly, the right hand coils of the mixing relays M1 to M5 are energized or deenergized in combinations representative of the character of the key tape over the pins of the key tape transmitter 44.

The two coils, left and right hand, of the mixing relays M1 and M5 are so arranged that, with both of the coils of a relay energized, the tongues of the relay remain on their break stops, as they do with neither of the coils energized. The energization of either a right hand or a left hand coil of a mixing relay is effective to operate the same to move the associated tongues out of engagement with their normal break stops and into engagement with their make stops. Thus, the mixing relays serve to combine or mix the impulses of the message character transmitted from the teleprinter 11 with the impulses transmitted from the key tape transmitter 44 in such a manner that like impulses, a marking and a marking or a spacing and a spacing, produce no operation of representative mixing relays, while unlike impulses produce operation of associated mixing relays. Accordingly, the tongues of the mixing relays M1 to M5 are set in combinations against their make or break stops representative of a character derived from the combination of a character from the teleprinter 11 and one from the key tape transmitter 44.

Following the operation of the mixing relays M1 to M5 in a combination to represent an enciphered character or a character derived from a combination of a message character from the teleprinter 11 and a key character from the key tape transmitter 44, the next operation is the transmission of this enciphered character to the line L. The transmission of the character is accomplished by means including the distributor transmitter 56, and the manner in which this is accomplished will now be described.

Each of the mixing relays M1 to M5 has three tongues associated therewith which will be operated in accordance with the energization and deenergization of the coils of the mixing relays in a manner hereinbefore set forth. The break stops of the outer tongues of the mixing relays M1 to M5 and the make stops of the middle tongues are all connected in parallel by a conductor 67 to the segment A on the ring 26 of distributor 22. Thus, each time the brush 28 contacts the segment A, positive potential from the solid ring 24 will be applied over the conductor 67 to the above-mentioned make and break stops of the mixing relays M1 to M5. The application of this potential occurs in timed relation to the operation of the mixing relays and takes place during the following revolution of the brushes.



The make stops of the outer tongues and the break stops of the center tongues of the mixing relays are all connected to ground, and the above-mentioned pairs of tongues are connected by individual conductors such as 38 and 39 to the terminals of associated sending storing relays S1 to S5. The sending relays S1 to S5 are polarized and are adapted to move their associated tongues from a retracted position to their make stops on the passage of potential of one polarity through the coils in one direction, whereas the tongues move in an opposite manner on the passage of the potential through the coils in the opposite direction. The tongues of the sending relays S1 to S5 are each connected by individual conductors 71 to segments numbered 1 to 5 of the segmented ring 62 of the distributor 56, and the make stops of the sending relays S1 to S5 are all grounded.

The position of a pair of tongues, the outer and center of a mixing relay such as M1, determines the direction of flow of potential from the segment A through the associated sending relay S1. Accordingly, as the brush 28 contacts the segment A of the ring 26, potential is applied through the coils of each of the sending relays S1 to S5 in either one or the other of two directions as determined by the condition of the mixing relays M1 to M5. The passage of current through the coils of the sending relays S1 to S5 positions the tongues according to the direction thereof, and thus the tongues of the sending relays are positioned in either a marking or spacing position in accordance with the nature of the enciphered character represented by the condition of the mixing relays M1 to M5. With a tongue of a sending relay S1 to S5 in its marking position, ground is applied to its associated segment on the ring 62, whereas with a tongue in its spacing position the circuit to the associated segment is open. In this manner the segments 1 to 5 of the ring 62 are selectively grounded in a combination representative of the enciphered character.

In timed relation with the operation of the sending relays S1 to S5, the release magnet 64 is energized by the brush 23 of distributor 22 contacting the segment B of ring 26 to complete a circuit from positive potential at ring 24, through the brush 28, segment B, over conductor 72 to the magnet 64. The energization of the magnet 64 operates the latch 63 to release the frictionally driven brushes 53 and 59 for one revolution. As the brush 59 rotates from its rest position in contact with the rest segment R, which for the above-described position of the switch 17 has ground applied thereto from the sixth arm of the switch, it contacts the open segment S to transmit from the solid ring 61 an open line condition through the switch 17 to the line L. The brush 59 then successively bridges the five numbered segments with the solid ring 61 to transmit to the line L a code combination of open and closed line conditions representative of the enciphered character which is set up in a manner previously described on the segments of the ring 62. Thus, the enciphered character representative of a combined character from the teleprinter 11 and a character from the key transmitter 44 is transmitted to the line. In addition to the above general operation of the enciphering mechanism there are numerous other ancillary operations operative on certain conditions which will be described in the following paragraphs.

When any character other than a blank is stored in the receiving storing relays R1 to R5, as

hereinbefore described, one or more of the tongues thereof will be operated to their make stops and establish a circuit from positive potential through the left hand coil of the associated mixing relay M1 to M5 and through the resistances 39 and 40 to negative potential at 41. While the resistances 39 and 40 limit the flow of current to such a value as to be practically ineffective on the mixing relays, it is of sufficient value to bring the control grid 73 of a vacuum tube 74 to such a positive value as to render the tube operative. This permits current to flow in the plate cathode circuit of the vacuum tube 74 and renders a normal reading relay 76 operative. Thus, each time any character other than a blank is stored in the relays R1 to R5, the relay 76 will be energized, and when a blank or an all-spacing code group is stored in these relays R1 to R5, the relay 76 will be unenergized. The function of the relay 76 will be described hereinafter in connection with other functions.

As is the usual practice in start-stop distributors of the type included in the ciphering mechanism, the character stored in the receiving storing relays R1 to R5 is not transferred therefrom until the subsequent revolution of the brushes. Accordingly, while a character is set up on the relays R1 to R5 on one revolution of the brushes 27 and 28, the transfer to the sending storing relays S1 to S5 of this character is not effected until the brushes 27 and 28 are released in response to the start impulse of the subsequent character transmitted from the teleprinter 11. When the brush 28 contacts segment A of ring 26, the enciphered character is transferred from the mixing relays M1 to M5 to the sending storing relays S1 to S5, and then the brush contacting segment B effects release of the brushes 53 and 59 of the distributor 56. Shortly after the brush 53 is released, it bridges segment D of ring 54 with the solid ring 57 and applies positive potential from the solid ring over the conductor 55 through the inner tongue and break stop of the relay 49 to the operating magnet 51 of the key tape transmitter 44. This effects operation of the magnet 51, and during operation thereof it steps the next key character perforation in the key tape of the key transmitter 44 over the transmitter pins, whereupon the transmitter operates in accordance with this key character to energize corresponding right hand coils of the mixing relays M1 to M5. Thus, the next key character of the key tape is set up in the right hand coils of the mixing relays M1 to M5 and is combining with the message character being transmitted from the teleprinter 11, as hereinbefore described.

