

June 4, 1946.

E. O. GAMMELL

2,401,474

TELETYPEWRITER SECRECY SYSTEM

Filed March 17, 1943

2 Sheets-Sheet 1

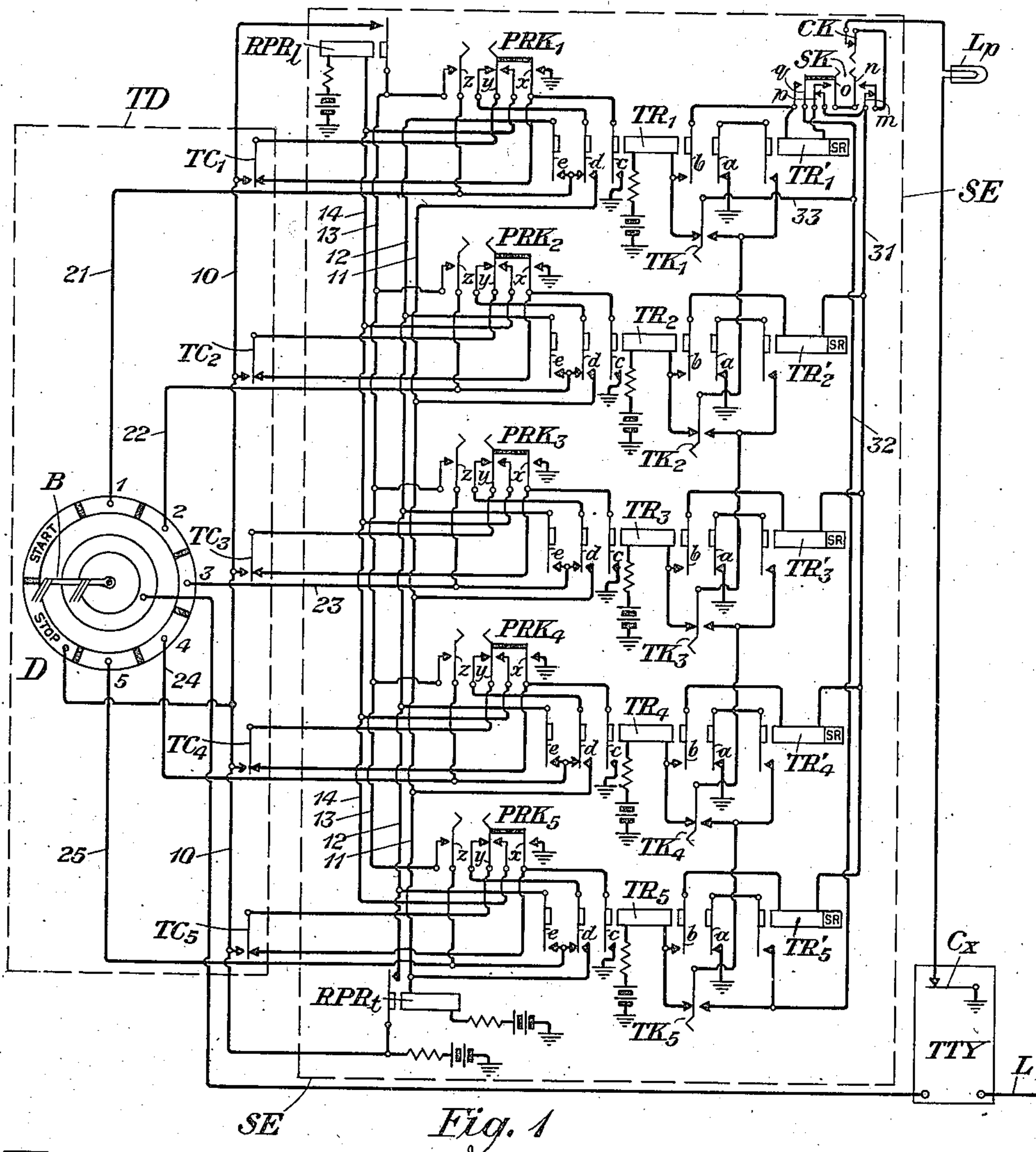


Fig. 1

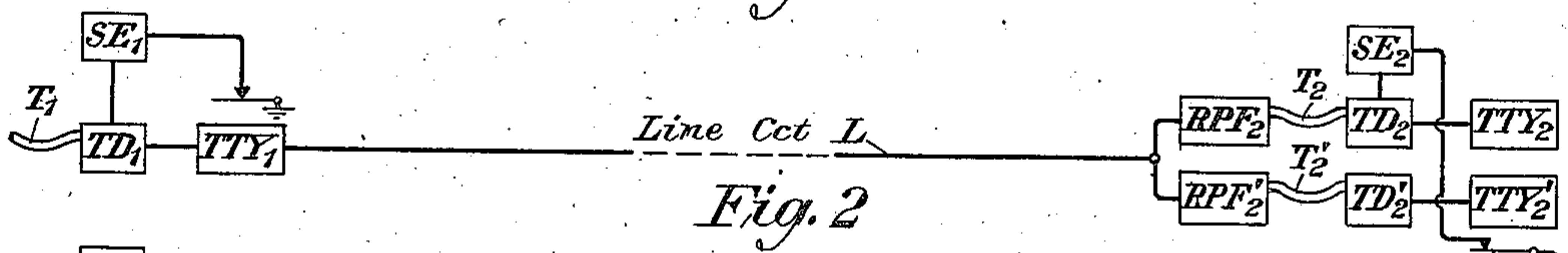


Fig. 2

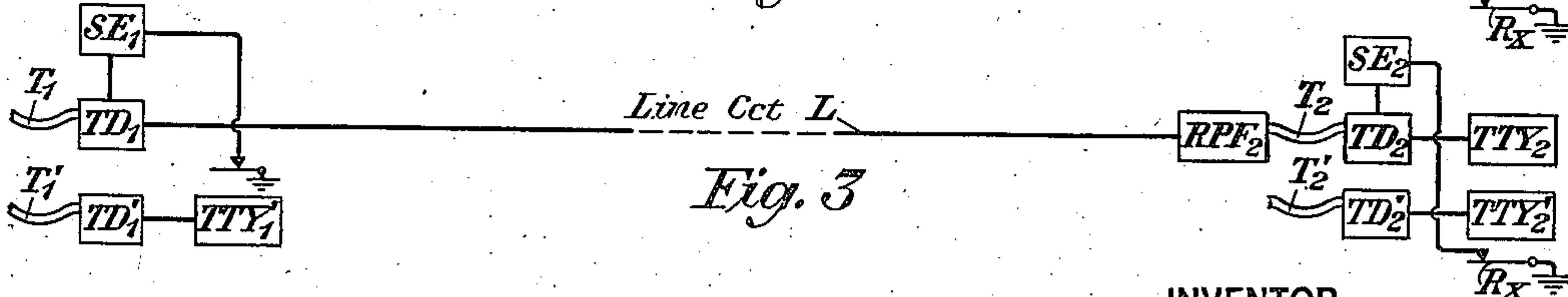


Fig. 3

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2 Sheets-Sheet 2

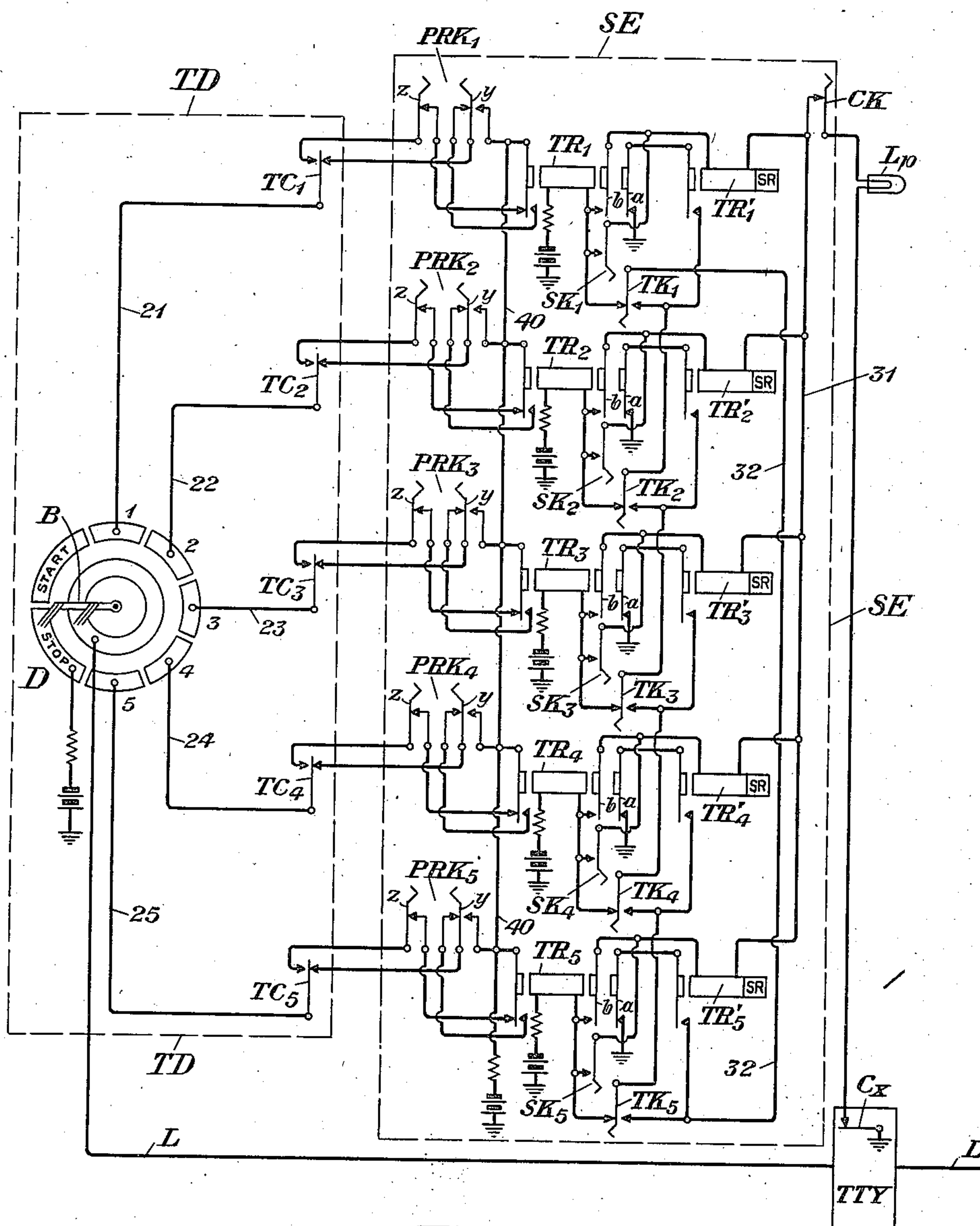


Fig. 4

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TELETYPEWRITER SECRECY SYSTEM

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18 Claims. (Cl. 178—22)

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This invention relates to secrecy systems. More particularly it relates to telegraph and teletypewriter systems which are arranged for the secret transmission of signals.

It has heretofore been the practice in teletypewriter systems, for example, to obtain some degree of secrecy by specially arranging the sending contacts and the receiving code bars of the teletypewriter machines. In such prior secrecy systems each teletypewriter signal or character—which usually includes five marking or spacing pulses in the ordinary Baudot code system—undergoes a change in one of its five pulses. For example, the second pulse will be reversed from its normal code at the transmitter from marking to spacing or vice versa. This system is so arranged that a corresponding reversal in the changed pulse is caused to take place at the corresponding code bars in the receiving machine so as to reproduce the original signal or character.

This prior secrecy arrangement has the disadvantage, however, that the enciphering or "scrambling" is uniform and consistent in that it always takes place on the same pulse—for example, the second pulse—of every teletypewriter signal or character. Due to the uniformity of enciphering or "scrambling" process the messages may be decoded readily by unauthorized parties. Moreover considerable time and expense is required to rearrange the sending contacts and the receiving code bars of this system so as to bring about a reversal of a different one of the five pulses of the signals or characters. Therefore frequent changes in the enciphering or "scrambling" practice are impractical. This is a serious difficulty for unless frequent changes are made in the cipher, the cipher takes on a pattern which is easily detected by one desiring to "break" the cipher.

One of the objects of the present invention is to make it possible to change the character of one or more pulses of the Baudot code promptly by a simple circuit translation as distinguished from a mechanical change in the transmitting mechanism and receiving mechanism of the teletypewriter units.

Another object of the invention is to automatically change the character of different pulses of the Baudot code at successive but unequal intervals in a manner determined by the transmitting station, with corresponding automatic changes at the receiving station so that a receiver will decode the message by making the proper changes in the received pulses.

Still another object of the invention is to pro-

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vide automatic translating equipment to produce changes in each of the pulses of the Baudot code in a desired order at successive but unequal intervals.

