

June 11, 1946.

L. A. BRIGGS ET AL

2,401,855

ENCIPHERING AND DECIPHERING SYSTEM

Filed May 27, 1942

2 Sheets-Sheet 1

Fig. 1.

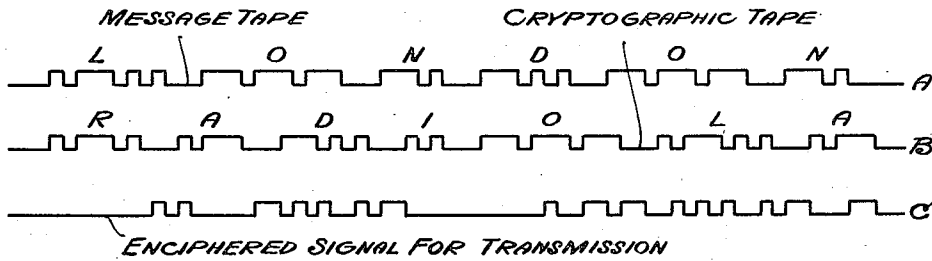
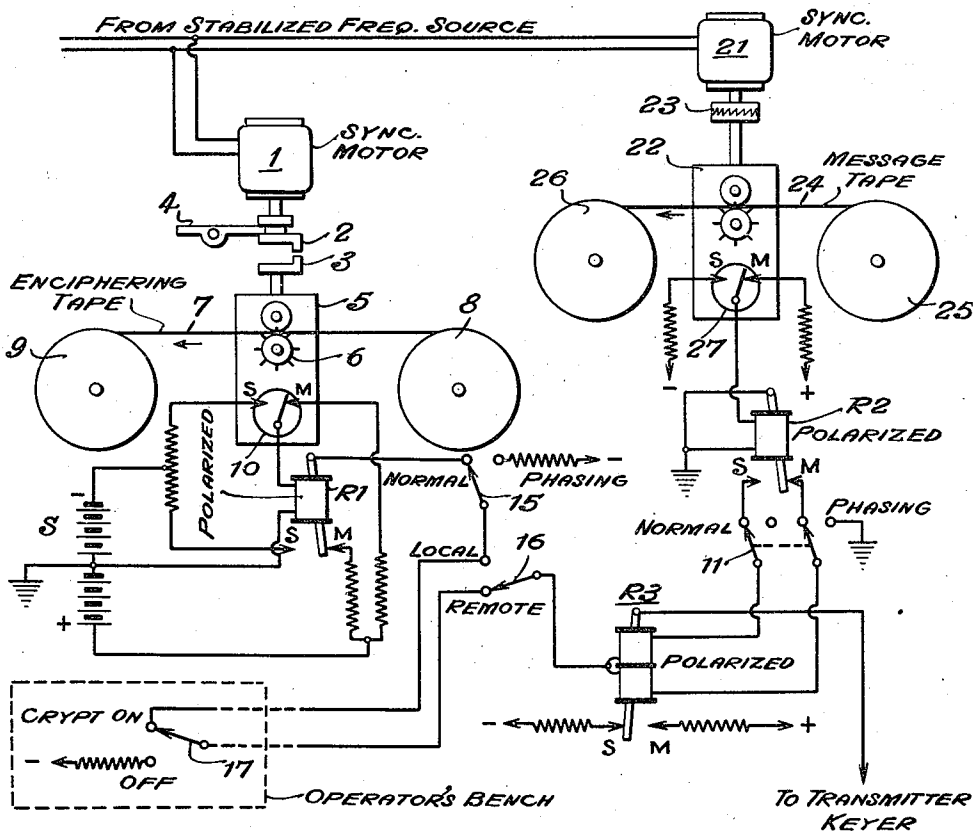


Fig. 2.