For reasons pointed out more in detail hereinafter, and particularly when the ciphering mechanism is used to transmit over a line circuit which may have repeaters therein of the type that fortuitously insert blank code groups in the message groups of signals being repeated, it is necessary for such conditions to prevent the ciphering mechanism from transmitting to the line blanks resulting from the combination of a key character and a message character. When a message character and a key character are of such a nature that a combination of the two in accordance with the principles of the ciphering mechanism are such as to form a blank, the ciphering mechanism is so controlled as to effect transmission of the key character without any transformation thereof and to delete the stepping operation of the key transmitter 44.

When the message character and the key char-



acter combine to form a blank, as they will when the two characters are alike, the mixing relays M1 to M5 are so operated that the tongues thereof are all positioned in contact with their break stops. After such positioning of the tongues of the mixing relays, the brush 28 contacting segment C of ring 26 applies positive potential from the solid ring 24 over a conductor 78, through the left hand coil of relay 49, thence over conductors 79, 81 and 82, through the inner tongue and break stop of each of the mixing relays M1 to M5, which are serially connected, to ground. This causes operation of the relay 49, and it is locked up by a circuit established from ground at its center tongue over conductors 83 and 79, through the left hand coil and conductor 78 to the segment C, which will at this time have positive potential applied thereto from the solid ring 24. The operation of the relay 49 establishes a second circuit from its grounded outer tongue over conductor 48 to the marking bus bar 47 of the key tape transmitter 44. Thus, both the spacing and marking bus bars of the key tape transmitter 44 for the above condition have ground applied thereto, and obviously ground will be applied to each of the tongues 43 in the tape transmitter 44 regardless of the position thereof. With ground on each of the tongues 43, the right hand coil of each of the mixing relays M1 to M5 will be energized, and for such a condition the tongues of the mixing relays will be selectively positioned in accordance with and in a combination representative of only the message character stored in the receiving relays R1 to R5. Thus, the effect of the key character in the key transmitter 44 is neutralized in regard to the operation of the mixing relays M1 to M5. The neutralization, as above, of the key character in the mixing relays M1 to M5, and the positioning thereof in accordance with the message character, removes the ground from the previously described operating circuit through the inner tongues of the mixing relays and the left hand coil of the relay 49. However, the relay 49 is maintained in an energized condition by the locking circuit from its grounded center tongue to the segment C of ring 26. Before the brush 28 leaves segment C of ring 26, the brush 58 contacts segment E of ring 54 to maintain the locking circuit through the left hand coil of relay 49, the battery for this locking circuit at this time being from the solid ring 57, through brush 58, segment E of ring 54, over a conductor 84 and through the left hand coil of relay 49 to its grounded center tongue.

The brush 58 contacts segment E in its rest position, and hence the locking circuit to the relay 49 remains established as long as the brush 58 remains stationary. On the next revolution of the brush 28 it releases brushes 58 and 59 when it contacts segment B, whereupon brush 58 passes off segment E and contacts segment D. During the previously described cycle of operation of the distributor 56, the contacting of brush 58 with segment D was effective to energize the magnet 51 of the key tape transmitter 44 to effect advancement of the tape therein. However, with the relay 49 energized, the circuit from the segment D of ring 54 to the magnet 51 is interrupted and, instead of being connected to the magnet 51, the segment D is connected through the inner tongue of relay 49 and associated make stop through the right hand coil of relay 49 to ground. Hence, as brush 58 contacts segment D with relay 49 energized, potential from the solid ring 57 is effective to hold relay 49 operated until the

brush passes out of engagement with segment D. Thus, for this revolution of the brush 58 the magnet 51 of the key tape transmitter 44 will not be energized, and the same character in the tape will remain in operative relation with the sensing pins. The passage of the brush 58 from engagement with segment D opens the circuit through the right hand coil of the relay 49, and as the circuit through the left hand coil will also be open at this time, the relay returns to its normal unenergized position. During the above-described revolution of the brush 58, the brush 59 rotating therewith is effective to transmit the character stored in the sending storing relays S1 to S5 to the line, this character being identical with the character in the receiving storing relays R1 to R5, as the key character in the key tape transmitter is rendered ineffective to change the message character in the mixing relays M1 to M5. Thus, when the key character and the message character are of such a nature that the combination thereof forms a blank, the message character is transmitted to the line without undergoing any transformation, and the advancement of the key tape for this particular character is prevented so that the key character is effective to combine with the subsequent message character.

It is possible to transmit a blank signal or one wherein all the intelligence impulses are of a spacing nature from the teleprinter 11, and it is desirable on the transmission of a blank signal from the teleprinter to prevent the normal operation of the ciphering mechanism to combine the blank signal with a key character from the key tape transmitter 44. The combination of a key character from the tape transmitter 44 with a blank signal or character from the teleprinter 11 would result in a transmission of the key character untransformed. As such a condition might facilitate the deciphering of a message wherein blanks might be contained, the ciphering mechanism is arranged to operate so that the blank signal from the message source such as the teleprinter is transmitted to the line without undergoing any change and without advancing the key tape in the key transmitter.

As hereinbefore described, the storing of a blank or all-spacing character on the receiving storing relays R1 to R5 removes the positive potential from the control grid 73 of the vacuum tube 74, whereupon the tube becomes non-conducting. The non-conducting condition of the vacuum tube 74 is established almost immediately, or before the brush 28 contacts segment C, and with the tube non-conducting the relay 76 releases to apply ground at its tongue over the conductor 81, conductor 79, through the left hand coil of the relay 49 and over conductor 78 to segment C of ring 26. Therefore, when the brush 28 reaches segment C, relay 49 will be operated and will lock itself up through the circuit hereinbefore described including the grounded center tongue of this relay.

