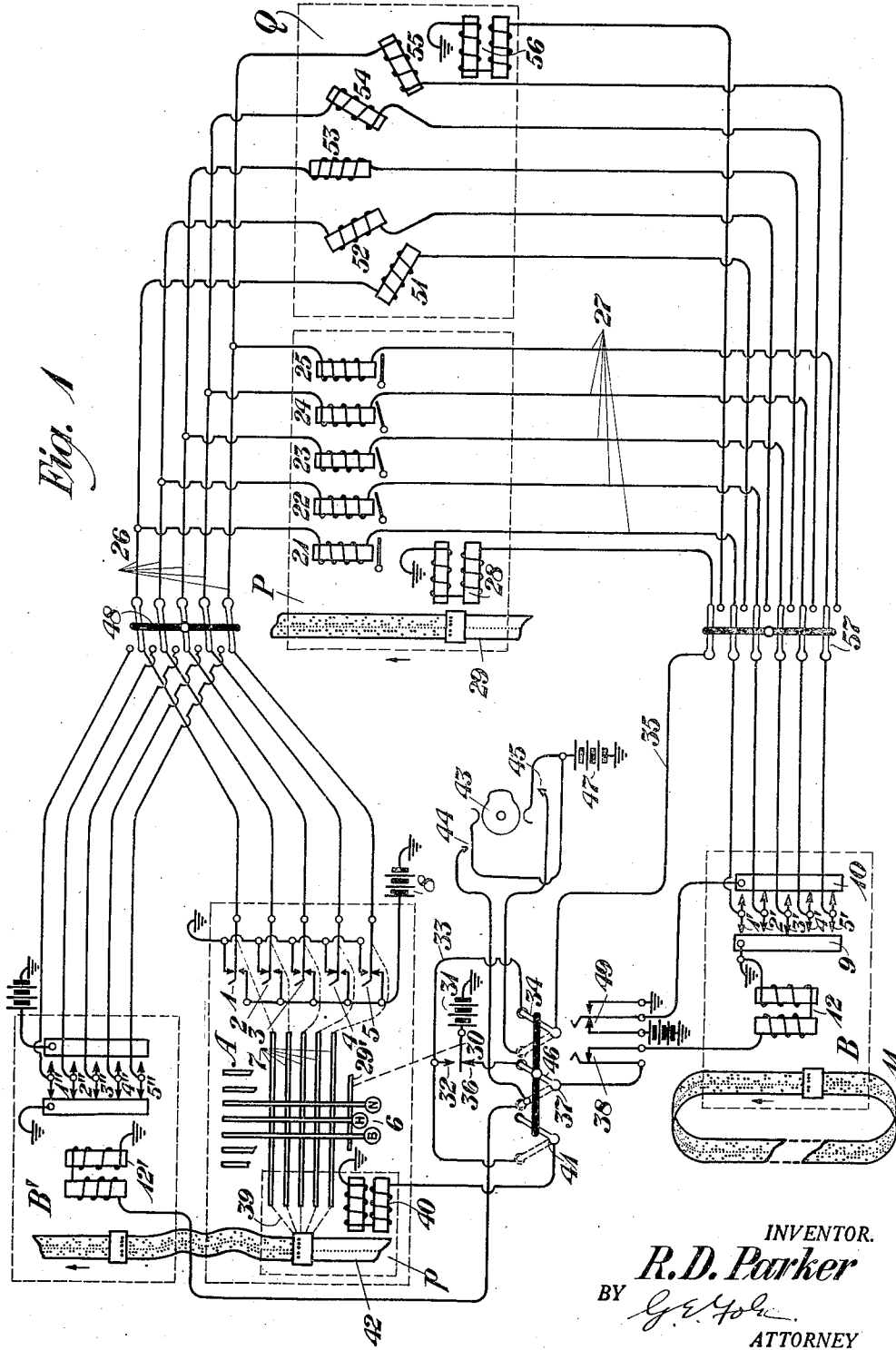


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APPLICATION FILED DEC. 9, 1918.

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Patented Nov. 4, 1919.
2 SHEETS—SHEET 1.