5 A further object of the invention is to provide means whereby the sending operator may prevent any one or more of the pulses of the Baudot code from being automatically changed in the desired order of succession.

10 A still further object of the invention is to provide means whereby the sending operator may at will change the character of any pulse, or of any desired number of pulses of a Baudot code combination, regardless of the action of any automatic translating equipment.

15 The invention also has as one of its objects to provide means whereby when any pulse or plurality of pulses of the Baudot code have been changed in character, either automatically or at the will of the sending operator, the receiving station after receiving the signals can set up a corresponding condition thereat to automatically restore the received message characters to their original form.

20 These and other objects of the invention are accomplished by means of the arrangements shown in the accompanying drawings and described hereinafter. In the drawings Figure 1 shows the apparatus to be used at the transmitting station for enciphering the message, it being understood that similar apparatus will be used at the receiving station for deciphering purposes. Fig. 2 is a schematic layout of a line circuit having enciphering arrangements at both the transmitting and receiving stations. Fig. 3 is a similar schematic layout of a slightly different form of system. Fig. 4 shows a modification of the enciphering apparatus of Fig. 1 in which the apparatus and operation is simplified, it being understood that similar equipment will be used at the receiving station.

40 Referring to Fig. 1, the circuit at the transmitting station includes the transmitting distributor and associated contacts shown at TD. It also includes a teletypewriter instrument TTY connected in the line circuit L leading from the transmitting distributor TD to the distant station. The instrument TTY serves to record the enciphered message at the transmitting station, and control the successive order in which the various impulses of the Baudot code will be changed in character. In addition there is provided a switching equipment SE for determining the manner and order in which the various pulses of the Baudot code will be reversed or otherwise

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changed in order to introduce a secret cipher into the transmitted message. The switching equipment SE as shown is closely associated with the transmitting distributor arrangement TD, and is controlled by the local teletypewriter instrument TTY by means of a contact C_x operated by the teletypewriter as will be described later.

The sending arrangement TD, as already described, includes the usual distributor D and rotating brush B for successively transmitting to the line L the five units of the Baudot code in a well understood manner. The transmitting apparatus TD also includes a set of five contacts TC₁, TC₂, TC₃, TC₄ and TC₅, which are ordinarily operated by means of a tape to determine whether the individual elements of the five unit code will be marked pulses or spacing pulses. It will be understood, of course, that the contacts instead of being operated by a tape may be operated by a key bar transmitter or other means well known in the art.