The operation of relay 49 as set forth above is effective to energize each of the right hand coils of the mixing relays M1 to M5, and at this time the left hand coils will also all be energized, as the blank or all-spacing signals from the receiving storing relays R1 to R5 will be transferred to their associated coils of the mixing relays. The net result at the mixing relays is that none are in an operated condition, and for such a condition they represent a blank. Thus, when the brush 28 subsequently contacts segment A, the blank



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character is transferred from the mixing relays M1 to M5 to the sending storing relays S1 to S5, which sets a blank character upon the segments of the ring 62. Following this operation, the brush 28 contacts segment B of ring 26 to effect release of the brushes of distributor 56, whereupon the brush 59 successively contacts the segments 1 to 5 of ring 62 and transmits an all-spacing or blank signal to the line L. The relay 49 is maintained in an operated condition for the desired length of time and then released in the manner above set forth. Thus, a blank character from the teleprinter 11 is transmitted to the sending line L without undergoing any change, and the key tape in the key transmitter 44 is not advanced, and the character represented by the perforations in the key tape over the pins is available and may be combined with the next message character transmitted from the teleprinter 11, provided the next message character is not a blank or a character similar to the one represented by the perforations in the key tape over the pins in the key tape transmitter 44.

The above description illustrates the manner of operating the ciphering mechanism when the same is functioning in an enciphering capacity or where a message character from the teleprinter 11 is combined with a key character from the tape transmitter 44 and the resulting enciphered character transmitted to the line L. The above method of operation occurs when the arms of the switch 17 are in contact with their associated left hand studs, and by moving the arms of the switch 17 or operating the same so that the arms contact their associated right hand studs the ciphering mechanism functions in a deciphering capacity. In changing the operation of the ciphering mechanism from enciphering to deciphering capacity, it is necessary that the line circuit be maintained in a closed condition and that no extraneous open or spacing impulse be transmitted thereover, as such an impulse would act like a regular start impulse and might be effective to release the distributors at the other end of the line and advance the key tape in the key tape transmitter thereat. The key tapes in the two key tape transmitters at the ends of the line must be maintained in synchronism, for if one tape is advanced without a similar advancement of the tape in the other transmitter the system will not function properly, as for proper operation it is absolutely necessary that the key tapes be stepped in synchronism. It is also necessary on operation of the switch 17 from one position to another to prevent operation of the relay 18 which, if operated, might be effective to release the distributor associated therewith. The feature of providing the switch 17 to control the ciphering mechanism to function either in an enciphering capacity or a deciphering capacity, or to remove the ciphering mechanism from operative association with the line circuit without disturbing the key tapes at either end of the line, constitutes one of the important features of the present arrangement. With the present arrangement of so controlling the ciphering mechanism, rephasing or resynchronizing of the key tapes at each end of the line is not required each time the function of the ciphering mechanism is changed from an enciphering capacity to a deciphering capacity, or vice versa, or when the ciphering mechanism is removed from and restored into operative relation with the line circuit.

With the switch 17 in the enciphering position or with the arms thereof in contact with

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their left hand studs, ground at the left hand stud of the sixth arm of the switch is connected to the rest segment R of ring 62, through brush 59 to ring 61, then over conductor 66 and through the seventh arm and left hand stud of the switch to the left hand stud of the first arm of the switch to the line L. The signals transmitted to the line with the switch in this position are produced as the brush 59 traverses the segmented ring 62 to transmit open and closed impulses to the line. In moving the arms of the switch 17 from contact with their left hand studs, with the exception of the eighth arm, the arms are adapted to contact their center studs before leaving their left hand studs. Thus, as the first arm of the switch 17 leaves its left hand stud, ground at the center stud of the third arm will be applied through the teleprinter 11 to the second arm and center stud, and thence through the center stud and first arm, to the line L. Thus, the first operation of the switch is to transfer the ground from the above-mentioned point to ground at a second point through the teleprinter 11. Movement of the fourth and fifth arms of the switch 17 from an enciphering to mid-position maintains the relay 18 in an energized condition so that the same cannot be operated inadvertently to initiate the movement of the brushes 27 and 28. In the mid-position the switch 17 disconnects the ciphering mechanism from the line L, but the teleprinter 11 is connected directly thereto. Thus, the teleprinter 11, which is a send-receive mechanism, can operate to transmit over the line L directly or to receive signals directly therefrom. The switch is placed in its normal position to transmit directly to and receive directly from the line L when it is desired to transmit information that it is not necessary to encipher.

The movement of the arms of the switch 17 from their mid-position into contact with their right hand studs or to deciphering positions places the relay 18 in series with the line L to ground, and the teleprinter 11 is connected from ground to the solid ring 61 of the distributor 56. With the switch in this position, the ciphering mechanism is operative to combine a key character from the key tape transmitter 44 with a character received over the line L, and the resultant character is recorded on the teleprinter 11. The manner of operation of the ciphering mechanism, when functioning in a deciphering capacity, is exactly the same as the function thereof in an enciphering capacity. In an enciphering capacity the signals originate in the teleprinter 11 and are combined with key characters from the tape transmitter 44 and are then transmitted to the line L. When functioning in a deciphering capacity, the signals can be considered to originate at the line L and are combined with characters from the key tape transmitter and are then transmitted to the teleprinter 11.

When the machine is used in a deciphering capacity, blanks received over the line L control the mechanism in exactly the same manner as the mechanism is controlled when the blanks originate in the teleprinter 11 with the mechanism functioning in enciphering capacity. Similarly, the fortuitous occurrence of a character received over the line L being similar to a key character in the tape transmitter controls the mechanism to delete the normal stepping pulse for the key transmitter, whereupon the received character is recorded unchanged at the tele-



printer, and the key character is available for combining with the next character received over the line.

From the above-described arrangement it will be evident that apparatus such as that shown in Fig. 1 is effective to combine a key character with a message character and transmit the enciphered character to the line L, and that with similar apparatus at the other end of the line the received enciphered character may be combined with the proper key character to produce the message character. Thus, as long as the two key tapes are similar and maintained in synchronism, the teleprinter 11 at the receiving end will print or record the same characters transmitted from the teleprinter at the sending end, although the signals transmitted over the line L in no way whatsoever resemble the message characters transmitted, and with key tapes of considerable length or indefinite length no pattern can be established whereby the message can be deciphered.