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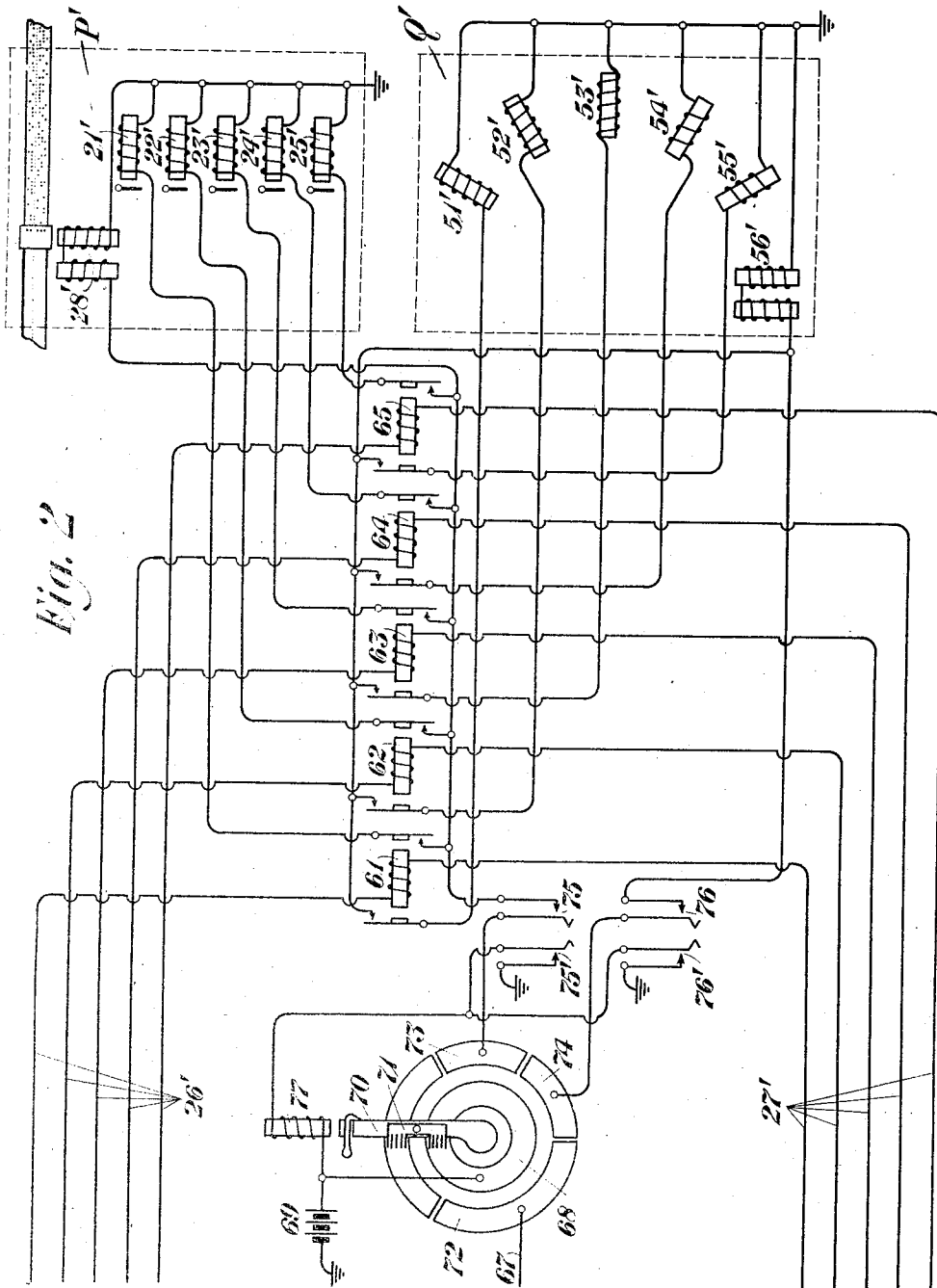


Fig. 2

INVENTOR.
R. D. Parker
BY *G. V. For*
ATTORNEY

UNITED STATES PATENT OFFICE.

RALZEMOND D. PARKER, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

CIPHERING AND DECIPHERING MECHANISM.

1,320,908.

Specification of Letters Patent.

Patented Nov. 4, 1919.

Application filed December 9, 1918. Serial No. 265,922.

To all whom it may concern:

Be it known that I, RALZEMOND D. PARKER, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Ciphering and Deciphering Mechanism, of which the following is a specification.

This invention relates to the transmission of signals and especially to telegraphic communication in which it is desired that the message be transmitted secretly. In a co-pending application of G. S. Vernam, Serial No. 253,962, filed Septemebr 13, 1918, owned by the assignee of this application, there is disclosed a system for transmitting messages by means of printing telegraph equipment arranged to automatically encipher a message between the transmitter and the line wire so as to be unintelligible to unauthorized persons tapping the line. At the receiving end the message is automatically deciphered and printed or otherwise recorded. In the use of such a system the operators at the sending or receiving end have access to the message in its original form, and must therefore be persons who can be intrusted with a knowledge of the message. In order to insure a high degree of secrecy it is desirable to provide means for readily enciphering a message by its originator, and convenience requires that such enciphering be done at many points other than the immediate termini of telegraph lines. By the present invention arrangements are provided for storing secret telegraph messages in cipher form such that they can be safely forwarded to telegraph offices and transmitted over the lines by any operator and by well known apparatus in any of a variety of ways.

