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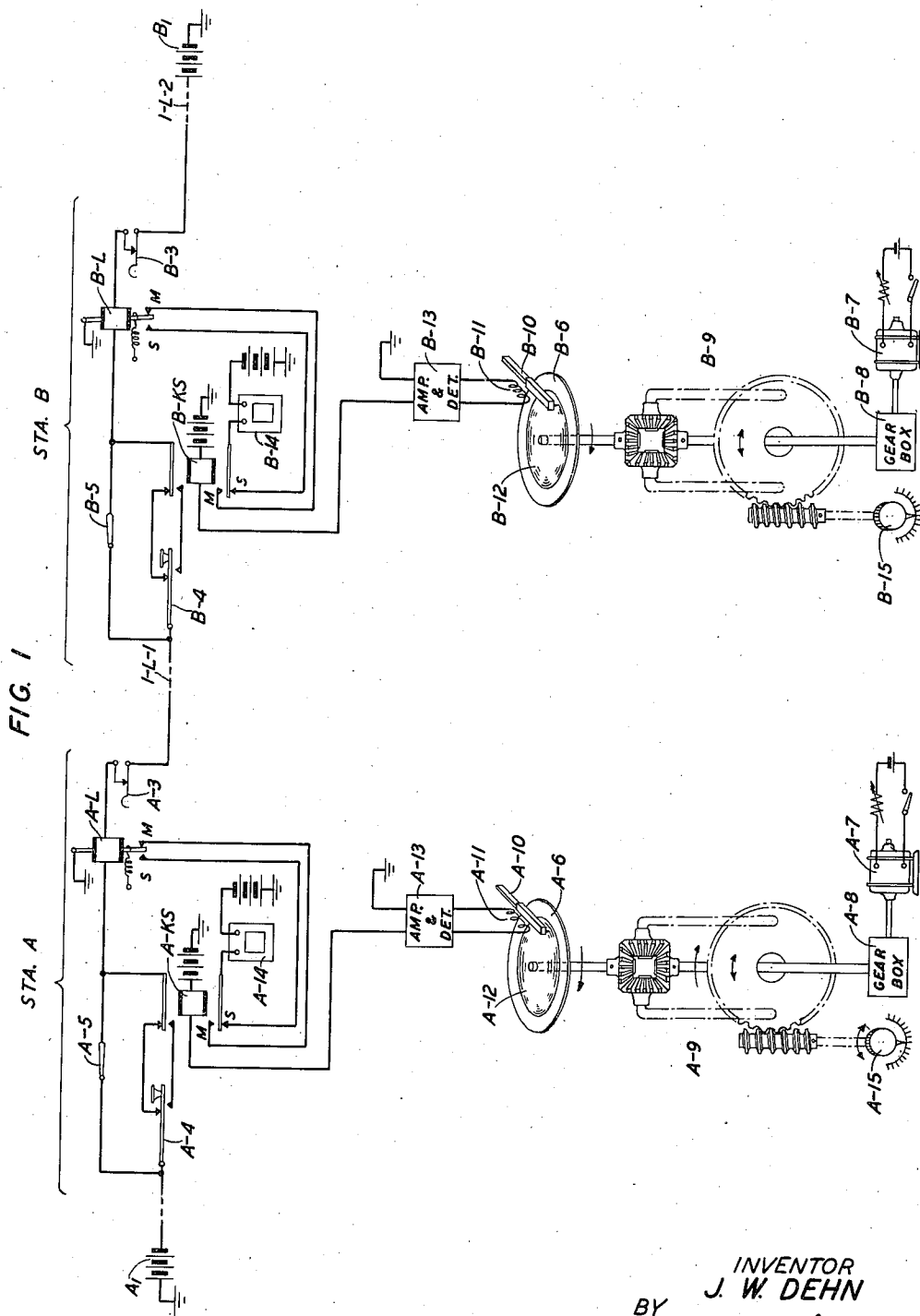
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2,466,390