In order to make an enciphered message still more difficult to decipher by anyone listening in on the enciphered message during transmission thereof, a modification of the enciphering mechanism, as shown in Fig. 2, may be employed. In this modification means are provided whereby the bus bars on the key tape transmitter are reversed each time a predetermined set of conditions exist, which conditions occur fortuitously.

The system disclosed in Fig. 2 is in many respects similar in operation to the system disclosed in Fig. 1, and hereinafter the description of Fig. 2 will be limited to the modification thereof in respect to Fig. 1. The same reference numerals are used in both figures to denote similar elements in both figures.

As fully described in connection with Fig. 1, it will be recalled that the left hand coil of relay 49 is energized when the brush 23 contacts segment C of ring 26 whenever a blank is set up in the receiving storing relays R1 to R5 or when a key character and a message character combine to form a blank and operate the mixing relays M1 to M5 accordingly. When either of the above two conditions exists, ground from the tongue of the relay 76 or ground through the inner tongues of the mixing relays M1 to M5 connected in series is applied to one terminal of the left hand coil of the relay 49 so that, when the brush 23 contacts segment C, a circuit through this coil is completed and the relay is energized. Before the brush 23 passes off of segment C of ring 26, brush 53 of the distributor 56 will have contacted segment D of ring 54 to apply positive potential from the solid ring 57 over conductor 55, through the inside tongue of relay 49, the make stop associated therewith, a resistance 88, Fig. 2, through the right hand coil of relay 49 and over a conductor 89 to the inner tongue of a relay 91. Let it be assumed that at this time the relay 91, together with a second relay 92, is in a deenergized condition, and therefore the inner tongue of relay 91 will be on its break stop. For this condition the above circuit from positive potential at the solid ring 57 is continued from the break stop of the inner tongue of relay 91 over conductor 93, through the left hand coil of relay 92 and a resistance 94 to a point 95, and then through a resistance 96 to negative potential at 97. The completion of the above circuit energizes the left hand coil of relay 92, causing its tongue, which is connected through a rectifier 98 to ground, to engage its make stop to com-

plete a circuit from ground through the rectifier 98, the tongue, make stop and right hand coil of the relay 92, a conductor 99, the coil of the relay 91 and a resistance 101 to the point 95. By choosing suitable values for the resistances 88, 94, 96 and 101 in connection with the resistances of the coil of relay 91 and the left hand coil of relay 92, the potential at the point 95 when the above-mentioned circuit from negative potential at 97 through the left hand coil of relay 92 to positive potential at the ring 57 is completed will be zero, or slightly positive with respect to ground. Hence, no current will flow through the coil of relay 91 or the right hand coil of relay 92 as long as the above-mentioned condition exists. However, when the brush 58 passes off segment D of ring 54, point 95 will become negative with respect to ground, causing current to pass from the grounded tongue of relay 92 through the right hand coil thereof and the coil of relay 91 to operate the relay 91 and to hold the relay 92 operated. The above circuit through the right hand coil of relay 92 and the coil of relay 91 is a locking circuit and maintains the relays in an energized condition until conditions hereinafter described occur to deenergize the relays. Thus, the impulse, which originates at the segment D of ring 54 and is normally used to energize the stepping magnet 51 of the key transmitter 44, is employed to effect energization of the relays 91 and 92, which are locked in their energized condition when a blank is set up in the receiving storing relays R1 to R5 or in the mixing relays M1 to M5.

The spacing and marking bus bars 46 and 47, respectively, of the key transmitter 44, Fig. 2, are connected to the outer and center tongues of relay 91. The make stop of the center tongue of relay 91 and the break stop of the outer tongue are grounded, while the make stop of the outer tongue and the break stop of the center tongue are connected by a conductor 102 to the make stop of the outer tongue of relay 49. The outer and center tongues of relay 49 are grounded the same as in the system shown in Fig. 1.

With both relays 91 and 49 in their deenergized position, as shown in Fig. 2, the spacing bus bar 46 of the key tape transmitter 44 has ground applied thereto, while the circuit to the marking bus bar 47 is open. The operation of the relay 49 in the manner hereinbefore set forth, by the storing of the blank combination in the receiving storing relays R1 to R5, or the operation of the mixing relays M1 to M5 in a combination to represent a blank, applies ground to the break and make stops associated with the center and outer tongues, respectively, of relay 91. Accordingly, for the above conditions ground will also be applied to the marking bus bar 47 of the key tape transmitter, which results in the energization of all of the right hand coils of the mixing relays M1 to M5 regardless of the position of the tongues 43 in the key transmitter. The tongues of the mixing relays thereupon assume a setting representative of the character stored in the receiving storing relays R1 to R5, which character is subsequently transmitted to the line L or to the teleprinter 11, depending upon the position of the switch 17.

With both relays 49 and 91 in a deenergized condition, the energization of relay 49 causes the energization of relay 91 which locks up and remains in a locked condition until, as hereinafter described, the same is unlocked. Following the transmission of a character which initiated the



operation of the relay 49, the same returns to its deenergized condition as above described, while the relay 91 remains locked, and for these conditions the marking bus bar 47 of the key tape transmitter will have ground applied thereto, and the circuit to the spacing bus bar will be open. Thus, by operating the relay 91 the connections to the spacing and marking bus bars 46 and 47, respectively, of the tape transmitter are reversed, and accordingly transmission of impulses therefrom representing perforations in the key tape will be reversed in accordance with the operation of the relay 91. In this manner the presence of a perforation representing the character E, for example, over the pins of the key transmitter 44 which normally operated the same to effect movement of the first tongue 43 into contact with the spacing bus bar 46 and thereby render the right hand coil of the first mixing relay M1 energized and the right hand coils of relays M2 to M5 deenergized, will, with the connections to the bus bars reversed, render the right hand coils of the mixing relays M2 to M5 energized and the right hand coil of relay M1 deenergized. Thus, the effect of a key character in the key tape transmitter on the mixing relays M1 to M5 is reversed each time a blank is set up on the receiving relays or the mixing relays interpret a key character and a message character in such a manner as to form a blank. Such an arrangement adds materially to the security of the system and renders it much more difficult for anyone to decipher the enciphered message.