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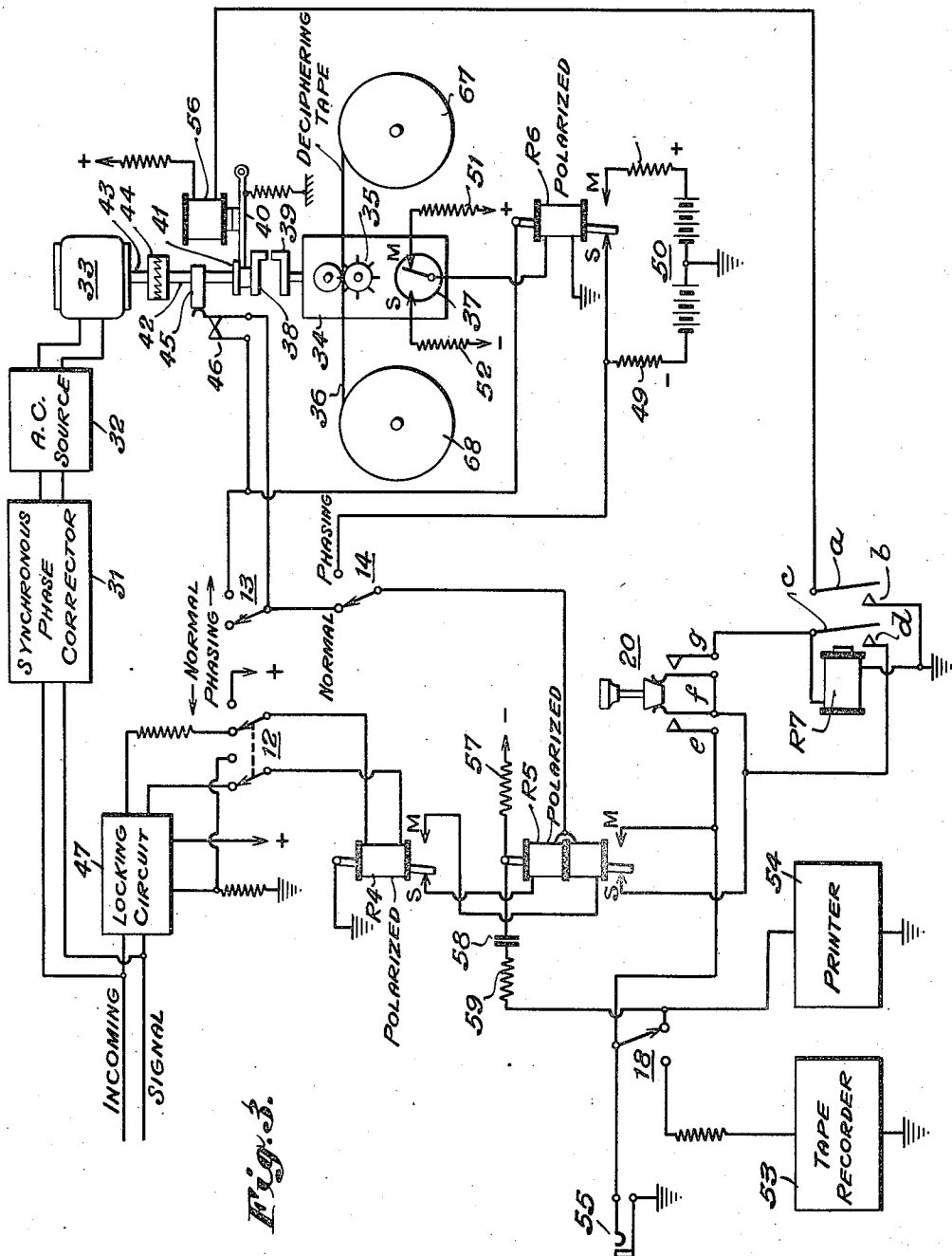


Fig. 3.

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ENCIPHERING AND DECIPHERING SYSTEM

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12 Claims. (Cl. 178-22)

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This invention relates to secret signaling systems and has particularly to do with apparatus and a method of enciphering telegraph code signals so as to insure secrecy in transmission.

Our system is adapted for use in connection with any of the well-known code systems of telegraphy as used for example on radio channels and wire lines. While it is possible to use our system in connection with the enciphering of equal length printer code signals, the system has further advantages in that it may be used in connection with the transmission of unequal length code signals, say, of the international Morse code. The transmitted signals, however, are derived from the random reversal of sense of the marking and spacing elements of the message signals. The transmitted signals are, therefore, quite unintelligible to an unauthorized person intercepting them.

In carrying out our invention, we make use of a cryptographic tape which is perforated with a random train of marking and spacing signals. Identical tapes so perforated are used at the transmitting and receiving stations, and these tapes must be fed through similar transmitting heads in phase with one another in order that the enciphering operation at the sending station may be complemented by a deciphering operation at the receiving station. The enciphering tape is fed through an auxiliary transmitter at the same baud rate at which a message tape is fed through a main transmitter.

The points of separation between the character code combinations of unequal length in the message tape, and in the enciphering tape, generally lack coincidence. This is particularly true where the message tape is perforated with Morse code combinations and where the enciphering tape is perforated with either Morse code combinations or a random train of perforations representing no intelligence whatsoever.