In the type of system herein disclosed two impulses are transmitted with each character in addition to the five character determining elements of the Baudot code thus making a seven-unit code. One of these additional impulses is a start impulse which precedes the five Baudot code impulses, which are in turn followed by the other additional impulse which is a stop impulse. The stop impulse is always a marking pulse and the starting impulse is always a spacing impulse in the system illustrated. The distributor D includes a solid inner ring connected to the line L and a segmented outer ring having the usual start and stop segments and in addition the five numbered segments. Each of the numbered segments is connected to an individual one of the tape transmitter contacts TC₁, TC₂, etc., so that a marking or spacing condition will be imposed upon the segment in accordance with whether or not the corresponding contact of the tape transmitter is operated or non-operated. By means of the brush B the start impulse, the five Baudot code impulses and the stop impulse are transmitted from the corresponding segments of the outer ring of the distributor to the inner ring of the distributor and thence to the line L in a manner well understood in the art.

The brush arm B of the sending distributor D operates continuously to send successions of code combinations for the different characters to be transmitted, and at each revolution of the distributor the controlling sending tape is advanced one step to set up a new combination upon the tape operated contacts TC₁-TC₅, inclusive. Each teletypewriter instrument, such as TTY, whether located at the sending station for local recording, or whether situated at the distant station for receiving the message is also provided with a rotating receiving selector somewhat similar in action to the distributor D as is well known. These distributors are of the start-stop type. Their mechanisms are released each time a start impulse is transmitted over the line, come to rest with the stopping impulse, until a succeeding start impulse is received.

With the tape contacts TC₁ to TC₅ in the position shown in Fig. 1 each of the five segments of the outer ring of the distributor D will be activated to transmit spacing impulses. This is accomplished in the illustrated circuit by maintaining the conductors connected to each of the segments 1, 2, 3, 4 and 5 open under normal conditions. When any one of the tape operated contacts is moved to the left, however, it will close

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the conductor leading to the corresponding segment in the outer ring of the distributor. Consequently a marking impulse will be sent, unless by means of the switching equipment SE the impulse is reversed in character for secrecy purposes, as will be described later.

The secrecy switching equipment SE involves five pairs of relays such as TR₁ and TR₁', one corresponding to each of the five contacts of the tape transmitter. When these five pairs of relays are unoperated and none of the keys PRK₁-PRK₅ is actuated, none of the Baudot code impulses sent out by the distributor D will be reversed in character. A key SK is provided which, when operated, actuates a first pair of TR relays in the chain to reverse the character of the first Baudot code impulse set up by the contact TC₁ of the tape transmitter. If the contact is set to produce a marking impulse, the first impulse actually transmitted will be a spacing impulse. If, on the other hand, the tape contact indicates a spacing impulse, the impulse actually transmitted will be a marking impulse. This means, of course, that the code for a different character from that set up by the tape will be sent out.

Associated with each pair of transfer relays, such as TR₁ and TR₁', is a transfer key. Thus the transfer key TK₁ is associated with the transfer relays TR₁ and TR₁'. A similar transfer key TK₂ is associated with the transfer relays TR₂ and TR₂', which control the reversing of the second Baudot code impulse, and similarly other transfer keys TK₃, TK₄ and TK₅ are associated with the other pairs of transfer relays.

The transfer relays are so wired that when the start key SK is operated even momentarily the first pair of transfer relays will be actuated. These relays will remain actuated to reverse the first impulse Baudot code combination sent out, until a special code combination or a group of code combinations is received to transfer the control to the next pair. For example, if the so-called "figures" code combination is applied to the teletypewriter TTY in Fig. 1, and this is followed by a particular code combination such as that of the letter S or the letter H prior to a signal combination which will unshift the teletypewriter TTY, said teletypewriter TTY will have its type bar or some part of its type bar operating mechanism arranged to open the contact C_x. The momentary opening of this contact will release the operated pair of transfer relays and will actuate and lock up a second pair of transfer relays such as TR₂ and TR₂', unless the transfer key TK₂ is operated, in which case the control will be passed to a third pair of transfer relays.

If the second pair of transfer relays TR₂ and TR₂' are actuated, they will reverse the second pulse of the Baudot code, and this second impulse will be reversed for each character transmitted until the combination Figs.-S (or other preferred character) again occurs as noted above. Thereupon the second pair of transfer relays will be released, and a third pair of transfer relays such as TR₃ and TR₃' are energized to reverse the third Baudot code impulse. In this manner, as successive Figs.-S combinations are received, the control will be transferred to successive pairs of transfer relays of the chain. After the last pair of transfer relays have been released by means of a Figs.-S combination, the first pair will be again actuated and successive transfers through the chain will again occur. This process will be continued until a clear-out key CK is op-

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erated to disable all of the pairs of transfer relays.

By actuating any one of the transfer keys, for example TK₃, the corresponding transfer relays TR₃ and TR₃' will be cut out of the chain. This will result in operating the other four pairs of transfer relays in succession to reverse the 1st, 2nd, 4th and 5th impulses of the Baudot code in successive and recurring order, without any reversal being made in the third pulse of the code. Also, if desired, any two or more pairs of the five pairs of transfer relays may be cut out by actuating the corresponding transfer keys of the TK group, so that only the remaining pairs of transfer relays will be operated successively and in recurring cycles.

Five "lock-in" pulse reversal keys PRK₁-PRK₅, inclusive, are provided. One of these pulse reversal keys corresponds to each element of the Baudot code, and when any one of these keys is operated, the corresponding segment in the outer ring of the distributor will have its pulse reversed. This pulse will be reversed continuously for each character to encipher the message in this manner so long as the key remains operated.

It will be understood that when the operator manually controls the reversal of pulses in the Baudot code by operating one of the pulse reverse keys, it will be necessary to send information of that fact in code or otherwise to the receiving station. The receiving operator may then make corresponding changes in the pulse reversal keys at the receiving station to re-invert the code impulse. Such information would normally be transmitted between messages over the same or over other transmission facilities.

It will be understood that at the receiving station, apparatus similar to that shown in Fig. 1 will be provided. Therefore the operator will not only have pulse reversal keys similar to those of the PRK group, but will also be provided with five pairs of transfer relays. These when set in operation, will be actuated in succession and in recurring cycles in the same order as the corresponding pairs of relays at the transmitting station through the codes perforated on the tape by the receiving reperforator. This causes a re-inversion of any pulse of the Baudot code which was reversed at the transmitting station, so that the original character of the message will be recorded on the receiving printer.

Whenever a change from one pair of transfer relays to another is made at the transmitting station as a result of a Figs.-S combination, the corresponding combination received on the tape at the receiving station is likewise used to operate upon the receiving printer to produce a corresponding change in the transfer relays at the receiving station, with the result that the message will be printed in its original form instead of its enciphered form.

Further details of the circuits and apparatus will be clear from a description of the operation, which is as follows:

Assuming that the secrecy switching equipment SE is in the normal position shown in Fig. 1, the sending operator by punching a message in the tape and causing it to be fed through the sending equipment to operate the contacts TC₁-TC₅, inclusive, will be able to send unenciphered messages over the line L in the usual manner, and they will be received by a distant station having similar equipment. The receiving equipment as shown schematically in Fig. 2 may consist of a reperforator PRF₂, which perforates the message

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in normal form on a tape T₂. When no ciphering is involved the tape T₂ will be punched in the same manner as the sending tape T₁ which is fed into the transmitting distributor TD₁. The reperforated tape T₂ at the receiver is then fed into the equipment TD₂ at the receiving station, which in turn causes the message to be recorded on the teletypewriter TTY₂ in the usual manner.

If, however, the sending operator desires to encipher the message, the receiving operator will be notified of that fact, and before the enciphered message is sent, the transmitting operator will operate his starting switch SK. The operation of the starting switch SK at the transmitting station illustrated in Fig. 1 completes a circuit from battery through the relay TR₁, over contact TK₁, over make contact *q* of switch SK, through the winding of relay TR₁', over operated contacts *p* and *o* of switch SK, over make contact *n* of switch SK, over the normal contact at the clearing-out switch CK, through the lamp L_p and over the switching contact C_x of the recording teletypewriter TTY to ground. Relays TR₁ and TR₁' are operated over this circuit.