With the relays 91 and 92 locked up as hereinbefore described, the next operation of the relay 49 in response to a predetermined condition effects unlocking of the relays 91 and 92. After relay 49 is energized, the next contact of the brush 53 with the segment D of ring 54 establishes a circuit from positive potential through the right hand coil of relay 49, conductor 89, inner tongue and make stop of relay 91, to the point 103. The application of positive potential at the point 103 is effective to hold relay 91 energized and to neutralize the locking current through the right hand coil of relay 92, which effects deenergization of the relay, whereupon the tongue breaks the above-mentioned locking circuit through relay 92. The circuit through the coil of relay 91 continues until the brush 53 passes off the segment D, whereupon the relay 91 returns to its deenergized position, and the tongues thereof make contact with their break stops. When the relay 49 is subsequently deenergized, the marking and spacing bus bars of the key tape transmitter will be returned to their original condition or the condition wherein the spacing bus bar 46 is grounded and the marking bus bar is open. Thus, by means of the relays 91 and 92 connected as described, the impulse transmitted from the segment D of ring 54, which is normally operative to energize the stepping magnet 51 of the key tape transmitter, is made to operate the relays 91 and 92 for one set of conditions and to return the relays 91 and 92 to their unoperated positions on the re-occurrence of the same condition.

In the above description the signals transmitted to the line L were of the start-stop type, and where the receiving and sending ends of the line are separated by a considerable distance it is more economical to repeat the signals into a channel of a multiplex system and transmit the signals over the greater part of the distance by multiplex signals. If, as shown in Fig. 3, station

A is connected with station B, with ciphering mechanisms such as that shown in Fig. 1 at each station, by means of line sections L1, L2 and L3, with sections L1 and L3 arranged to transmit start-stop or simplex type signals and section L2 adapted to transmit multiplex signals, then repeaters of the multiplex-simplex type at stations C and D are necessary. The repeaters at stations C and D may be of the type disclosed in a patent to Noxon, No. 2,014,908, and in this type of repeater blanks are transmitted over the multiplex section when there are no intelligence signals received over the simplex section. Blanks are also fortuitously inserted in the transmitted signals by the multiplex-simplex repeaters, as they operate continuously, and their speed of operation is faster than the maximum speed of operation of the simplex lines. The blanks fortuitously inserted by the multiplex-simplex repeaters at stations C and D are deleted by the ciphering mechanism in the manner hereinbefore described, and the blanks are not effective to step the key tape at the receiving station, and accordingly the blanks have no effect. Thus, by the system disclosed in Fig. 1, a ciphering mechanism which is operable through multiplex-simplex repeaters is possible, and such constitutes an important improvement over prior art ciphering arrangements.

It is obvious, of course, that various other modifications of the system disclosed herein may be made without departing from the spirit or essential attributes of the invention, and it is desired, therefore, that only such limitations be placed thereon as are specifically set forth in the appended claims.

What is claimed is:

1. In a telegraph system, a source of message character code groups, a source of key character code groups, an enciphering means, means including said enciphering means to combine message character code groups with key character code groups to form according to a predetermined plan enciphered characters, a transmitting mechanism normally operative to transmit said enciphered characters to a sending circuit, and means operative on the combination of a message character with a key character to form a predetermined enciphered character to control said enciphering means and said transmitting mechanism to transmit said message character unchanged.

2. In a telegraph system, a source of message character code groups, a source of key character code groups, an enciphering means, means including said enciphering means to normally combine message character code groups with key character code groups to form according to a predetermined plan enciphered characters, a transmitting mechanism normally operative to transmit said enciphered characters to a sending circuit, and means operative on the receipt of a predetermined message character from said message character source to control said enciphering means and said transmitting mechanism to transmit said predetermined message character unchanged.

3. In a telegraph system of the type described, a cyclically operable character combining mechanism, a message character transmitting mechanism for transmitting message characters to said combining mechanism, a key character transmitting mechanism for transmitting key characters to said combining mechanism, said key character transmitting mechanism being controlled by a control strip normally advanced



on each cycle of operation of said combining mechanism, means for normally controlling said combining mechanisms to combine consecutive message characters with consecutive key characters in said control strip to form enciphered characters, a transmitting mechanism controlled by said combining mechanism to transmit said enciphered characters, means operative on the transmission of similar message and key characters to said combining mechanism in a cycle of operation to control said transmitting mechanism to transmit a like character and means operative during such cycles of operation of said transmitting mechanism to delete the normal advancement of the control strip in said key character transmitting mechanism.

4. In a telegraph system of the type described, a cyclically operable character combining mechanism, a message character transmitting mechanism for transmitting message characters to said combining mechanism, a key character transmitting mechanism for transmitting key characters to said combining mechanism, said key character transmitting mechanism being controlled by a control strip normally advanced on each cycle of operation of said combining mechanism to combine consecutive message characters with consecutive key characters in said control strip to form enciphered characters, a transmitting mechanism controlled by said combining mechanism to transmit said enciphered characters, means operative on the transmission of predetermined characters from said message character transmitting mechanism to said combining mechanism to control said transmitting mechanism to transmit a predetermined character and to delete the normal advancement of said control strip in said key character transmitting mechanism for the accompanying cycle of operation of said combining mechanism.

5. In a cipher telegraph system, a send-receive teleprinter for transmitting code groups and recording received code groups, a key character transmitter for transmitting key character code groups, a send-receive line circuit, an enciphering mechanism, a multiple positionable switching means interconnecting said key character transmitter, said teleprinter, said enciphering mechanism and said line circuit, means controlled by said switching means in one position to control said enciphering mechanism to combine key characters from said key character transmitter with characters transmitted from said teleprinter to form enciphered characters and transmit the same to said line circuit, said send-receive teleprinter recording characters as transmitted therefrom with said switching means in such a position and means controlled by said switching means in a second position to control said enciphering mechanism to combine key characters from said key character transmitter with enciphered characters received over said line circuit to form deciphered characters and transmit the same to said teleprinter.