SECRET TELEGRAPH SYSTEM

Filed March 30, 1944

3 Sheets-Sheet 1



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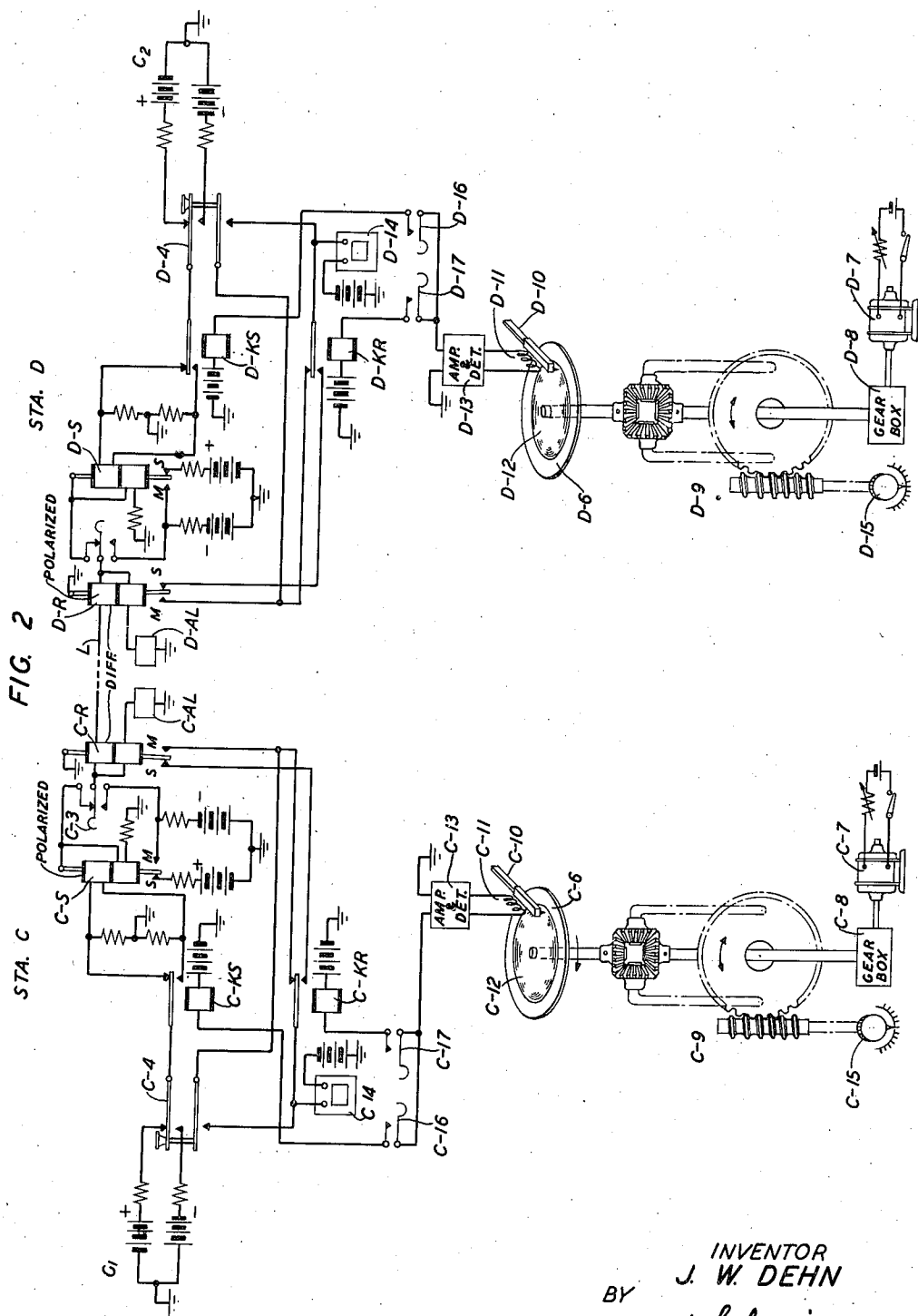
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SECRET TELEGRAPH SYSTEM