The message tape commonly transmits a continuous flow of equal length printer code signals. The character code combinations have no space separation. It is well known, however, that a tape perforated to transmit equal length code signals may be used either for control of a multiplex or a simplex printer. Irrespective of use in a multiplex or a simple channel system, the cryptographic tape is preferably perforated with unequal length character combinations or with a random train of unintelligible marking and spacing elements. Such a cryptographic tape substantially introduces a loss and gain of individual marking code elements in a random

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manner. Furthermore, no possible analysis of the transmitted signals will disclose the points of separation of the character code combinations with certainty. In this respect, our system has great advantages over previously known systems of enciphering by means of a cryptographic tape.

It is an object of our invention to provide a cryptographic system for telegraph communications such that the transmitted signals shall be undecipherable by an unauthorized recipient.

It is another object of our invention to provide automatic means for deciphering cryptographic communications signals.

Still another object of our invention is to provide a method for correctly phasing the receiving apparatus with respect to the transmitting apparatus when cryptographic tape transmitters are used at both terminals. This method includes automatically starting a deciphering tape at the receiving station at the precise moment when a corresponding point in the enciphering tape becomes effective for signal transmission.

Other objects and advantages of our system will be made apparent in the description to follow. This description is accompanied by drawings, in which:

Fig. 1 shows graphically three typical trains of marking and spacing signals, one train being a message in ordinary Morse code, the second train representing code signals in a cryptographic tape, and the third train constituting the enciphered signal to be transmitted;

Fig. 2 shows a circuit diagram of apparatus to be used at a transmitting station; and

Fig. 3 shows a circuit diagram of apparatus to be used at a receiving station.

The method of attaining our objects is best illustrated by reference to Fig. 1. Bearing in mind that the prime objective is to distort the message signals so that they shall be rendered unintelligible when intercepted by an unauthorized person, it will be observed that the enciphered signal shown on line C of Fig. 1 bears no apparent relation to the train of signals shown on line A, which represents the usual Morse code elements. The enciphered signal for transmission results from certain reversals of sense of the marking and spacing elements in train A, such as may be produced by simultaneously running a cryptographic tape through an auxiliary transmitter and combining the effects of the two simultaneous transmissions of train A and train B. The distortion is such that when a marking element of a message occurs simultaneously with a marking element in the cryptographic tape, a

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space signal is transmitted. Likewise, when the message tape and the cryptographic tape both provide a spacing condition, a space signal is also transmitted. Marking elements are transmitted only when the sense of the signals in the message tape and the cryptographic tape is opposed.

At the receiving station a replica of the cryptographic tape is provided whereby the enciphered signal as received may be decoded.

The deciphering process at the receiving station may be best understood in its relation to the enciphering process at the transmitting station by reference to the following tabulation showing the four possible permutations of marking elements M and spacing elements S in the message and cryptographic tapes respectively:

Transmitter		(3) Cryptogram as trans- mitted	Receiver	
(1) Message tape	(2) Enciphering tape		(4) Deciphering tape	(5) Effects recorded
M M S S	M S M S	S M M S	M S M S	M M S S

Thus the code elements of the message tape may or may not be reversed in sense. Note the difference between columns 1 and 3. Note, too, the likeness between columns 1 and 5, and the likeness between columns 2 and 4. The sense reversals take place in accordance with the random occurrence of marking code elements in the enciphering tape. The sense of the code elements in the message tape is unchanged when accompanied by a spacing element in the enciphering tape. It will be clear that the code elements of the transmitted cryptogram, column 3, are incapable of translation into the code elements of the message signals, column 1, without the aid of deciphering tape, column 4, which must be an exact duplicate of the enciphering tape, column 2.

From the foregoing paragraph, it will be observed that the superposition of one train of code signals upon another causes random "drop-outs" and "fills" to appear in the transmitted signals. These signals are then restored to normal condition through the decoding device which is associated with the receiver.

Although the apparatus which is used at the transmitting and receiving stations is similar in many respects, it is deemed preferable for a clear understanding of the invention as a whole that the circuit arrangements be separately described for the two stations. The method of phasing the receiving apparatus with the transmitting apparatus involves steps, however, in which both the transmitting station and the receiving station must be considered parts of a complete system. We shall first, therefore, describe the apparatus to be used at the transmitting station.

The transmitting station

Successful operation of our system requires that the tape transmitter be operated by a motor which is driven from a stabilized frequency source. Such a motor drive is commonly used for tape transmission in multiplex and simplex printer code signaling and has also been found useful in the transmission of Morse signals. Means are well known in the art for maintaining the apparatus at a receiving station in synchronism with the incoming signals, provided these signals are made up of marking and spacing elements of uni-

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form length and multiples of the baud unit length by which the shortest signaling elements are measured.