Contact *b* of relay TR₁ completes the locking circuit of relays TR₁ and TR₁' from battery through the winding of relay TR₁, over the front contact of armature *b* of relay TR₁, through the winding of relay TR₁', over normal contact *p* of switch *k* (as soon as said switch has been restored to normal), over normal contact *m* of said switch SK, over the contact of clearing-out key CK, through the lamp L_p and over contact C_x to ground. Relays TR₁ and TR₁' are now locked up and remain locked up so long as the switch C_x of the recording teletypewriter TTY remains closed.

Before the relay TR₁ was operated the activating circuit over segment No. 1 of the distributor D extended from said segment over the back contact of armature *d* of relay TR₁, over normal contact *y* of pulse reversal key PRK₁ to the tape-operated contact TC₁ of the transmitter. If said tape operated contact is in its normal position as shown, the circuit will continue over its normal contact to the armature *c* of relay TR₁, which in the released condition of the relay is open. Consequently the segment 1 will be activated to send an open circuit or spacing impulse.

If, however, the message character involved a Baudot code combination in which the first pulse is marking, the switch TC₁ would be moved to its alternative position, whereupon the circuit previously traced would extend over the left-hand contact of TC₁ and over the conductor 19 to battery. Under these conditions the first impulse of the Baudot code would be a marking impulse. This impulse would, of course, be preceded as is usual by a start impulse as the brush B passes over the start segment, which is open circuited so that a spacing pulse is sent to the line L. As the brush passes over the segment 1, a marking impulse will be sent over the brush B and the inner ring of the distributor to the line L, if the switch TC₁ is in its left or alternative position. If on the other hand it is in its normal position, an open circuit or spacing impulse will be sent to the line L.

However, when the relay TR₁ is energized as above described, the first impulse of the Baudot code will be reversed. Let us first suppose that the character to be transmitted calls for a Baudot code combination in which the first pulse is a spacing pulse. The contact TC₁ will then be in

its right-hand or normal position and a circuit will be completed from ground over front contact *c* of relay TR_1 , over contact TC_1 , over normal contact y of key PRK_1 , over the front contact of armature d of relay TR_1 , and through the winding of reverse pulse relay RPR_t to battery.

Relay RPR_t is energized and its front contact completes a circuit from battery over said front contact, over conductor 12, over the front contact and armature e of relay TR_1 , over conductor 21 to segment 1 of the distributor, and thence over the brush of the distributor to line L. Accordingly the first Baudot pulse sent to the line will be a marking pulse, although the character of the message to be transmitted called for a spacing impulse. This will result in sending over the line a Baudot code combination corresponding to a different character from that actually punched in the sending tape. Any unauthorized person tapping the line would, therefore, not receive the message transmitted.

Similarly if the character to be transmitted involved a Baudot combination whose first pulse is marking, the contact TC_1 would be shifted to its left position. The circuit will now be from battery through the winding of relay RPR_t , over conductor 11, over the front contact of armature d , of relay TR_1 , over normal contact y of key PRK , over contact TC_1 in its left position to conductor 10, and over conductor 10 to battery. No current will flow through the circuit under these conditions, and the relay RPR_t will remain deenergized. Consequently no battery will be connected to the first segment of the distributor D, because segment 1 of the distributor is connected over the front contact of armature e of relay TR_1 , and over conductor 12 to an open contact of the relay RPR_t . Therefore the first pulse of the Baudot code, which in the case of the character of the message would have been marking, will now be a spacing pulse, again giving an unauthorized person tapping the line a wrong character.

As long as relays TR_1 and TR_1' remain energized, the 2nd, 3rd, 4th and 5th pulses of the Baudot code will not be reversed, but will be sent in normal condition. For example, let us suppose this second pulse is a spacing pulse, and the relay TR_2 is not energized, as will be the case when relays TR_1 and TR_1' are operated. Segment 2 of the distributor D will now be connected over conductor 22, back contact of armature d of relay TR_2 , normal contact y of key PRK_2 , over tape contact TC_2 in its right-hand position to the armature c of the relay TR_2 . As this armature is retracted, an open circuit condition is applied to the segment 2. If, however, the second pulse is a marking pulse, segment 2 of the distributor D will be connected over conductor 22, over the back contact of armature d of relay TR_2 , over normal contact y of key PRK_2 , over contact TC_2 in its left-hand position, and thence over conductor 10 to battery. Consequently a marking impulse will be sent to the line L. In other words, the second impulse of the Baudot code will not be reversed, whether it is a marking or a spacing impulse.

The same holds true for the 3rd, 4th and 5th impulses of the Baudot code, as will be evident from tracing the connections from the 3rd, 4th and 5th segments of the distributor over the contacts of deenergized relays TR_3 , TR_4 or TR_5 , as the case may be. In other words, as long as the relays TR_1 and TR_1' are energized, the first

pulse of the Baudot code will always be reversed, but the others will be sent normally.

Let us assume that the first letter transmitted, after the relays TR_1 and TR_1' are actuated, is the letter A. The five units of the Baudot code for letter A will be mark-mark-space-space-space. With the first pulse reversed by reason of the energization of relays TR_1 and TR_1' the actual code transmitted will be space-mark-space-space-space, which is the code for "line feed." Consequently at the receiving station, if no deciphering arrangement were provided, the receiver TTY_2 would be operated, not to record the letter A, but a line feed operation, and this is also the signal that anyone attempting to tap the line would get. However, when the receiving station is equipped with a deciphering arrangement, the signals are perforated on tapes such as T_2 and T_2' by means of a reperforators RPF_2 and RPF_2' respectively, as shown in Fig. 2.

The received enciphered tape T_2 is fed into the transmitter TD_2 and a duplicate enciphered tape T_2' produced by the perforator RPF_2' and fed into the transmitter TD_2' . With the secrecy equipment at the receiving station set in accordance with the code transmitted by the sending operator prior to the message, the tapes T_2 and T_2' are thus fed in an identical manner into the two tape transmitters TD_2 and TD_2' respectively. Tape T_2' and transmitter TD_2' are used to transmit the enciphered message to TTY_2' equipped with a contact operating similarly to C_x of TTY_1 . Contact R_x operates the secrecy switching equipment SE_2 at the same position on the tape T_2' and in response to the same combination of characters as teletypewriter TTY_1 did at the sending station.

Tape T_2 when fed into the tape transmitter TD_2 at the receiver will not impress upon the associated teletypewriter TTY_2 a line feed signal. Instead it will record letter A upon the teletypewriter because of the action of the switching equipment SE_2 at the receiver. This switching equipment is substantially identical with that shown in Fig. 1. Since this switching equipment is set at the receiving station in the same manner as equipment TTY_1 at the sending station, relays corresponding to TR_1 and TR_1' will be actuated and will re-invert the first Baudot code impulse. Consequently the Baudot code combination for "line-feed," when applied to the tape transmitter TD_2 in the code form space-mark-space-space-space, will have its first impulse reversed by the switching equipment SE_2 . It therefore becomes mark-mark-space-space-space, and causes the teletypewriter TTY_2 to record the letter A.

All subsequent characters and stunt signals transmitted will have their first pulses reversed when sent out from the transmitting station, and restored to normal at the receiving station in a manner similar to that above described, as long as the relays TR_1 and TR_1' at the transmitting station and the corresponding relays at the receiving station remain energized. For example, if now the letter G is transmitted, the code for this letter, which is normally space-mark-space-mark-mark, will have its first pulse reversed so that it comes out mark-mark-space-mark-mark. This is the code for "figures-shift," i. e. the code for the stunt operation which causes the printer to shift from letters to figures. The "figures-shift" signal will then be transmitted over the line and received at the receiving station.

If in the original message the letter G is fol-

lowed immediately by the "space" signal, which is space-space-mark-space-space, the relays TR₁ and TR₁' at the transmitter will reverse the first pulse of the "space" signal so that it will be sent out as mark-space-mark-space-space, this being the code for the letter S. Consequently the line L will receive instead of the successive character combinations G-space, the successive code combinations corresponding to "figures-S."