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3 Sheets-Sheet 2



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FIG. 3

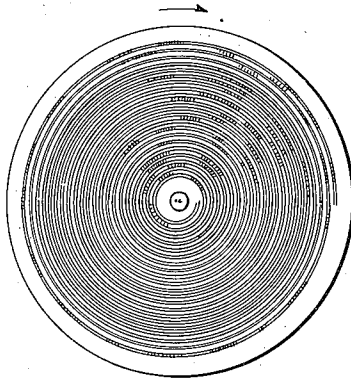
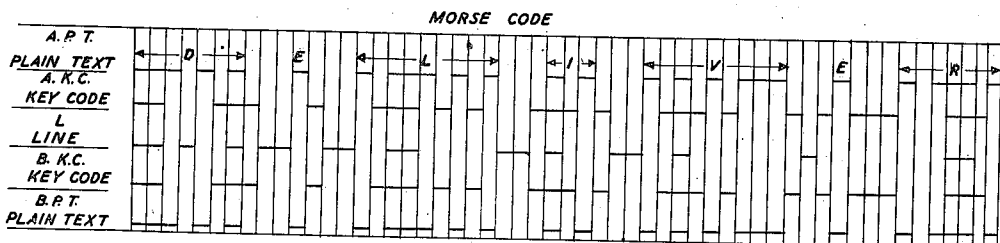


FIG. 4



LINED INTERVAL INDICATES MARK IMPULSE
BLANK INTERVAL INDICATES SPACE IMPULSE
RELATIVE ARRANGEMENTS OF SIGNAL IMPULSES AT STATIONS A AND B ARE
SHOWN WITHOUT CONSIDERATION OF TIME LAG OF THE LINE CIRCUIT

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2,466,390

SECRET TELEGRAPH SYSTEM

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2 Claims. (Cl. 178—22)

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This invention relates to telegraph intercommunication systems using synchronized devices for ciphering and deciphering messages transmitted over a channel interconnecting two or more stations. More particularly the system provides for changing or coding a message before it reaches the actual transmitting stage and for automatically decoding the message at the receiving station, or stations, for which it is intended, the coding and decoding being effected by current waves produced by synchronized phonographic devices.

In telegraph systems designed to transmit secret messages the telegraph signals of such messages might be enciphered by changing marking signals to spacing signals and vice versa, at irregular intervals by means of a key code resembling a series of letters in the Morse, Continental or Baudot code. For example, if the corresponding impulses or sections of impulses of the plain, or message, text and the key code at the sending station are both marking or both spacing, marking current will be transmitted over the line; if one of the corresponding impulses or sections thereof is spacing and the other marking, spacing current will be transmitted. At the receiving station of the transmission line the key code acts upon the line signals conversely to reproduce the plain text. The device at each station for producing the marks and spaces of the key codes must run in synchronism with all similar devices in the system, and must produce an irregular series of marks and spaces which have no relation to the marks and spaces of the plain text. Furthermore, if the key code device at the receiving station is slightly out of synchronism with the key code device at the sending station suitable means are provided for adjusting the key code device at the receiving station into synchronism with the key code device of the sending station.

An object of the invention is to utilize two synchronously operated devices, one at each station of a telegraphic intercommunicating system, for producing key codes in the form of electric waves and superimposing these key codes simultaneously at the sending and the receiving stations on the message transmitted from one station and received at one or more of the other stations.

According to the present invention the suitable means of producing the marks and spaces of the key code at the sending and receiving stations are phonographic records (either disc or cylinder) of which the sound track during the rotation of the record causes to be transmitted a

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current wave or "tone" for mark impulses and no current or "no tone" for space impulses. With a suitable pick-up, amplifier-detector and electromagnetic relay the current wave of the key code is effective to change in the plain text marks to spaces and vice versa, depending upon the intervals of "tone" and "no tone" impulses in the produced electric, or sound, wave. In this arrangement one record can contain a number of different key codes by using a different frequency for each key code and providing filters for selecting the desired code.

A feature of the invention is the provision whereby the message text to be transmitted is broken up or disguised at the sending station and restored at the receiving station or stations by means of two synchronously operated phonographic devices producing identical key codes.

Another feature resides in the identical key codes simultaneously produced, taking into consideration the time lag of transmission over the interconnecting channel, which consists of "tone" for mark pulses and "no tone" for space pulses, for operating a ciphering relay at the sending station and a deciphering relay at the receiving station or stations.

Another feature residing in the identical key codes, is that the key code at the sending station so operates the local ciphering relay as to change the condition of the transmission channel to transmit a mark pulse when corresponding pulses or sections of pulses of both the message text and the key code are alike, and to transmit a space pulse when said corresponding pulses or sections of pulses are unlike.