6. In a cipher telegraph system, a send-receive teleprinter for transmitting code groups and recording received code groups, a key character transmitter for transmitting key character code groups, a send-receive line circuit, an enciphering mechanism, a multiple positionable switching means interconnecting said key character transmitter, said teleprinter, said enciphering mechanism and said line circuit, means controlled by said switching means in one position to control

said enciphering mechanism to combine key characters from said key character transmitter with characters transmitted from said teleprinter to form enciphered characters and transmit the same to said line circuit, said send-receive teleprinter recording characters as transmitted therefrom with said switching means in such a position, means controlled by said switching means in a second position to control said enciphering mechanism to combine key characters from said key character transmitter with enciphered characters received over said line circuit to form deciphered characters and transmit the same to said teleprinter, and means controlled by said switching means in a third position to connect said teleprinter directly to said line circuit to record signals received thereover and to transmit signals directly thereto.

7. In a telegraph system of the type described, a message character transmitting mechanism, a key character transmitting mechanism adapted to be controlled in accordance with the perforations in a perforated key tape, a combining mechanism normally operative to receive and combine message characters with key characters to form enciphered characters, a transmitting mechanism normally operative to transmit said enciphered characters to a sending circuit and concomitantly advance the tape in said key character transmitting mechanism, means operative on the receipt at said combining mechanism of similar characters from said message character transmitting mechanism and said key character transmitting mechanism to control said transmitting mechanism to transmit said message character unchanged, to delete the normal stepping of said key tape in said key character transmitting mechanism and to effect predetermined changes of said key character transmitting mechanism.

8. In a telegraph system of the type described, a source of message character code groups, a source of key character code groups, means for combining said message character code groups with said key character code groups to form in accordance with a predetermined plan enciphered character code groups, a transmitting means for transmitting said enciphered character code groups, code reading means, a first means including said reading means operative on the combination of a key character with a message character to form a predetermined enciphered character code group to control said transmitting means to transmit said message character code group unenciphered and a second means including said reading means operative on the transmission of a predetermined message character code group from said message character source to control said transmitting means to transmit said message character code group unenciphered.

9. In a secret telegraph system, a source of message character code groups, a key character transmitting means including spacing and marking bus bars with tongues arranged to contact said bus bars in accordance with the perforations in a controlling key tape, said bus bars having different connections thereto, means for combining message character code groups with code groups from said key character transmitting means to form an enciphered characters, a transmitting means for transmitting said enciphered characters and also operative to advance the controlling key tape in said key character transmitting means, means controlled by enciphered char-



acters of predetermined nature to reverse the connections to said spacing and marking bus bars in said key character transmitting means, to control said transmitting means to transmit the message character unchanged and to delete the stepping impulse to said key character transmitting means.

10. In a telegraph system of the type described, a source of message character code groups, a source of key character code groups including a transmitter having two bus bars with members adapted to contact the same in accordance with the nature of a control medium, one of said bus bars normally having ground connected thereto and the other normally being in an open circuit, a cyclically operable means normally operative to combine, in a predetermined manner, the individual impulses of a message character with the individual impulses of a key character to form an enciphered code and concomitantly advancing the control medium in said key character transmitter, and means operative on the combining of the impulses of a message character with the impulses of a key character to form a predetermined enciphered code group to reverse the connections to said bus bars, to transmit the message character unenciphered and to prevent the advancement of the control medium in said key transmitter for the attendant cycle of operation of said combining means.

11. In a telegraph system of the type described, a source of message character code groups, a source of key character code groups including a transmitter having two bus bars with members adapted to contact the same in accordance with the nature of a control medium, one of said bus bars normally having ground connected thereto and the other normally being in an open circuit, a cyclically operable means normally operative to combine, in a predetermined manner, the individual impulses of a key character to form an enciphered code group character, means for transmitting said enciphered characters and concomitantly advancing the control medium in said key character transmitter, means operative on the receipt of message characters of predetermined nature to control said combining means to delete the normal combining operation thereof and to control said transmitting means to transmit characters of predetermined nature for such abnormal cycles of operation of combining means, and means for deleting the advancement of the control medium in said key transmitter and to reverse the connections to the bus bars therein on said abnormal operation of said combining means.

12. In a telegraph system of the type described, a source of message character code groups, a source of key character code groups including a transmitter having two bus bars with members adapted to contact the same in accordance with the nature of a control medium, one of said bus bars normally having ground connected thereto and the other normally being in an open circuit, a cyclically operable means initiated into operation on the receipt of each code group from said message character source, said last-mentioned means having normal and abnormal cycles of operation, means operative on normal cycles of operation of said means to combine, in a predetermined manner, the individual impulses of a message character with the individual impulses of a key character to form an enciphered character and transmit the same, means operative in an abnormal cycle of operation to reverse the bus bars of said key transmitter, to delete the normal

advancement of the control medium therein and to transmit the message character unchanged, a first means controlled by said message characters and a second means controlled by said enciphered characters for determining through which of said two cycles of operation said cyclically operable means operate.

13. In a telegraph system of the type described, a source of message character code groups, a source of key character code groups including a transmitter having two bus bars with members adapted to contact the same in accordance with the nature of a control medium, one of said bus bars normally having ground connected thereto and the other normally being in an open circuit, a cyclically operable means initiated into operation on the receipt of each code group from said message character source, said last-mentioned means having normal and abnormal cycles of operation, means operative in normal cycles of operation of said means to combine, in a predetermined manner, the individual impulses of a message character with the individual impulses of a key character to form an enciphered character and transmit the same, means operative in an abnormal cycle of operation to reverse the bus bars of said key transmitter, to delete the normal advancement of the control medium therein and to transmit the message character unchanged, a first means controlled by said message characters and a second means controlled by said enciphered characters for determining through which of said two cycles of operation said cyclically operable means operates, and means for maintaining the connections to said bus bars in reversed condition until the next abnormal cycle of operation of said cyclically operable means.

14. In a telegraph system, a first source of character code groups, a second source of character code groups, a combining means, means including said combining means normally operative to combine a code group from said first source with a code group from said second source, a transmitting means for transmitting said combined code groups, a first means controlled by code groups of predetermined nature from said first source and a second means controlled by code groups from said first source and code groups from said second source having a predetermined relationship with each other to delete the normal combining operation of said combining means and to control said transmitting means to transmit code groups of predetermined nature.