Referring now particularly to Fig. 2, we show a synchronous motor 1 driven from a stabilized frequency source (not shown). On the shaft of motor 1, we provide a clutch member 2 which may be engaged with another clutch member 3 upon proper manual setting of a lever 4. The tape transmitter unit 5 is of conventional type and includes a sprocket tape feed wheel 6, the teeth of which mesh with feed holes in an enciphering tape 7. This tape may, if desired, be carried on an unwinding drum 8 and a winding drum 9.

Details of construction of the tape-controlled transmitting unit 5 are not given because they are well known in the art. As a result of feeding the tape successively to different transmitting positions, marking and spacing contacts may be made by the keying unit 10 so as to actuate a polarized relay R1 in dependence upon the polarity of the current which is fed to the tongue in the unit 10. Relay R1, as well as other polarized relays shown in the drawings, should be of the well-known type which is designed to magnetically hold its tongue against one contact following a movement thereto, and during a no-current condition in its windings, and until a subsequent energization which moves the tongue to the opposite contact.

Another synchronous motor 21 is employed to drive a message tape transmitting unit 22 through a clutch member 23. The transmitting unit 22 may be exactly similar to the aforementioned transmitting unit 5. A message tape 24 may be carried on two drums 25 and 26, the one for feeding into the unit 22 and the other for winding up the tape after it has been used. Conventional keying units 10 and 27 in the transmitters 5 and 22 respectively each have spacing contacts connected through suitable resistors to the negative terminal of a direct current source S. The marking contacts in these keying units 10 and 27 are likewise connected through suitable resistors to the positive terminal of the same direct current source. The mid-point on this source is grounded. To simplify the drawings, only a few of the circuit connections to the source S are completed, while others are indicated by + and - signs.

The tongue of the keying unit 27 is connected to one winding terminal of a polarized relay R2. The other winding terminal is grounded. The polarized relay R3 is jointly controlled by relays R2 and R1 and is used for combining the effects of transmission from the message tape 24 and the enciphering tape 7. Relay R3 is polarized and has two windings the upper of which is normally connected to the spacing contact in relay R2, whereas the lower winding is normally connected to the marking contact in relay R2. An inner terminal of one winding and an outer terminal of the other winding on relay R3 are interconnected and are conductively connected to the switch blade 16.

The message tape sender may be used either with or without the enciphering tape sender. Accordingly we use switches 16 and 17 in the positions shown for combining the message tape impulses with the enciphering tape impulses. Switch 17 is preferably located at the operator's bench and should be thrown downwardly for transmission of straight Morse signals. The same result may be obtained at the monitoring station where switches 15 and 16 are located. The enciphering tape sender is rendered effective when

switch 15 is thrown to the left. The right hand position of switch 15 is used for phasing. The enciphering of signals may be started or stopped at the operator's station by suitably setting the switch 17, provided switch 16 is previously set to the position marked "Remote." Accordingly, relay R3 can be removed from the influence of impulses from relay R1 by setting the blade of switch 15 to its negatively poled right hand contact, or by setting switch 16 to the "remote" side and switch 17 to its negatively poled lower contact.

When the message sender relay R2 is to be the sole means for controlling relay R3, the operator throws switch 17 to the "off" position so that negative battery may be applied to the center terminals of relay R3. When the grounded tongue of relay R2 is on the marking side, it feeds a neutral potential through the lower winding of relay R3 and thence to the negative terminal of the source S. This condition is reflected by the throwing of the armature in relay R3 to the marking side where it derives a positive potential to be fed to a transmitter keyer. The keyer is not shown, but may be of a type which is conventional in radio transmitters. When relay R2 is on the spacing side, then a neutral potential is fed through the spacing contact to the upper winding of relay R3 and thence to the negative battery terminal. Energization of the upper winding in this manner will cause the armature of relay R3 to be attracted to its spacing contact, from which it derives a negative potential to be applied to the transmitter keyer.

In the preceding paragraph, the operation of the transmitting apparatus is described as though the enciphering tape were held inactive. When enciphering of the message is to be performed, however, the manual lever 4 will be moved to engage the clutch members 2 and 3 so as to feed the enciphering tape simultaneously with the message tape 24 and at the same rate of feed.

During the enciphering of messages, the two tape controlled keyers 10 and 27 will operate in such manner as to obtain a cryptographic train of signals according to column 3 in the foregoing table of marking (M) and spacing (S) elements. The joint control of relay R3 by relays R1 and R2 may be readily understood when it is observed that the action of relay R3 depends upon which of its windings is energized by relay R2, and upon the direction of the current flow in the selected winding. Relay R1 controls the direction, and relay R3 operates like any conventional polarized relay.