Another feature residing in the identical codes, is that the key code at the receiving station or stations so operates the local deciphering relay as to register, or record, a mark pulse when the incoming corresponding pulses or sections of pulses of both the received message text and the key code are alike, and to register a space pulse when the corresponding pulses or sections of pulses are unlike.

Another feature is the adaptation of a single phonographic device at each station for producing a key code that is usable for both ciphering and deciphering messages transmitted in either direction over the channel interconnecting the stations.

Another feature is the provision of an indicating device at the receiving station or stations, operable conjointly under the control of signals received from the transmission channel extending from the sending station, and the local signal

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changing device for indicating departure from synchronism between the signal changing devices at the sending and the receiving stations.

Another feature is the provision of a rotatable phonographic record and a driving motor therefor at each of the stations of the system for causing to be produced a key code identical with those simultaneously produced, taking into consideration the time lag of transmission over the interconnecting channel, at the other interconnected stations, each rotatable record having manually adjustable means whereby it may be advanced or retarded, at will, during its operation.

Another feature resides in the additional use of the indicating device in that it also serves as a sounder in registering the incoming messages at the receiving station.

A more detailed description follows in conjunction with the drawing wherein:

Fig. 1 shows the invention adapted for use in a simple telegraph intercommunicating system of two or more stations employing neutral relays having mechanically biased armatures, for transmission of message signals and ciphering and deciphering signals;

Fig. 2 shows the invention adapted for use in a differential duplex telegraph intercommunicating system of two stations each of which is provided with send and receive relays of the polarized type for respectively transmitting and receiving message signals and neutral relays with mechanically biased armatures for respectively transmitting ciphering and deciphering signals;

Fig. 3 shows the plan view of a phonographic record and the sound tracks therein for causing the key codes to be produced;

Fig. 4 illustrates graphically the manner in which message signals to be transmitted over the line circuit are changed by the interrupting, or phonographic, device at the transmitting station and the signals received over such line circuit are changed in the opposite sense at the receiving station to reproduce the intelligence originally prepared for transmission.

Figure 1

Referring to Fig. 1 in more detail, there is shown a system comprising two or more stations A, B, etc., stations A and B being interconnected by line 1—L—1 and station B and the next adjacent station (not shown) interconnected by line 1—L—2. Grounded negative battery A—1 and grounded positive battery B—1 are respectively connected to opposite ends of the system and the line circuit including line 1—L—1 and 1—L—2 is normally closed.

Station A comprises line relay A—L of the neutral type having a mechanically biased armature, break key A—3, telegraph transmitter key A—4, operate-to-send key A—5 whereby the latter key must be operated to its alternate position to allow sending at station A, rotatable phonographic turntable A—6 driven by motor A—7 through a system of gears represented by gear box A—8 and synchronism corrector mechanism A—9, arm A—10 for supporting the magnetic stylus, coil A—11 inductively connected to the magnetic stylus for translating the motion of the stylus derived from the sound track of the rotating phonographic record A—12 into corresponding electrical impulses, amplifier and detector A—13, ciphering relay A—KS responsive to the electric impulses in the output of amplifier-detector A—13 for ciphering, or changing, the message signals for transmission over the line, and buzzer A—14

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for receiving messages and for indicating before a message is started whether or not the local phonographic device (when station A is receiving) is in synchronism with the phonographic device at the sending station, such as station B.

Station B has equipment that is identical with that at station A and the reference characters at both stations are the same except that the letter designation of the station is used as a prefix to the reference characters local to that station.

Similarly, the equipment at each of the other stations, not shown, would be identical with that at station A.