15. In a telegraph system, a first source of character code groups, a second source of character code groups, a combining means, means including said combining means normally operative to combine a code group from said first source with a code group from said second source, a transmitting means for transmitting said combined code groups, a first means controlled by code groups of predetermined nature from said first source and a second means controlled by code groups from said first source and code groups from said second source having a predetermined relationship with each other to delete the normal combining operation of said combining means and to control said transmitting means to transmit code groups of predetermined nature, and to vary in accordance with a predetermined plan following code groups from said second source.

16. In a telegraph system, a first source of code groups with each group composed of a definite number of coded impulses, a second source of code groups composed of a like number of coded



impulses, means for combining in accordance with a predetermined plan code groups from each of said sources to form other code groups containing the same number of impulses, means for controlling said combining means to vary the plan of combining said code groups, and means controlled by code groups from a predetermined one of said sources for controlling said last-mentioned means.

17. In a telegraph system, a first source of code groups, a second source of code groups, a cyclically operable combining means for combining code groups from each of said sources to form combined code groups, a first reading means for reading code groups from one of said sources, a second reading means for reading combined code groups, a transmitting means for transmitting said combined code groups, means controlled by either of said reading means to delete a cycle of operation of said combining means, and means operative on the deletion of a cycle of operation of said combining means to control said transmitting means to transmit a code group from only one of said sources.

18. In a telegraph system, a send-receive line circuit, a station including a send-receive telegraph machine, a key character transmitter, a ciphering mechanism and a multi-positionable control switch at each end of said line circuit, means including the switch at one of said stations in a predetermined position for controlling the associated ciphering mechanism to combine characters from the send-receive telegraph machine with characters from said key character transmitter thereat to form enciphered characters and to transmit the same to said line circuit, said send-receive telegraph machine recording the characters as transmitted therefrom with said switch in said predetermined position means including the switch at the other of said stations in a predetermined position to control the associated ciphering mechanism to combine the character received over said line circuit with characters from said key character transmitter thereat to form deciphered characters and means including the send-receive telegraph machine at the second station for recording said deciphered characters.

19. In a telegraph system, a send-receive line circuit, a station including a send-receive telegraph machine, a key character transmitter, a ciphering mechanism and a multi-positionable control switch at each end of said line circuit, means including the switch at one of said stations in a predetermined position for controlling the associated ciphering mechanism to combine characters from the send-receive telegraph machine with characters from the key character transmitter thereat to form enciphered characters and to transmit the same to said line circuit, said send-receive telegraph machine recording the characters as transmitted therefrom with said switch in said predetermined position, means including the switch at the other of said stations in a predetermined position to control the associated ciphering mechanism to combine the character received over said line circuit with characters from said key character transmitter thereat to form deciphered characters, means including the send-receive telegraph machine at the second station for recording said deciphered characters, and means including the switches at each of said stations in a second predetermined position for reversing the functioning of said first and second stations.

20. In a telegraph system, a send-receive line circuit, a station including a send-receive telegraph machine, a key character transmitter, a ciphering mechanism and a multi-positionable control switch at each end of said line circuit, means including the switch at one of said stations in a predetermined position for controlling the associated ciphering mechanism to combine characters from the send-receive telegraph machine with characters from said key character transmitter thereat to form enciphered characters and to transmit the same to said line circuit, means including the switch at the other of said stations in a predetermined position to control the associated ciphering mechanism to combine the character received over said line circuit with characters from said key character transmitter thereat to form deciphered characters, means including the send-receive telegraph machine at the second station for recording said deciphered characters, means including the switches at each of said stations in a second predetermined position for reversing the functioning of said first and second stations, and means for maintaining said line circuit in a predetermined condition during the operation of said switches.

21. In a telegraph system, a send-receive line circuit, a station including a send-receive telegraph machine, a key character transmitter, a ciphering mechanism and a multi-positionable control switch at each end of said line circuit, means including the switch at one of said stations in a predetermined position for controlling the associated ciphering mechanism to combine characters from the send-receive telegraph machine with characters from said key character transmitter thereat to form enciphered characters and to transmit the same to said line circuit, means including the switch at the other of said stations in a predetermined position to control the associated ciphering mechanism to combine the character received over said line circuit with characters from said key character transmitter thereat to form deciphered characters, means including the send-receive telegraph machine at the second station for recording said deciphered characters, means including the switches at each of said stations in a second predetermined position for reversing the functioning of said first and second stations, means for maintaining said line circuit in a predetermined condition during the operation of said switches, and means for maintaining said ciphering mechanisms and said key transmitter in predetermined conditions during the operation of said switches.

22. In a telegraph system, a send-receive line circuit, a station including a send-receive telegraph machine, a key character transmitter, a ciphering mechanism and a multi-positionable control switch at each end of said line circuit, means including the switch at one of said stations in a predetermined position for controlling the associated ciphering mechanism to combine characters from the send-receive telegraph machine with characters from the key character transmitter thereat to form enciphered characters and to transmit the same to said line circuit, said send-receive telegraph machine recording the characters as transmitted therefrom with said switch in said predetermined position means including the switch at the other of said stations in a predetermined position to control the associated ciphering mechanism to combine the character received over said line circuit with characters from said key character transmitter thereat to form de-



ciphered characters, means including the send-receive telegraph machine at the second station for recording said deciphered characters, means including the switches at each of said stations in a second predetermined position for reversing the functioning of said first and second stations, and means controlled by the switches at each of said stations in a third position for connecting the send-receive telegraph machines directly to the line circuit to enable the same to directly transmit and receive characters thereover.

23. In a telegraph system, a line circuit including simplex operated terminal sections and at least one intermediate multiplex operated section, signal repeaters at the junctions of said multiplex and simplex operated sections which operate to fortuitously insert predetermined code groups into the code groups repeated, cyclically operable simplex message character send-receive mechanisms at the terminals of said circuit, means at the terminals of the line for enciphering and deciphering messages transmitted and received respectively over said line, means for normally operating said enciphering means concomitantly with each message character code group transmitted, means for normally operating said deciphering means concomitantly with each character code group received, and means for preventing the operation of said deciphering means on receipt of the predetermined code groups inserted at said repeaters.