Apparatus for accomplishing the above indicated objects is shown in the accompanying drawings, in which Figure 1 shows diagrammatically a system which may be used both to encipher and store on a tape or sheet, outgoing messages and to decipher and record incoming messages in like manner, and Fig. 2 shows a modification thereof.

Referring to Fig. 1 A represents a keyboard transmitter such as is commonly used in printing telegraph systems. It is provided with a keyboard similar to a typewriter keyboard, of which three keys 6 only are shown. These key levers operate upon

five bars 7 to depress them in different combinations representing the various characters. The bars 7 have mechanical connection, indicated by the dotted lines, to a set of switches 1, 2, 3, 4 and 5. These switches are here shown as normally resting on grounded back contacts and moving when operated by their connection with the bars 7 to front contacts connected to the battery 8.

B is a tape transmitter of the usual form employed in printing telegraphy, provided with positive and negative busbars 9 and 10 between which move a set of contacts 1', 2', 3', 4' and 5' under the influence of tape controlled pins, in a well known manner. The tape indicated at 11 is stepped along by the control magnet 12 so that the successive characters indicated on the tape are successively set up on the contacts 1', 2', 3', 4' and 5'. Transmitters of this kind being in common use and well known to those skilled in the art need no detailed description. The tape 11 is a "key" tape for the ciphering and deciphering, two copies only of which are made, one for use at the point where the message originates, and the other where it is to be received. It is conveniently made in the form of a closed loop of any desired length as indicated on the drawing.

A perforator P is connected between the keyboard transmitter A and the tape transmitter B. It has controlling magnets 21, 22, 23, 24 and 25, whose windings are connected on one side by conductors 26 to the contacts 1, 2, 3, 4 and 5 respectively of the keyboard transmitter A, and on the other side by conductors 27 to the contacts 1', 2', 3', 4' and 5' respectively of the tape transmitter B. The punching magnet 28 perforates the tape 29 in a well known manner, in accordance with the combination set up by the magnets 21, 22, 23, 24 and 25.

The controlling magnet 12 of the tape transmitter B and the punch magnet 28 of the perforator P are under the control of the keyboard transmitter A, so that the tape on each is moved along one step for each character lever of the keyboard depressed. This is conveniently accomplished by a bar 29' arranged to be depressed by the operation of any key of the keyboard, and it is here shown as controlling the said magnets through a switch 30 which it mechanically

operates. When the bar 29 is operated, the switch 30 closes the circuit of the magnet 28 from the battery 31 through front contact 32, conductor 33, switch 34 and conductor 35 to the magnet and ground, thereby perforating the tape 29 in accordance with the combined effects of the contact combinations set up in the keyboard transmitter contacts and the tape transmitter contacts. When the bar 29 is released the circuit of the magnet 12 is closed from the battery 31 through the back contact 36, switch 37, switch 38, magnet and ground, thereby moving the key tape one step and setting up a new combination on the contacts 1', 2', 3', 4' and 5', to cooperate with the next combination of contacts set up in the keyboard transmitter.

The key tape 11 of the transmitter B contains a succession of symbols representing characters preferably selected at random. The manner in which this transmitter cooperates with the keyboard transmitter to encipher the message will be understood from the following.

Let it be supposed that the "H" key lever has been depressed in the transmitter A. The code symbol for H is — — + — +. This means that contacts 3 and 5 will be moved from their ground connection to their battery connections as indicated on the drawing. If it happens that the letter "G" whose symbol is — + — + +, is at the moment in the tape transmitter B, contacts 2', 4' and 5' will be moved from the grounded bus-bar 9 to the battery bus-bar 10. Magnet 21, therefore, of perforator P, will receive no current because both ends of its winding are connected to ground; magnet 22 will be energized since one end of its winding is connected to ground at contact 2, the other end to battery at contact 2'; magnet 23 will be operated since it is connected to battery at 3 and ground at 3'; magnet 24 will be operated since it is connected to ground at 4 and battery at 4', and magnet 25 will remain unoperated since it is connected to battery both at 5 and 5'. The combination indicated by the magnets 21, 23, 24 and 25 under these current conditions is therefore — + + + — which is the code symbol for the letter C. Perforations indicating this letter are therefore made in the tape by punching magnet 28. In like manner each successive character indicated by the operation of the keyboard at A is altered by the condition of the contacts of the transmitter B, so that the message as perforated in the tape 29 is in a completely disguised form. Since the key tape 11 is moved preferably for each letter recorded, it will be obvious that the code by which the enciphering of the message is accomplished is selected anew for each character of the message and it therefore becomes impossible to decipher the mes-

sage without the use of a corresponding key tape.