The teletypewriter TTY₁ at the transmitting station is so arranged that when the combination "Figs.-S" is received, the switch C_x is opened for a short interval, thereby releasing the locking circuit previously traced for the relay TR₁ at the transmitting station. This causes the relay TR₁ to fall off and open the circuit of the relay TR₁'. Relay TR₁' is slow to release, and therefore a momentary circuit is closed from ground over the back contact of armature *a* of relay TR₁, over the front contact of the armature of relay TR₁', over the normal contact of key TK₂, and through the winding of relay TR₂ to battery.

Relay TR₂ is now energized and at the front contact of its armature *b* completes a locking circuit (as soon as contact C_x is reclosed) through the winding of relay TR₂', over conductor 31, over the normal contact *m* of start key SK, over the normal contact of clear-out key CK, through the lamp L, and thence to ground over the contact C_x of the teletypewriter TTY. Contact C_x was of course closed again as soon as the code combination for character S completed its operations upon the teletypewriter TTY. Relays TR₂ and TR₂' at the transmitting station are now energized, and the former by operating its armatures *c*, *d* and *e* produces a reversal of the second pulse of the Baudot code for each character thereafter transmitted, until another shift takes place as will be described later.

In the meantime the codes representing "figures-shift" and character S are transmitted over the line L in succession. The reperforator RPF₂' at the receiving station perforates the code "figures shift" and character S upon the tape T₂. The combination Figs.-S when fed into transmitter TID₂ causes the teletypewriter TTY₂' to open a contact R_x. This contact operates the switching equipment SE₂ at the receiver in a manner similar to that just described in the case of the contact C_x at the transmitting station. This operation releases the relays at the receiver corresponding to TR₁ and TR₁' and energizes and locks up relays at the receiver corresponding to TR₂ and TR₂'. Before this transfer from the one set of relays to the other occurs in the apparatus SE₂ at the receiver, the code combinations corresponding to "Figs.-S" which have been already perforated in the tape T₂ will be translated by means of the switching equipment SE₂ at the receiver into the corresponding code combinations with the first pulse reversed. Since these codes correspond to the letter G followed by the space signal, the letter G will be recorded on the teletypewriter and will be followed by a spacing operation.

After the relays TR₂ and TR₂' at the transmitter and the corresponding relays at the receiver have been operated, the second pulse of each succeeding character will be reversed at the transmitter, and the corresponding character at the receiver will have its second pulse reinverted to restore the character to its original form. For example, if the letter A, whose code is mark-mark-space-space-space, is in the original mes-

sage, it will be converted at the transmitting station into the code mark-space-space-space-space, which is the code for the letter E. This code for letter E, upon being received at the receiving station, will have its second pulse again reversed, so that it will be sent into the recording teletypewriter TTY₂ in the form mark-mark-space-space-space. Subsequent characters will be similarly enciphered at the transmitter and deciphered at the receiver so long as the relays TR₂ and TR₂' at the transmitter and the corresponding relays at the receiver are energized at the proper times.

However, if in the course of the transmitted message the letter B occurs and is followed by the letter U, another shift in the enciphering arrangement will take place. The code for the letter B is mark-space-space-mark-mark, and by reversing the second pulse it comes out mark-mark-space-mark-mark, which it will be remembered is the code combination for "figures shift." The letter U, whose code is mark-mark-mark-space-space, will have its second pulse reversed, and will come mark-space-mark-space-space, which it will be recalled is the code combination for the letter S. Thus we will again transmit into the teletypewriter TTY₁ the combination "figures-S" to again open the contact C_x of said teletypewriter TTY₂'. The code combination "figures-S" will also be transmitted over the line L to reperforator RPF₂, as will be described later.

The opening of the contact C_x at the transmitter will release the locking circuit to the relay TR₂, which in turn opens the circuit for the relay TR₂'. By reason of the fact that the latter is slow-acting, however, a momentary circuit is closed from ground over the back contact of armature *a* of relay TR₂, front contact of relay TR₂', over the normal contact of the key TK₃, and through the winding of relay TR₃ to battery. Relay TR₃ is energized and is locked up through the winding of relay TR₃' and over the contact C_x of the teletypewriter. This contact having been opened only momentarily, is now closed. Relays TR₃ and TR₃' are now energized, and so remain until a new "figures-S" combination occurs in the teletypewriter TTY₁. The relay TR₃ through the make contacts of its armatures *c*, *d* and *e* reverses the third pulse of each succeeding Baudot code transmitted, and this condition continues so long as relays TR₃ and TR₃' remain energized. A corresponding operation of R_x takes place at the receiving station with a similar transfer of the reversing operation from the second to the third impulse. When similar successive operations of C_x and R_x occur, the succeeding relays are operated in their turn in a similar manner to that above described.

Sooner or later, with the apparatus at both transmitter and receiver advanced to reverse the 5th pulse, a new combination of letters or other signals will occur, which, when their fifth pulses have been reversed, will cause the combination "figures-S" to be regarded on the teletypewriter TTY₁ and transmitted over the line L to the reperforators RPF₂ and RPF₂'. The momentary opening of the contact C_x releases the relay TR₅ and closes a momentary circuit from ground over the back contact of armature *a* of relay TR₅, over the front contact of slow release TR₅', which has not yet released, over conductors 32 and 33, over the normal contact of key TK₁, and through the winding of relay TR₁ to battery. Relay TR₁ will be energized and will be locked up through the winding of relay TR₁' over a circuit previously

traced to again cause the reversal of the first pulse of each Baudot code. A similar action will take place at the receiver during the deciphering operations to shift from the fifth pair of transfer relays to the first pair of transfer relays and reverse the first pulse of each Baudot code.

As subsequent "Figs.-S" combinations occur the energized set of transfer relays will be deenergized and the next set actuated at both transmitter and receiver, so that the cycle of transfers already described is repeated. This condition continues until the transmitting operator operates the clear-out key CK. By holding the key CK operated until the slow-release relay of the transfer combination is released, all transfer relays at the transmitting station will be deenergized, and no pulses of the insuing Baudot codes will be reversed. This operation will normally occur at the end of a message, and the operator will then send an agreed signal to apprise the receiving operator that the coding apparatus is not thereafter to be used. Thereupon the receiving operator will operate the key corresponding to CK and release the transfer relays which are energized at that time, thus restoring the receiving apparatus to normal.

In the description above given all five sets transfer relays are operated in succession, but the lapse of time after one pair of relays has been operated until a succeeding pair has been operated varies, and is determined by the fortuitous occurrence of certain character or signal codes in the message after it has been enciphered. This, of course, increases the difficulty of "breaking" the cipher. However, if desired, further variations in the shifting of the cipher may be introduced by excluding certain pairs of transfer relays from the chain. This exclusion is accomplished by the transfer keys TK₁—TK₅, inclusive.

If, for example, the transfer key TK₁ is moved to its alternate position so that the spring rests upon the right-hand contact, then the operation of the start key SK will not actuate relay TR₁ but will complete a circuit for the relay TR₂ as follows: from battery through the winding of the relay TR₂, over the normal contact of transfer key TK₂, over the alternate contact of key TK₁, over conductor 33, over make contact *q* of key SK, through the winding of relay TR₁', through contacts *p* and *o* of key SK, over make contact *n* of said key, and thence by a circuit previously traced to ground over the contact C_x. Relay TR₁' is released after key SK is restored to normal.

In the meantime relay TR₂ operated by this circuit locks up over its contact *b*, through the winding of relay TR₂' which now operates. The transfer relay TR₂ thus acts to reverse the second pulse of each Baudot code until the "Figs.-S" combination occurs and momentarily opens the contact C_x. This releases the transfer relays TR₂ and TR₂' and energizes relays TR₃ and TR₃'. In this manner the control is shifted from the second pair of transfer relays to the third. As later "Figs.-S" combinations occur control passes from the third pair to the fourth, from the fourth to the fifth, and from the fifth back to the second, etc.