METHOD OF OPERATION OF FIG. 1

Station A originates a call

Normally the equipments at all stations of the system are in the positions shown. Assume that the subscriber at station A desires to send a message to station B and the remaining stations, not shown, the subscriber at station A opens switch A—5 and operates transmitting key A—4 to send an unciphered signal to the subscriber at station B and the remaining stations. Upon receipt of the unciphered signal at one of the receiving stations, say station B, the subscriber thereat closes the start key for motor B—7 and the subscribers at the remaining stations, not shown, operate similar motor start keys. The subscriber at station A at the same time closes the start key for motor A—7. Motor A—7, upon operating, causes turntable A—6 to rotate through gear systems A—8 and A—9 which operate on the principle disclosed in G. A. Locke U. S. Patent 1,717,049, issued May 22, 1928, and motor B—7, upon operating, causes turntable to rotate through gear systems B—8 and B—9 which also operate on the Locke principle. The rotating turntables at the sending and the receiving stations will, in all likelihood, be out of phase and out of synchronism with each other at the start. The description of the method of operation herein will now be confined to stations A and B since the operation of the equipment at the remaining stations is similar to that of station B. Phonographic records A—12 and B—12 respectively affixed to turntables A—6 and B—6, are provided with identical sound tracks, as shown on the disc in Fig. 3, for transmitting during the respective rotating operations coding or decoding signals consisting of "tone" impulses during which an alternating current of audio frequency is produced by the magnetic stylus and "no tone" impulses during which no alternating current is produced. These identical sound waves are respectively impressed on amplifier-detectors A—13 and B—13, the outputs of which respectively operate relays A—KS and B—KS.

The sound wave caused to be produced by record A—12 intermittently operates relay A—KS. Relay A—KS, upon operating, moves its mechanically biased armatures to their alternate positions in response to the "tone" impulses and returns them to their normal positions during the time that each "no tone" impulse is being received by the relay winding. Each time relay A—KS operates its upper armature to its alternate position it momentarily opens the normally closed line circuit, thereby permitting the line relay A—L at station A and relay B—L at station B to move their respective armatures to alternate positions under the influence of their biased springs. The intermittent action of relays A—L and B—L follows that of relay A—KS.

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The sound wave caused to be produced by record B—12 intermittently operates relay B—KS. Relay B—KS, upon operating, moves its mechanically biased armatures to their alternate positions in response to each "tone" impulse and returns them to their normal positions under the influence of their biased armatures during the time that each "no tone" impulse is being received. Each time relay B—KS operates its upper armature to its alternate position it momentarily opens the normally closed line circuit thereby permitting relay A—L at station A and relay B—L at station B to move their respective armatures to their alternate positions under the influence of their biased springs.

Should relays A—KS and B—KS operate simultaneously receivers, or buzzers, A—14 and B—14 would not operate which would indicate that turntable B—6 is operating in synchronism with turntable A—6. However, at the start of operation buzzer B—14 would most likely operate in that at the start the turntables would not be in synchronism. In the latter case the subscriber at station B manually rotates knob B—15 to advance or retard turntable B—6 until buzzer B—14 ceases to operate which indicates that the turntable B—6 is in synchronism with turntable A—6 and the system is ready for transmission of the secret message.

Fig. 4 which shows graphically the time relation of the impulses of the plain text, or message, with respect to the key codes at both stations A and B and the ciphered signals that are transmitted over the line circuit. Graph APT shows the message signals as originally transmitted or prepared by transmitter key A—4, graph AKC shows the key code in the output circuit of amplifier-detector A—13, graph L shows the unintelligible signals as changed by the key code represented by graph AKC for transmission over the line circuit, graph BKC shows the key code in the output circuit of amplifier-detector B—13 which changes the unintelligible signals received over the line circuit to signals that are intelligible, and graph BPT shows the intelligible signals representing the effect of the impulses shown in graph BKC on the impulses shown in graph L, the effect resulting in reproducing the message as originally transmitted by transmitter key A—4. It will be noted in Fig. 4 that when station A is the sending station and corresponding pulses or section of pulses in graphs APT and AKC are alike, that is, when a mark pulse or section of pulse of the message signal occurs simultaneously with a "tone" pulse or section of pulse of the key code signal, or when a space pulse or section of pulse of the message signal occurs simultaneously with a "no tone" pulse or section of pulse of the key code signal, a mark pulse is transmitted over the line. When the simultaneous pulses or sections of pulses of the message and coding signals are unlike, as contrasted with the conditions defined above, a space pulse is transmitted over the line. When station B is the receiving station and the corresponding pulses or sections of pulses in graphs L and BKC are (1) alike, the resulting pulse in the intelligible received message as indicated in graph BPT is marking, (2) unlike, the resulting pulse is spacing. When station B is sending and station A is receiving the same conditions exist except the graphs are reversed in the order in which they appear in Fig. 4, graph BPT being the transmitted, or prepared, message and APT, the intelligible message recorded or registered at the receiving station A.