24. In a telegraph system, a line circuit including simplex operated terminal sections and at least one intermediate multiplex operated section, signal repeaters at the junctions of said multiplex and simplex operated sections which operate to fortuitously insert predetermined code groups into the code groups repeated, cyclically operable simplex message character send-receive mechanisms at the terminals of said circuit, means at the terminals of the line for enciphering and deciphering messages transmitted and received respectively over said line, said enciphering and deciphering means normally operating concomitantly with each transmitted and received code group respectively, means for preventing the normal operation of the enciphering means on the transmission of code groups of a second predetermined nature, and means for preventing the normal operation of said deciphering means on the receipt of the code groups inserted at said repeaters and the receipt of the code groups of said second predetermined nature.

25. In a telegraph system, a line circuit including simplex operated terminal sections and at least one intermediate multiplex operated section, signal repeaters at the junctions of said multiplex and simplex operated sections which operate to fortuitously insert predetermined code groups into the code groups repeated, cyclically operable simplex message character send-receive mechanisms at the terminals of said circuit, means at the terminals of the line for enciphering and deciphering messages transmitted and received respectively over said line, said enciphering and deciphering means normally operating to combine each message code group to be transmitted and each received enciphered code group with a key code group, said key code groups being similar sequences, means operative on the occurrence of a message code group similar to the key code group to be combined therewith to prevent the operation of said enciphering means and effect transmission of said message code group unchanged, and means operative on the receipt of a

code group at the deciphering station similar to the key code group to be combined therewith to prevent operation of said deciphering means and effect recording of the received code group unchanged.

26. In a telegraph system, a source of message character code groups, a source of key character code groups, an enciphering means, means including said enciphering means to combine message character code groups with key character code groups to form according to a predetermined plan enciphered character code groups, a transmitting mechanism normally operative to transmit said enciphered character code groups to a sending circuit and means operative on the combination of a message character code group with a key character code group to form a blank character code group to control said enciphering means and said transmitting mechanism to transmit said message character code group unchanged.

27. In a telegraph system, a source of message characters, a source of key characters, an enciphering means, means including said enciphering means to combine message characters with key characters to form according to a predetermined plan enciphered characters, a transmitting mechanism normally operative to transmit said enciphered characters to a sending circuit and means operative on the combination of a message character with a key character to form a blank character to delete the transmission of said blank character and transmit said message character unenciphered.

28. In a telegraph system, a source of message characters, a source of key characters, an enciphering means, means including said enciphering means to combine message characters with key characters to form according to a predetermined plan enciphered characters, a transmitting mechanism normally operative to transmit said enciphered characters to a sending circuit and means operative on the combination of a message character with a key character to form a blank character to delete the transmission of said blank character and transmit unenciphered one of the characters that combined with the other to form said blank character.

29. In a telegraph system, a source of message characters, a source of key characters, an enciphering means, means including said enciphering means to combine message characters with key characters to form according to a predetermined plan enciphered characters, a transmitting mechanism normally operative to transmit said enciphered characters to a sending circuit and means operative on the combination of a message character with a key character to form a blank character to delete the transmission of said blank character and transmit unenciphered one of the characters from a predetermined one of said sources that combined with the character from the other of said sources to form said blank character.

30. In a telegraph system, a source of message character code groups, a source of key character code groups, an enciphering means, means including said enciphering means to normally combine message character code groups with key character code groups to form according to a predetermined plan enciphered character code groups, a transmitting mechanism normally operative to transmit said enciphered character code groups to a sending circuit and means operative on the receipt of a blank character code group from said message character code group



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source to control said enciphering means and said transmitting mechanism to transmit said blank character code group unchanged.

31. In a telegraph system of the type described, a cyclically operable character combining mechanism, a message character transmitting mechanism for transmitting message characters to said combining mechanism, a key character transmitting mechanism for transmitting key characters to said combining mechanism, said combining mechanism normally operating to combine successive message characters with successive key characters to form enciphered characters, a third transmitting mechanism controlled by said combining mechanism to transmit said enciphered characters, means operative on the transmission of predetermined characters from said message character transmitting mechanism to said combining mechanism to control said third transmitting mechanism to transmit a predetermined character and to delete a cycle of operation of one of said transmitting mechanisms for the accompanying cycle of operation of said combining mechanism.

32. In a telegraph system of the type described, a cyclically operable character combining mechanism, a message character transmitting mechanism for transmitting message characters to said combining mechanism, a key character transmitting mechanism for transmitting key characters to said combining mechanism, said combining mechanism normally operating to combine consecutive message characters with consecutive key characters to form enciphered characters, a third transmitting mechanism controlled by said combining mechanism to transmit said enciphered characters, means operative on the transmission of a predetermined character from said message character transmitting mechanism to said combining mechanism to control said third transmitting mechanism to transmit a predetermined character and to delete a cycle of operation of one of said transmitting mechanisms for the accompanying cycle of operation of said combining mechanism.

33. In a telegraph system of the type described,

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a cyclically operable character combining mechanism, a message character transmitting mechanism for transmitting message characters to said combining mechanism, a key character transmitting mechanism for transmitting key characters to said combining mechanism, means for controlling said combining mechanism to combine consecutive message characters with consecutive key characters to form enciphered characters, a third transmitting mechanism controlled by said combining mechanism to transmit said enciphered characters, means operative on the transmission of similar message and key characters to said combining mechanism in a cycle of operation to control said third transmitting mechanism to transmit a similar character and combine one of said like characters in said transmitting mechanisms with a succeeding unlike character in the other of said transmitting mechanisms.

34. In a telegraph system of the type described, a cyclically operable character combining mechanism, a message character transmitting mechanism for transmitting message character code groups to said combining mechanism, a key character transmitting mechanism for transmitting key character code groups to said combining mechanism, means for normally controlling said combining mechanism to combine consecutive message character code groups with consecutive key character code groups to form enciphered character code groups, a third transmitting mechanism controlled by said combining mechanism to transmit said enciphered character code groups, means operative on the transmission of similar message and key character code groups to said combining mechanism in a single cycle of operation of said combining mechanism to control said third transmitting mechanism to transmit a like character code group and means operable during such cycles of operation of said third transmitting mechanism to delete a cycle of operation of one of said transmitting mechanisms.

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