Various other combinations may be set up. For example, if the key TK₃ is shifted to its alternate position with key TK₁ restored to normal, the operation of the start key SK will energize the first pair of transfer relays TR₁ and TR₁'. When the next "Figs.-S" combination occurs, these relays will be restored to normal and relays TR₂ and TR₂' will be operated. When the follow-

ing "Figs.-S" combination occurs and relay TR₂ is deenergized, a momentary circuit is closed from ground over the back contact of armature *a* of relay TR₂, over the front contact of relay TR₂' (which is slow to release), over the spring of key TK₃ resting on its right-hand contact, over the spring of key TK₄, resting on its left-hand contact, and through the winding of relay TR₄ to battery. Thus the second pair of transfer relays are released, the third pair is skipped, and the fourth pair is operated.

It will also be obvious that two or more pairs of transfer relays may be eliminated by operating a corresponding number of the transfer keys. For example, if transfer keys TK₃ and TK₄ are operated, then the control will be exercised by the first pair of transfer relays, then by the second pair, and third by the fifth pair, after which it is returned to the first pair.

It will be understood that whenever the sending operator decides to eliminate any pair of transfer relays or any group of transfer relays, information must be transmitted to the distant station in code to that effect, so that the corresponding changes in the switching equipment at the receiving station will be made. This, of course, will usually be done between messages, although by prearranged understanding this information could be included in the body of a message being transmitted.

By means of the keys PRK₁—PRK₅, inclusive, the sending operator may at will (after having first operated the clear-out key CK) arrange to reverse any pulse of the Baudot code. For example, suppose the sending operator operates the key PRK₂. Then, if the tape contact TC₂ is in its normal or right-hand position, as is the case when the second pulse of the character code is a spacing signal, a circuit will be closed from ground over make contact of spring *x* of the key PRK₂, over tape contact TC₂ in its right-hand position, over make contact of spring *y* of key PRK₂, and then over conductor 14 and through the winding of relay RPR₁ to battery. The operation of relay RPR₁ completes a circuit from battery over conductor 10, over the front contact of relay RPR₁, over conductor 13, over make contact of spring *z* of key PRK₂, and over conductor 22 to the second segment of the outer ring of the distributor D. This causes a marking signal to be sent for the second element of the Baudot code instead of a spacing signal. In other words, the second pulse of the Baudot code is reversed.

If on the other hand tape contact TC₂ is in its left-hand or marking position, as would be the case when the second element of the desired code is a marking pulse, the circuit previously traced for the relay RPR₁ will be open at contact TC₂. Consequently battery will not be applied to the second segment of the distributor over the circuit previously traced, said circuit being open at the contact of relay RPR₁. The second element of each code transmitted will be reversed as long as the key PRK₂ remains operated.

In a similar manner if key PRK₄ is operated and the contact TC₄ is in its right-hand position, a circuit will be completed for the relay RPR₁ from ground over make contact *x* of key PRK₄, right-hand position of tape contact TC₄, make contact *y* of key PRK₄, and over conductor 14 to the winding of relay RPR₁. Said relay at its front contact connects battery to the conductor 13, and thence over make contact *z* of key PRK₄, and over conductor 24 to the fourth segment of the distributor, thus sending a marking impulse instead

of a spacing impulse. If, however, the tape contact TC_4 is in its left-hand position, the circuit above traced for relay RPR_1 will be held open at said tape contact TC_4 , and no battery will be applied to the fourth segment of the distributor. Hence a spacing signal will be sent instead of a marking signal.

It will be evident that the sending operator upon operating any one of the PRK keys, must apprise the receiving operator by a suitable code what combination is to be used, so that the receiving operator may make similar changes in the receiving equipment. When the PRK keys are used as above described the cipher will not be changed automatically, as is the case with the transfer relays, but can only be changed when the sending operator chooses to do so.

In the arrangement shown in Fig. 2 enciphering by means of transfer relays is shifted automatically from one set of transfer relays to another whenever a certain combination of signals appears in the enciphered message. If desired, however, this shift from one set of transfer relays to another may be controlled automatically by means of a separate tape, as shown in Fig. 3. Here the setting of the transfer relays in the equipment SE_1 is controlled by special character or other code combinations punched in a cipher tape T_1' . The message to be sent is perforated in the tape T_1 , and transmitted in an enciphered form determined by the setting of the transfer relays in the equipment SE_1 to the perforator RPF_2 , which perforates the tape T_2 in accordance with the enciphered message. When the tape T_2 is fed through the transmitting distributor TD_2 , the switching equipment SE_2 (which is set to correspond to the equipment SE_1 under the control of a cipher tape T_2' like cipher tape T_1') will decipher the message and cause it to be printed on the teletypewriter TTY_2 in normal form.

In order to shift the control from one set of transfer relays to another at each station, the cipher tapes T_1' and T_2' are previously prepared. These tapes may have punched in each of them either a random succession of characters or a single character which is repeated until such time as it is desired to shift from one set of transfer relays to another. Wherever it is desired to shift the control, the combination "Figs.-S" will be punched in the tapes, and when this combination is impressed upon the teletypewriter TTY_1' , the latter will operate its contact corresponding to C_x and cause a shift to the next set of transfer relays in the equipment SE_2 . The similar tape T_2' provided at the receiving station operates the teletypewriter TTY_2' . Whenever the latter receives the combination "Figs.-S" (or any other combination that is decided upon) it will open its contact R_x to shift the control in the switching equipment SE_2 from one pair of transfer relays to the next.

The message originally impressed upon the tape T_1 will thus be sent over the line L in enciphered form, but when fed through transmitter TD_2 will be deciphered and restored to its original condition. The tapes T_1' and T_2' are, of course, punched so that the transfer combination, such as "Figs.-S" will occur at different intervals of time and the random characters which occur in between these intervals on the tape will be printed on the teletypewriters TTY_1' and TTY_2' . However, as these characters are merely punched in the tape to fill in the space between shifting

combinations, they have no meaning and may be chosen arbitrarily. Consequently the printing of these characters on the teletypewriter above referred to may be ignored.

It has been shown in connection with the arrangement of Fig. 1 that desired pulses of the Baudot code can be reversed by using a relay RPR_t under the control of the several sets of transfer relays, or by means of a relay RPR_1 under the control of selected lock-in reverse pulse keys PRK_1 to PRK_5 , inclusive. In Fig. 4 an alternative arrangement is disclosed which simplifies both the apparatus and its operation, by eliminating the relays RPR_t and RPR_1 entirely, by reducing the number of contacts on the transfer relays and on the lock-in reversal pulse keys, by simplifying the circuit and in other respects. In this arrangement it is possible also to reverse more than one pulse in each character combination.

In Fig. 4, instead of having a single start key SK , individual start keys SK_1 to SK_5 , inclusive, are provided, one for each set of transfer relays. This enables the attendant, by operating the start key corresponding to a particular set of transfer relays, to start the pulse reversals for any given series at any desired pulse of the code. In Fig. 1 the successive reversals always start with the first pulse.

By means of these individual starting keys the attendant may also cause reversals of any two or more pulses of each Baudot code. To do this it is only necessary to operate simultaneously the starting keys corresponding to the transfer relays controlling the pulses which it is desired to reverse. When a plurality of sets of transfer relays are thus operated to reverse, for example, the second and fourth pulses, the circuit of Fig. 4 operates to transfer the reversal control, in response to "figures-S" combination, to the next corresponding pair of pulses. For example, the control is shifted from the second and fourth to the third and fifth impulses, then to the fourth and first, then to the fifth and second, etc. In the arrangement of Fig. 1 it will be recalled that in order to produce such a dual control it was necessary first to operate the transfer keys TK_1 , TK_2 and TK_3 and then operate the starting key SK to actuate the fourth set of transfer relays. Then the transfer keys TK_2 and TK_3 had to be restored to normal, leaving the transfer key TK_1 still actuated, whereupon when the start key SK was again actuated to set a second pair of transfer relays into operation.