Station B originates a call

The method of operation in establishing a connection when the call originated at station B is substantially the same as that described hereinbefore for a call originated at station A except that the key code relay B—KS becomes the send code relay, and key code relay A—KS becomes the receive code relay, and the correction for synchronism is made at station A by operating, or turning, knob A—15.

Figure 2

Referring to Fig. 2 in more detail, there is shown a system comprising two stations C and D, stations C and D being interconnected by line conductor L. Grounded battery C₁ and grounded battery C₂ are respectively provided at opposite ends of the system and the line circuit is normally deenergized.

Station C comprises receive relay C—R and send relay C—S, both of the polarized type, artificial line C—AL, key code sending relay C—KS and key code receive relay C—KR, both of the neutral type, break key C—3, telegraph transmitting key C—4, rotating phonograph turntable C—6 driven by motor C—7 through a system of gears represented by gear box C—8 and synchronism corrector mechanism C—9, arm C—10 for supporting the magnetic stylus, coil C—11 inductively connected to the magnetic stylus for transmitting the motion of the stylus derived from the sound track of the rotating phonograph record C—12 into corresponding electrical impulses, amplifier-detector C—13 for operating either of relays C—KS or C—KR depending on whether station C is prepared to send or receive, buzzer C—14 for receiving messages and for indicating before the start of a message whether or not the local phonographic device (when station C is receiving) is in synchronism with the phonographic device at the sending station, such as station B, and send key blade C—16 and receive key blade C—17 either of which may be operated depending upon whether station C is arranged to send or to receive. The key comprising send key blade C—16 and receive key blade C—17 when in its normal position, as shown, allows the transmission of unciphered messages which will be received without interruption provided the corresponding key at station D is likewise in its normal position.

Station D has equipment that is identical with that at station C and the reference characters at both stations are the same except that the letter designation "D" of the station is used as a prefix to each of the reference characters.

Relay C—R at station C and relay D—R at station D are arranged to operate differentially. Relay C—S at station C, relay D—S at station D each have two windings wound in the same direction, so that currents flowing in their respective lower windings tend to hold the relays in the positions to which they were last operated until the currents in their respective upper windings are reversed.

METHOD OF OPERATION

Station C originates a call

Normally the equipment at both stations of the system is in the positions shown. Assume that the subscriber at station C desires to send a message to station D, the subscriber at station C operates transmitter key C—4 whereby the upper lever of key C—4 is transferred from the

positive to the negative pole of battery C₁. In response to the reversal of current in its upper winding, send relay C—S operates in its right-hand, or marking, position, for the interval of time for which key C—4 is held operated. The current in the lower winding of relay C—S as hereinbefore stated, tends to hold the relay in the position to which it was last operated when no current flows in the upper winding. Key C—4, in its operated position, also connects the right-hand, or marking, contact, of receive relay C—R to a circuit extending over its lower lever to grounded battery, through the winding of buzzer C—14 which does not operate at this time because relay C—R is in its spacing position. Relay C—S, upon operating to its right-hand position, connects grounded negative battery to a circuit extending over break key C—3, through the windings in parallel of the receive relay C—R, one path including the upper winding of the relay C—R and extending over line circuit L and the other including the lower winding and extending through artificial line C—AL to ground. Relay C—R being of the differential type does not operate on signals transmitted from station C.

The signal incoming over line circuit L flows through the upper and the lower winding, in series, of receive relay D—R to ground and relay D—R being of the differential type operates to its left-hand, or marking, position in response to the signal received from line circuit L. Relay D—R, upon operating to its left-hand position, closes a circuit for operating buzzer D—14. The subscriber at station D, upon hearing the buzzer, knows that the subscriber at station C is originating a call. The subscriber at station D accordingly operates receive key blade D—17, and also the motor start key for closing the operating circuit for motor D—7. The subscriber at station C after sending the call signal operates send key blade C—16 and also the motor start key for closing the operating circuit for motor C—7. Turntables C—8 and D—6 are therefore started. The magnetic stylus supported by arm C—10 and being in engagement with the sound track on phonographic record C—12 which is now rotating, causes a key code signal current wave to be impressed on the circuit including coil C—11 inductively connected to armature C—10, amplifier-detector C—13, closed contact of key blade C—16, winding of key code send relay C—KS and grounded battery. At the same time, taking into consideration the time lag of line circuit L, the magnetic stylus supported by arm D—10 and being in engagement with the sound track on the phonographic record D—12 which is now rotating, causes a key code signal current wave to be impressed on the circuit including coil D—11 inductively connected to arm D—10, amplifier-detector D—13, closed contact of receive key blade D—17, winding of key code receive relay D—KR and grounded battery. Relays C—KS and D—KR respond to their respective sound waves which are identical, the operation of each being intermittent to produce a key code represented by identical graphs AKC and BKC shown in Fig. 4. Since the styli on the phonographic records C—12 and D—12 are started from corresponding points in the sound tracks the intermittent operation of the relays C—KS and D—KR in response to the "tone" pulses in the respective sound waves, should be in synchronism. Relay C—KS, upon operating in response to each "tone" pulse in the sound wave, moves its