The manual switches 11, 15, and 16 shown at the transmitting station are used for phasing at the outset of transmission of intelligence. The method of phasing will be described in more detail after covering a description of the receiving station.

The receiving station

It will be understood that the function of the "decoder" section in the receiving station is to restore the drop-outs and fills which have been inserted by the enciphering transmitter at the transmitting station. It, therefore, follows that the decoder must be driven in synchronism and in phase relation with the code elements as initiated at the transmitting station. Synchronism is obtained in a conventional manner by the use of a synchronous phase corrector unit 31, Fig. 3. A convenient phase corrector has been shown and described in United States Patent No. 2,258,151, granted October 7, 1941 to E. R. Shenk.

Other types of phase correctors may, however, be used if desired. Such phase correctors are rendered responsive to the incoming signals for controlling the frequency of a local oscillator which in turn determines the regulation of the frequency of an alternating current source, indicated at 32 for driving a synchronous motor 33.

A deciphering tape transmitter is conventionally indicated at 34 as having a tape sprocket feed wheel 35 for feeding a deciphering tape 36 past the points of detection of its perforations. The tape is unwound from a reel 67 and rewound on a reel 68.

In order to have the motor 33 running in proper phase relation at the instant of starting the deciphering tape, an automatic clutch mechanism is provided which has a "one-point" engagement. This clutch mechanism comprises a driving clutch member 38 which is rotated by the motor 33 and a driven clutch member 39 mounted on the shaft of the transmitting head 34. The clutch members 38 and 39 are held mutually engaged by means of a spring-actuated lever arm 40 the end of which rides in a groove on the hub 41 at the end of the motor driven shaft 42. For phasing purposes, the shaft 42 is coupled to the motor shaft 43 by means of a pair of toothed coupling disks 44. Mounted on the shaft 42 is a cam 45, this being provided for actuating a pair of contact springs 46 to close the same once during the occurrence of each baud of signal reception. Of course, a commutator switch may be substituted for the springs 46 if desired. The cam and contact spring construction as shown operates as a telegraph regenerator in order to select a smaller period of time within the baud unit itself in which to combine the deciphering tape signals with those from the incoming signal circuit. In this manner any slight phase irregularities may be neglected between the operation of the receiving relay R4 and the relay R6, where the latter is controlled by the deciphering code transmitter 34. The cam 45 rotates once for every baud and produces contacting time for the contact springs 46 equal to about 50% of the baud time unit.

The incoming signals are applied to a locking circuit 47 which may be of any well-known type. The output from the locking circuit is normally connected across the winding of polarized relay R4. This relay has marking and spacing contacts associated with its grounded tongue so that one or the other of two winding circuits in polarized relay R5 may be energized in dependence upon the position assumed by the armature of relay R4. The references M and S, by which the contacts of relay R4 are designated, refer to marking and spacing conditions to be assumed by relay R4 in response to the incoming code signals.

Relay R5 has two windings which are respectively energizable by the marking and spacing contacts of relay R4. The outer end of the one winding is connected to the inner end of the other and these ends are normally connected through switch 14 and contacts 46 to the tongue of relay R6. The marking and spacing contacts of relay R6 are suitably polarized, being connected through resistors 48 and 49 respectively to the positive and negative terminals of the source 50. This source has a grounded mid-tap.

The winding of relay R6, which is a polarized relay, is in circuit between the tongue of the tape controlled keyer 37 and ground. The marking and spacing contacts of the keyer 37 are also

connected to the positive and negative terminals respectively of source 50, and such connections are provided with suitable resistors 51 and 52.

The method of phasing

The transmitter heads 5 and 22 at the transmitting station and the transmitter head 34 at the receiving station may all of them be of a type which automatically transmits alternate bauds as marking and spacing elements when running without tape. At the transmitting station, it is necessary to mutually phase the transmitter heads 5 and 22. This operation is as follows:

Either of the transmitter heads 5 or 22 when operated alone may be caused to deliver alternate marking and spacing impulses to a radio transmitter keyer or to a monitoring device connected to the tongue of relay R3. To do this the transmitter heads are run without tape. Using the transmitter head 22 alone, switch 17 is moved downwardly to its "off" position while switch 16 is moved downwardly to its "remote" position. Relay R3 then operates under control of relay R2 and in accordance with the vibrating tongue of the keying unit 27.