The details of the circuit arrangement of Fig. 4 will be clear from the following description of its operation. Assuming first that no one of the five sets of transfer relays are operated and that none of the lock-in pulse reversal keys PRK_1 to PRK_5 are operated, it will be evident that under these conditions the message will be transmitted in normal code combinations without being enciphered by any pulse reversals. For example, as the brush arm B of the distributor D passes over its No. 1 segment, the line L will be connected over the inner ring of the distributor, thence over the brush B to segment No. 1 of the distributor, and over conductor 2! to the tape contact TC_1 . If the first pulse is a spacing pulse the tape contact TC_1 will be in its right-hand position and the circuit will be continued over said contact and over the normal contact of spring y of key PRK_1 to the front contact of armature c of relay TR_1 . As the relay TR_1 is not energized, the front contact of said armature c is open and consequently an open circuit

pulse is transmitted to the line. If, however, the first pulse of the code combination is a marking pulse, the tape contact TC₁ will be in its left-hand position, and the circuit will be extended over the normal contact of spring z of key PRK₁, over the back contact of armature c of relay TR₁, and thence over conductor 40 to battery. Under these conditions a marking impulse is transmitted to the line L. The first pulse is consequently not reversed.

Similarly, as the brush passes over the second segment of the distributor, if neither the transfer relay TR₂ nor the key PRK₂ is actuated, an open circuit will be transmitted to the line when the tape contact TC₂ is in its right-hand or spacing position, whereas if it is in its left-hand or marking position, battery will be connected to the line. Hence the second impulse will not be reversed, and under the conditions assumed the remaining pulses are also sent normally.

If it is desired to encipher the message the operator may cause the first pulse to be reversed by operating the start key SK₁, thus energizing transfer relays TR₁ and TR₁' in series over an obvious circuit extending over the make contact of the start key SK₁ and over the contact C_x of the teletypewriter TTY. When thus actuated relays TR₁ and TR₁' are locked up in series over the front contact of armature b of relay TR₁ and over the contact C_x of the teletypewriter TTY.

Under these conditions, if the tape contact TC₁ is in its right-hand position, as would be the case when the first pulse of the enciphered Baudot code is a spacing pulse, the circuit from the first segment of the distributor will be extended over the right-hand contact of tape contact TC₁, over the normal contact of spring y of key PRK₁, over the front contact of armature c of relay TR₁ (which is now pulled up) and thence over conductor 40 to battery. Consequently a marking pulse will be transmitted to the line instead of a spacing pulse. If, however, the tape contact TC₁ is in its left-hand or marking position, the circuit from the first segment of the distributor will be extended over said contact and over normal make contact of spring z of key PRK₁ to the back contact of armature c of relay TR₁. As this relay is pulled up the circuit is open at this point and a spacing pulse instead of a marking pulse is sent to the line L.

Thus the first pulse of each Baudot code will continue to be reversed until a "figures-S" combination is received. Such a combination will cause the teletypewriter TTY to open the contact C_x, thereby unlocking transfer relays TR₁ and TR₁'. A momentary circuit is now established from ground over the back contact of armature a of relay TR₁, over the front contact of relay TR₁' (which is slow to release so that its armature has not yet fallen off) and thence over the normal contact of key TK₂ and through the winding of relay TR₂ to battery. Relay TR₂ is operated and locked up in series with relay TR₂' over an obvious circuit extending over the front contact of armature b of relay TR₂ and the contact C_x of the teletypewriter TTY, which has again closed. With relays TR₁ and TR₁' now de-energized and relays TR₂ and TR₂' operated, the second pulse of the Baudot code will be reversed and this will continue until in response to another "figures-S" combination, the contact C_x is again opened, when relays TR₂ and TR₂' will be released and relays TR₃ and TR₃' will in turn be actuated and locked up. In this manner the transfer relay sets are operated in succession, and

when the last set is operated and then again released the first set will be operated and the process repeated just as in the case of Fig. 1.

Instead of starting the enciphering operation by reversing the first pulse of the Baudot code, the process may be started on any other desired pulse. For example, if it is desired to start the process on the third pulse the start key SK₃ is operated and this energizes relays TR₃ and TR₃', which are locked up to reverse the third pulse of each successive Baudot code until the contact C_x is subsequently opened in response to a "figures-S" combination. This releases the third set of transfer relays and causes relay TR₄ to be operated over the back contact of armature a of relay TR₃ and the front contact of slow release relay TR₃'. Relay TR₄ now locks up in series with relay TR₄', thereby reversing the fourth pulse. The next time the contact C_x is opened the fourth set of transfer relays will be released and the fifth set will be operated. When the contact C_x is again released the fifth set of transfer relays will be released and the relay TR₁ will be operated over a circuit extending over the back contact of armature a of relay TR₅, front contact of the armature of slow release relay TR₅', and over conductor 32 to the winding of relay TR₁, which operates and locks up in series with relay TR₁' to reverse the first pulse, etc.

If it is desired to reverse two pulses of each Baudot code, for example the second and fourth, start keys SK₂ and SK₄ will be actuated, thus energizing relays TR₂ and TR₂' in series and relays TR₄ and TR₄' in series. The circuit of these two parallel sets of transfer relays is extended over a common conductor 31 and over the clear-out key CK to ground over contact C_x. All of these relays will be locked up so that the second and fourth Baudot pulses will be reversed in each successive code combination until in response to a "figures-S" combination the contact C_x is momentarily opened, when the second and fourth sets of transfer relays will be released. The release of the relay TR₂ causes relay TR₃ to be energized over an obvious circuit and locked up in series with relay TR₃'. Likewise the release of relay TR₄ causes relay TR₅ to be energized over an obvious circuit and locked up in series with relay TR₅'. Both sets of relays are connected in parallel through a common circuit extending over conductor 31 and over the contact C_x to ground. The third and fifth pulses of successive Baudot codes will now be reversed until the next opening of the contact C_x occurs, when the control will be transferred from the third and fifth sets of transfer relays to the fourth and first sets. When these two sets are released the control is next transferred to the fifth and second sets of transfer relays, etc.

It will also be evident that more than two pulses of the Baudot code may be reversed. For example, by operating start keys SK₁, SK₃ and SK₅ the first, third and fifth sets of transfer relays may be simultaneously energized and locked up to reverse the first, third and fifth pulse of each Baudot code. When, thereafter, the "figures-S" combination occurs, these sets of transfer relays will be released and the control will be transferred to the second, fourth and first sets of transfer relays. In response to the next release of the contact C_x the control will be transferred to the third, fifth and second sets of transfer relays, etc.

Any desired pulse of the Baudot code may be reversed, or any desired combination of pulses

of a given combination of a Baudot code may be reversed, by operating the proper lock-in pulse reverse key of the group PRK₁ to PRK₅, inclusive. For example, if the key PRK₁ is operated, the circuit from the first segment of the distributor will be extended over the spacing contact of the tape contact TC₁, over the make contact of spring *y* of PRK₁, and thence over conductor 40 to battery to send a marking impulse instead of a spacing impulse. If the tape contact is in its marking position the circuit will be extended over the left-hand contact of tape contact TC₁ to the spring *z*, at which point the circuit will be open, thus sending a spacing impulse to the line instead of a marking impulse.

It will be obvious that if, for example, keys PRK₁ and PRK₃ are operated at the same time, both the first and third pulses will be reversed by said keys. Likewise if the keys PRK₂, PRK₄ and PRK₅ are operated at the same time, the second, fourth and fifth pulses will be reversed, etc.