armature intermittently from one of its contacts to the other and causes the current in the upper winding of send relay C—S to be intermittently reversed in direction. The armature of relay C—S is moved accordingly from one of its contacts to the other to transmit over a line circuit L pulses such as represented by graph AKC shown in Fig. 4, there being no message transmitted at this time. Receive relay C—R does not respond to the signal waves transmitted from station C over line circuit L because, as stated before, it is of the differential type. The signal wave incoming at station D, however, operates differential receive relay D—R which intermittently closes an operating circuit for buzzer D—14. Buzzer D—14 operates only in the event that the key code receive relay D—KR is in the position shown at the time relay D—R responds to a "tone" pulse in the incoming pulse series. In other words, since the sound waves produced by records C—12 and D—12 are identical, the operation of relays C—KS and D—KR, respectively, resulting therefrom when the turntables at both stations are operating, will be simultaneous, and each time that relay D—R operates to its marking position, relay D—KR, under the influence of the sound wave on record D—12, moves to its operated position so that the operating circuit for buzzer D—14 is maintained open when turntable D—6 is in synchronism with turntable C—6. Therefore should the sound wave in the output circuit of amplifier-detector D—13 be out of synchronism with the wave in the output circuit of amplifier-detector C—13, buzzer D—14 would operate intermittently to indicate to the subscriber at station D that correction for synchronism is required. By slowly turning knob D—15 the synchronism corrector mechanism D—9 is advanced or retarded until buzzer D—14 ceases to operate indicating that turntable D—6 is in synchronism with turntable C—6. The system is now ready for transmission of the secret message.

Station D originates a call

The method of operation in establishing a call originating at station D is substantially the same as that described hereinbefore for a call originating at station C except that key code send key blade D—16 at station B instead of key code receive blade D—17 at station D is operated and key code receive key blade C—17 instead of key code send key blade C—16 at station C is operated.

What is claimed is:

1. In a system for imparting secrecy to signals transmitted by means of impulses over a channel of transmission, means for impressing upon the channel signals represented by two signaling conditions, signal changing means for varying the signals at random independently of the signal transmitted and other signal changing means at the receiving end of the channel for causing converse variations to the received signals whereby they are restored to intelligible form, said signal changing means at the transmitting and receiving end of the channel comprising rotatable elements, means for starting said elements in synchronism in combination with an indicator at the receiving end operable conjointly under control of signals from the incoming line and the signal changing device at said receiving end for indicating departure from synchronism in combination with manually adjustable means for advancing or retarding the rotatable means at the receiving end of the channel to bring it

into synchronism with said signal changing means at the transmitting end.

2. In a system for imparting secrecy to signals transmitted by means of impulses over a channel of transmission, means for impressing upon the channel signals represented by two signaling conditions, signal changing means for varying the signals at random independently of the signal transmitted and other signal changing means at the receiving end of the channel for causing converse variations to the received signals whereby they are restored to intelligible form, said signal changing means at the transmitting and the receiving end of the channel comprising rotatable elements, means for starting said elements in synchronism in combination with an indicator at the receiving end operable conjointly under control of signals from the incoming line and the signal changing device at said receiving end for indicating departure from synchronism in combination with manually adjustable means for advancing or retarding the rotatable means at the receiving end of the channel to bring it into synchronism, wherein the signal changing means

each consists of a record advanceable by a rotating motor, and manually adjustable means operable for advancing or retarding the record at the receiving end with respect to the motor while observing the indicator.

JOSEPH W. DEHN.

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