Polarized relay R3 may also be caused to operate under control of the transmitting head 5 when switch 11 is moved to the right and switch 15 moved to the left with switch 16 moved upwardly to its "local" contact. If switch 16 remains on its lower contact, then switch 17 must be moved to its upper contact. Under any of these conditions, the keying operation by the unit 10 in the transmitter head 5 will operate relay R1 thereby to deliver alternate positive and negative impulses to the lower winding of relay R3. Switch 11 being in the right hand position, the circuit through the lower winding in relay R3 is completed to ground, and is incomplete through the upper winding. Hence, relay R3 vibrates in the same manner as relay R1.

In order to ascertain if the keyers 5 and 22 are mutually phased, switches 11 and 15 are both thrown to the left and switch 16 may be thrown upwardly; or if it is down, then switch 17 must be thrown to its upper contact. Correct phasing between the keyers 5 and 22 may be observed, even without the tapes in either of them, when the output from relay R3 is a continuous dash. If the phase relation is incorrect, then relay R3 will vibrate and the members 23 should be momentarily declutched and reclutched until the proper phase adjustment is found. However, in accordance with an improved method of phasing, the field of the motor 21 may be rotated until the correct phase adjustment is obtained. After the two transmitter heads 5 and 22 have been mutually phased the head 5 should be declutched by operation of the lever 4. A few moments of transmission of constant signal reversals by transmitter head 22 alone will serve the requirements for phasing the receiving station with the transmitting station.

A blank portion of tape 24 should next be inserted in the keying unit 22 and an enciphering tape 7 should be inserted in the keying unit 5; but unit 5 should remain idle; that is, with the members 2 and 3 declutched. The enciphering tape 7 will be adjusted with several blank center-holes back of the tape sprocket wheel so that when clutching takes place, a moment will elapse before the first character of the enciphered tape is reached. The transmitting operator will now wait for a brief period to enable the receiving

operator to complete the necessary steps of adjustment of the receiving apparatus.

At the receiving station (Fig. 3), reception of the constant phase reversals which resulted from operating the transmitter head 22 alone may be observed by plugging a synchroscope, wave analyzer or other suitable monitoring receiver into the jack 55, or by throwing switch 18 to the left and allowing the incoming signals to be recorded on the instrument 53. When the incoming signal alone is to be recorded, switch 14 should be thrown to the right so as to supply negative potential to the windings of relay R5. The incoming signals pass through the locking circuit 47 to relay R4 when switch 12 is thrown to the left. Relay R5 is now controlled by relay R4 and delivers marking impulses in response to the constant keying by the transmitter.

Before the transmitting station stops its constant pulse keying, the receiving operator should momentarily throw his switch 14 to the left for testing his deciphering apparatus. Switches 12 and 13 are now temporarily moved to the right. This causes relay R4 to be held to the spacing side. Furthermore, the contacts 46 being short-circuited, the marking impulses produced by relay R6 endure for the full time interval of the baud. Relay R5 thus responds only to keying by relay R6 under control of constant pulse reversals by the keying head 37, assuming that no tape 36 is as yet fed to the sprocket wheel 35.

The coincident reception of signal reversals effective upon relay R4 and of pulse reversals effective upon relay R6 should next be observed, and it is essential that this be done before the transmitting station ceases to send such reversals.

For this purpose switch 13 is moved to the left thereby opening the short circuit across the cam-controlled contacts 46. Switches 12, 13, 14 and 18 are all set to their left hand positions. The proper phase relation of keyer 37 with respect to the incoming signals will then be denoted by a continuous space appearing on the synchroscope plugged into jack 55, or on the tape of recorder 53. If the phase relation is incorrect, then the clutch members 44 must be separated and re-clutched, or else the field of motor 33 must be rotated until the correct phase adjustment is obtained.

Through the operation of the cam 45 contacts 46 are closed during the middle-half of each baud. If this cam 45 is properly phased, the actual synchronism between the deciphering tape impulses and the incoming signals does not need to be so critically maintained as would otherwise be necessary.

Starting the enciphering and deciphering tapes in step

It will be understood, of course, that two essential conditions for deciphering the incoming signals are firstly to have the enciphering and deciphering tapes absolutely identical and secondly that the tapes be run absolutely in step one with the other. In order to start the transmission of the enciphered intelligence at the moment when the deciphering tape can suitably translate the same, the following procedure is necessary.