It will be noted that further variations of enciphering code combinations may be obtained by using both the transfer relays and the lock-in pulse reversal keys. For example, suppose the sets of transfer relays are arranged to operate in successive order to transfer the control of code reversals from the first set to the second, from the second to the third, then to the fourth, etc., as successive "figures-S" combinations occur to open the contact C_x. If at the same time the key PRK₂ is actuated, the enciphering of the code combination will be varied. When the first set of transfer relays is operated the first pulse will be reversed by said transfer relays. The second pulse is controlled by the key PRK₂ and is therefore reversed by the key, notwithstanding the fact the second set of transfer relays is not operated at this time. Under these conditions both the first and second pulses of each code combination would be reversed until the contact C_x is opened in response to a "figures-S" combination. This releases the first set of transfer relays and operates the second set of transfer relays. Under these conditions the first pulse will not be reversed because the first set of transfer relays is released. With the key PRK₂ and the second set of transfer relays operated, only the second pulse of each code combination will be reversed but this reversal is determined not by the operated second set of transfer relays but by the second key PRK₂. When the next "figures-S" combination occurs the second set of transfer relays will be released and the third set of transfer relays operated. Under these conditions, the key PRK₂ being operated, the second and third pulses will be reversed, the former under the control of the key PRK₂ and the latter under the control of the third set of transfer relays.

It will be understood that the transfer keys TK₁ to TK₅ inclusive operate as in Figure 1 to omit any desired transfer relays from the chain so that the pulses corresponding to the omitted transfer relays will not be reversed.

Thus it will be seen that more varied enciphering arrangements of code combinations may be set up with more disturbing effects upon an unauthorized teletypewriter connected to pick up signals from the line L.

While this invention has been disclosed in certain specific arrangements which are deemed desirable, it will be obvious that the principles herein set forth may be embodied in many other organizations widely different from those illustrat-

ed without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, means responsive to the occurrence of certain Baudot code combinations to encipher a message by reversing the electrical character of any desired one of the pulses of each of a number of successive Baudot code combinations before the code combination is transmitted, the corresponding pulse whether marking or spacing being always reversed in all successive code combinations until a different enciphering reversal is set up, and means responsive to the occurrence of certain Baudot code combinations to restore the pulse previously reversed to normal and to reverse another pulse of each of a different number of successive Baudot code combinations.

2. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, means responsive to the occurrence of certain Baudot code combinations to encipher a message by reversing the electrical character of any desired one of the pulses of each of a number of successive Baudot code combinations before the code combination is transmitted, the corresponding pulse whether marking or spacing being always reversed in all successive code combinations until a different ciphering reversal is set up, means responsive to the occurrence of certain Baudot code combinations to restore the pulse previously reversed to normal and to reverse another pulse of each of a different number of successive Baudot code combinations, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulse to normal and thereby to cause the corresponding character or other signal to be received in deciphered form.

3. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, and means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms.

4. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated

device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulse to normal and thereby to cause the corresponding character or other signal to be received in deciphered form.

5. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, and means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, the time interval between such successive shifts of reversal control arbitrarily varying in accordance with fortuitous recurrence of said certain Baudot code combinations.

6. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, the time interval between such successive shifts of reversal control arbitrarily varying in accordance with fortuitous recurrence of said certain Baudot code combinations, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulse to normal and thereby to cause the corresponding character or other signal to be received in deciphered form.

7. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession,

thereby successively enciphering further messages or parts thereof in other forms, and means operating in response to further occurrences of said certain Baudot code combinations to again cause transfer of reversal control through said devices in the same succession.

8. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, means operating in response to further occurrences of said certain Baudot code combinations to again cause transfers of reversal control through said devices in the same succession, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulse to normal and thereby to cause the corresponding character or other signal to be received in deciphered form.

9. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, and means operating in response to further occurrences of said certain Baudot code combinations to again cause transfers of reverse control through said devices in the same succession, the time interval between such successive shifts of reversal control arbitrarily varying in accordance with fortuitous recurrence of said certain Baudot code combinations.

10. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to the other of said devices in succession, thereby suc-

cessively enciphering further messages or parts thereof in other forms, means operating in response to further occurrences of said certain Baudot code combinations to again cause transfers of reversal control through said devices in the same succession, the time interval between such successive shifts of reversal control arbitrarily varying in accordance with fortuitous recurrence of said certain Baudot code combinations, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulse to normal and thereby to cause the corresponding character or other signal to be received in deciphered form.

11. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, and means to prevent the operation of any of said devices at will so that transfers of control will take place successively among only the devices not prevented from operation, thereby preventing reversals of certain of the pulses of Baudot code combination.

12. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing the corresponding pulse of each Baudot code combination before the code combination is transmitted, means causing one of said devices to control the reversal of the pulse controlled by it in a plurality of Baudot code combinations to thereby encipher a message or part thereof in one form, means responsive each time certain Baudot code combinations occur to defeat control by a previously operated device and to transfer pulse reversal control to other of said devices in succession, thereby successively enciphering further messages or parts thereof in other forms, means to prevent the operation of any of said devices at will so that transfers of control will take place successively among only the devices not prevented from operation, thereby preventing reversals of certain of the pulses of Baudot code combinations, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulse to normal when received and thereby to cause the corresponding character or other signal to be received in deciphered form.

13. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable when operated of reversing said pulses before the code combination is transmitted, means to operate any desired set of said devices to reverse the

electrical character of corresponding impulses in a given number of successive code combinations to thereby encipher a message, the corresponding impulses in all successive code combinations continuing to be reversed until a different set of ciphering devices is operated, and means responsive to the occurrence of certain Baudot code combinations to restore said selected devices to normal and operate a different set of said devices to reverse a different plurality of pulses in a different number of succeeding code combinations.

14. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, devices individual to each of the five pulses comprising the Baudot code and capable of reversing said pulses before the code combination is transmitted, means to operate a selected set of said devices to reverse the corresponding impulses in successive code combinations and thereby encipher a message, and means responsive each time certain Baudot code combinations occur to defeat control by the set of devices previously operated and to transfer pulse reversal control to different sets of said devices in succession, the time interval between such successive shifts of reversal control arbitrarily varying in accordance with fortuitous recurrence of said certain Baudot code combinations.

15. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, means whereby the sender may at will encipher a message by causing the reversal of the electrical character of any desired one of the pulses of each of a number of successive Baudot code combinations before the code combination is transmitted, the same corresponding pulse whether marking or spacing being always reversed in all successive code combinations until a different ciphering reversal is set up at the will of the sender, and means operating thereafter to cause the reversal of another pulse in each of a different number of successive Baudot code combinations.

16. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, means whereby the sender may at will encipher a message by causing the reversal of the electrical character of any desired one of the pulses of each of a number of successive Baudot code combinations before the code combination is transmitted, the same corresponding pulse whether marking or spacing being always reversed in all successive code combinations until a different ciphering reversal is set up at the will of the sender, means operating thereafter to cause the reversal of another pulse in each of a different number of successive Baudot code combinations, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at the transmitting station to restore said pulse to normal and thereby to cause the corresponding character or other signal to be received in deciphered form.

17. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, means whereby the sender may at will encipher a message by causing the reversal of the electrical character of any desired set of pulses of each of a number of successive Baudot code combinations before the code combination is transmitted, the same corresponding set of

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pulses whether marking or spacing being always reversed in all successive code combinations until a different ciphering reversal is set up at the will of the sender, and means operating thereafter to cause the reversal of another set of pulses in each of a number of successive Baudot code combinations.

18. In a secrecy system, means to translate messages into Baudot code combinations representing characters and other signals to be transmitted, means whereby the sender may at will encipher a message by causing the reversal of the electrical character of any desired set of pulses of each of a number of successive Baudot code combinations before the code combination is

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transmitted, the same corresponding set of pulses whether marking or spacing being always reversed in all successive code combinations until a different ciphering reversal is set up at the will of the sender, means operating thereafter to cause the reversal of another set of pulses in each of a number of successive Baudot code combinations, and means at a receiving station operating on a particular pulse of a Baudot code combination which is reversed at a transmitting station to restore said pulses to normal and thereby to cause the character or other signal to be received in deciphered form.

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