At the transmitting station the keying units 5 and 22 will have been mutually phased and otherwise conditioned so that the output will be continuously spacing. At the receiver the switches 12, 13, and 14 are set in their indicated normal positions. Relay R7 is energized by depressing

push button 20. The clutch members 38 and 39 are magnetically disengaged by means of the magnet 56 in response to the actuation of relay R7. The circuit closed by push button 20 may be traced from the negative side of the source through resistor 57, the tongue of relay R5, the spacing contact thereof, contacts *f* and *g* of the push button switch 20, and thence through the coil of relay R7 to ground. Relay R7 when closed becomes locked up by the closing of its contacts *c* and *d*. The contacts *a* and *b* of relay R7 are also closed for energizing the clutch magnet 56. The clutch members 38 and 39 will thus remain disengaged by the pulling up of the armature 40 under control of the magnet 56. This condition will persist as long as the continuous spacing conditions prevail in the locking circuit 47, which holds the relay R4 on the spacing side. During this time, the decoding tape is to be placed in position so as to be advanced by one or two center-holes before the first marking perforation. The degree of advance necessary to compensate for any lag in the re clutching of the members 38 and 39 will vary with the equipment used.

The transmitting station attendant having allowed sufficient time for the receiving station equipment to be duly adjusted and phased, now manually operates his clutch lever 4, permitting the enciphering tape transmitter 5 to start. He immediately feeds the perforated message portion of the tape 24 to transmitter 22 so that no appreciable number of enciphering signals will go out over the transmission channel to be intercepted.

The first marking impulse to be received and applied to the locking circuit 47 will energize relay R4 thereby to throw its armature to the marking side. A polarity reversal, therefore, takes place in relay R5 which opens the locking circuit through relay R7. The clutch magnet 56 now becomes de-energized and the deciphering tape transmitter 34 starts in step with the enciphering tape transmitter 5 at the transmitting station.

It will be observed by reference to Fig. 1 of the drawings that message signals of any type may be enciphered and deciphered in accordance with the procedure hereinbefore described. That is to say, our system may be used for the enciphering of Morse code signals or any other form of code signals which employ two elements, namely, marking and spacing elements. If uniform length code signals are used in the message, they may still be enciphered by introducing "fills" and "drop-outs" in accordance with a Morse code enciphering tape. When this is accomplished, the deciphered signals may be applied to the printer 54 at the receiving station by moving the switch 18 to its right hand position. Under these conditions, the uniform length code signals will be enciphered by code signals which are not of uniform length. Therefore, the character separation is completely lost with respect to the enciphered signals and is restored only at the authorized receiving station. When Morse signals are to be enciphered by means of an enciphering tape also bearing Morse code signals, the character separation is also completely destroyed in the transmission, and often times a space signal of three bauds, such as is commonly used for separating the characters, may have a "fill" introduced in any one of its three bauds, thus destroying its identity. Under these conditions, the deciphering of the enciphered signal by unau-

thorized recipients is rendered exceedingly difficult, if not utterly impossible.

We are aware that the general principles of enciphering and deciphering messages is quite old in the art. In a general way, the methods herein described are a development of the art from the basic conceptions of Gilbert S. Vernam as shown in his Patent No. 1,479,846, dated January 8, 1924, and as further disclosed in a Matheson Patent No. 2,175,847, dated October 10, 1939. Our improvements, however, consist to some extent in providing independent random reversals of the elemental baud elements of the signals irrespective of their identity with one or another of the successive characters. Our improvements are also directed to the methods of phasing the receiving equipment with that of the transmitter. From a practical standpoint, these methods have been proven to be essential to the successful commercial operation of our device. However, the scope of the invention itself is not limited to the exact details of construction herein shown and described.

We claim:

1. The method of cryptic signaling which comprises storing a train of character code element combinations in conformity with a given code, said train representing a piece of intelligence to be communicated to a remote point, providing storage at the points of transmission and remote reception of a cryptic train of marking and spacing signal elements having a random sequential arrangement said arrangement being identical at the two said points, transmitting a third train of signal elements in accordance with a rule such that signal elements of like sign in the intelligence train and in the cryptic train produce a spacing condition to be communicated and signal elements of unlike sign in the intelligence train and in the cryptic train produce a marking condition to be communicated, causing a deciphering operation at the remote point to be initiated by a start signal received from the point of transmission, causing said deciphering operation to be continuously performed by synchronous operation of the receiving apparatus with respect to the transmitting apparatus, and causing the storage of the cryptic train at said remote point to restore the intelligence of said third train only at that remote point.

2. The method of enciphering and deciphering equal length signals which consists in combining the effect of a signal separating two successive character code combinations of a message with the effect of a random marking or spacing element in the body of a cryptic character code signal combination, combining other effects which occur simultaneously in the message signals and the cryptic signals to produce a train of enciphered signal components having no identification of the points of separation between the signal elements of successive character code combinations either in the message or in the cryptic signals, combining the effects of a stored replica train of said cryptic signals with effects produced by the enciphered train to restore the original signals, thereby to render the enciphered train decipherable only at a point of reception where said replica train is stored, and transmitting to said point of reception a start signal which results in phasing the effects of said replica train with respect to said cryptic signals.

3. In a synchronous telegraph system of the type wherein the distributors run uninterruptedly during the transmission of intelligence, the meth-

od of phasing a decoding tape at a receiving station with an enciphering tape at a transmitting station which consists in holding both tapes stationary for a certain time interval preparatory to the transmission of an enciphered train of signals, and causing the transmission and reception of the first marking element in said enciphered train to start the feeding of said decoding tape.

4. In a telegraph system, the combination of a transmitting station comprising two perforated tape keying units having contacting members one set of which is responsive to perforations in a message tape and another set of which is simultaneously responsive to perforations in a cryptographic tape, a receiving station comprising relay means responsive to incoming signals derived from the joint operation of the two keying units at said transmitting station, a perforated tape keying unit at said receiving station, a decoding tape which is a replica of said cryptographic tape, means at said receiving station for starting and continuously feeding said decoding tape through its keying unit in phase with the feeding of said cryptographic tape, and relay means under joint control of said signal responsive relay means and impulses derived from the operation of said decoding tape keying unit for making impulses at said receiving station corresponding to the perforations of said message tape.

5. In combination, a signal responsive relay, a second relay, a decoding tape, a keyer operable by said tape to control said second relay, a third and polarized relay having two windings arranged and connected for alternate energization by the marking and spacing contacts of said signal responsive relay, a common connection from said windings to the tongue of said second relay, polarizing means operable through the marking and spacing contacts of said second relay for controlling the direction of current flow through either of the windings of said signal responsive relay, and a utilization device operable by pulses through the tongue and at least one of the contacts of said third relay.

6. A telegraph code enciphering system comprising two synchronously driven motors, a tape keying unit operable by each motor, clutching and declutching means operable to start one of said keying units in proper phase relation to the other, two polarized relays each having a winding individually connected to the output circuit of a respective one of said keying units, a direct current source having terminals individually connected to the stationary contacts in said keying units, said source also having a neutral tap connected to one end of each said relay winding, a message tape arranged to control one of said keying units, an enciphering tape arranged to control the other of said keying units, a third polarized relay having two windings individually connected to the outer contacts of one of the first mentioned relays and commonly connected to the relay tongue of the other of the first mentioned relays, and a communications channel keyer operable in response to magnetic reversals in the armature of said third relay.

7. A telegraph code enciphering system according to claim 6 and including switching means for testing the control of said third relay by either of said keying units singly and subsequently by the two of said keying units jointly.

8. A telegraph code enciphering system according to claim 6 and including switching means located at a monitoring position and further switching means located at a sending operator's position, whereby at either of said positions the keying unit which carries the enciphering tape may be thrown into or out of service.

9. A telegraph code deciphering system comprising a signal responsive locking circuit, a synchronously motor driven tape keying unit, means for correcting the driving speed and cyclic phase of said keying unit in accordance with the baud rate of reception of a train of incoming signals, a relay operable by current pulses delivered thereto from said locking circuit, a second relay operable by current pulses delivered thereto from said tape keying unit, a third and polarized relay having two windings individually connected to the outer contacts of the first said relay, the tongue of said first relay being grounded, said third relay windings having a common connection to the tongue in said second relay, a direct current source having a grounded neutral tap and positive and negative terminals connected respectively to the outer contacts of said second relay, a signal translating device arranged for control by current pulses through said third relay, and a deciphering tape arranged to be fed through said synchronously driven keying unit.

10. A telegraph code deciphering system according to claim 9 and including magnetically controlled declutching means operable to arrest said keying unit prior to the reception of an enciphered train of signals, and means including a manually operated switch and a relay the energization of which is initiated by said manually operated switch and is held under control of a current traversing the spacing contact of said third relay, whereby said declutching means is maintained operative until the first marking signal response to said train of incoming signals is made by said third relay.

11. A telegraph code deciphering system according to claim 9 and including switching means operable at times to render said third relay responsive to current reversals applied singly by either the first or the second said relay, and at times to render said third relay responsive to current reversals resulting from the joint operation of said first and second relay.

12. A telegraph code deciphering system according to claim 9 and including cyclically operable means for abbreviating the time intervals during which said third relay windings are energizable under joint control of the two relays first mentioned, as compared with the duration of a signal baud.

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