It may be desirable under certain circumstances to make a permanent record of the message in its unciphered condition at the originating point. This can be easily done by use of the apparatus customarily associated with the keyboard transmitter in standard printing telegraph equipment. This equipment ordinarily comprises a keyboard transmitter, with a set of electrical contacts as above described, and a perforator also operated by the key levers, a tape transmitter similar to the transmitter B already described, and a printer, for printing in page form, received or transmitted messages. If this equipment is used in carrying out the present invention, it will be seen that the enciphered message may be perforated in a tape at the keyboard transmitter and this tape then run to the tape transmitter which can be made to cooperate with the ciphering transmitter B in the same manner as the keyboard transmitter cooperates in the method of enciphering above described.

A keyboard perforator associated with the keyboard transmitter in Fig. 1 is indicated at *p*. The combination of perforations made by its punches is controlled by mechanical connections (indicated by the dotted lines 39) between the bars 7 and the punches, and the punching magnet 40 operates the punches when its circuit is closed by a contact controlled by the keyboard. This is indicated in the present instance by a circuit between the front contact 32 of the switch 30 and the magnet 40 passing through the switch 41 when moved to dotted line positions. Thus each time the key is depressed the tape will be perforated in accordance with the combination representing the character on that key. The tape after being punched will be fed through the tape transmitter B' which has five contacts 1'', 2'', 3'', 4'' and 5'', and a controlling magnet 12', similar to the corresponding elements of transmitter B. When a message is to be enciphered by the cooperation of the transmitters B and B', a timing device of some kind for coordinating the operation of the transmitters and the perforator, is desirable. A simple cam switch 43 is here indicated for this purpose, though segments on the distributor of the printer equipment or any other convenient timing element may be employed. The controlling switch 43 has two contacts 44 and 45, the former for simultaneously closing the operating circuits of the transmitters B and B' and the latter for closing the circuit of the punching magnet of perforator P. In order that the perforator and transmitter B may be used with either the keyboard transmitter A

or the tape transmitter B', switches 34 and 46 are provided for transferring their operating circuits from the control of the keyboard transmitter to the control of the switch 43. When these switches are moved to the dotted line position, current from the battery 47 will be supplied, first to the transmitter controlling magnets 12 and 12' (here shown as connected in parallel though of course they may be otherwise arranged) and then to the punching magnet of the perforator through the switch 45. Since switches 34, 41 and 46 are all to be moved when changing the method of enciphering the message, they are here shown as provided with a single handle for convenience. A gang switch 48 is also provided for transferring the conductors 26 from the contacts of the keyboard transmitter to the contacts of the tape transmitter B'.

It may sometimes be desirable to record a part of the message in unciphered form on the tape of the perforator P, and to facilitate this a switch 49 is provided for transferring the positive bus-bar of the transmitter B from battery to ground. The switch 38 is simultaneously operated to open the circuit of the control magnet 12. With both of its bus-bars connected to ground the transmitter B will have no effect upon the combination set up in the keyboard transmitter or the tape transmitter B' as the case may be.

When a message is enciphered by first perforating it upon the tape 42, this tape may be either completed before it is inserted in the tape transmitter B' or fed immediately from the perforator to the transmitter. In the latter case a control device (not shown) for the transmitter B' is provided, such, for instance, as is shown in patent to Dixon No. 1,192,171, for preventing the transmitter from overtaking the perforator p.

It may be desired to record the enciphered or deciphered message in printed form rather than upon a perforated tape and in deciphering this is of course generally preferable. For deciphering a printing mechanism such as is ordinarily found in connection with apparatus of the kind above described may be employed. The arrangement for this purpose is shown in Fig. 1 where the control magnets of the printer Q are indicated at 51, 52, 53, 54 and 55, and the printing magnet at 56. The magnets 51 to 55 are connected respectively to the five conductors 26 in parallel with magnets of the perforator P. The other terminals of the magnets are connected to contacts of a switch 57 which serves to transfer the connections of the contacts 1', 2', 3', 4' and 5' of the transmitter B from the perforator magnets to the printer magnets, and to transfer the circuit 35 of the timing switch

43 from the punching magnet 28 to the printing magnet 56.

In sending messages in accordance with the present invention the tape from the perforator P will ordinarily be used in the tape transmitter of an ordinary printing telegraph equipment, and the message will be received in a perforating machine sometimes called a re-perforator, which reproduces at the receiving end a tape identical with that in the transmitter at the sending end. This equipment is all well known in the art, and in itself constitutes no part of my invention. In fact the message may be transmitted in any convenient manner. It may, for instance, be translated and sent by Morse or other code, or even by mail or other convenient means. If sent by Morse code, it will be restored to a perforated tape form at the receiving end, so that in any case the receiver of the message is provided with a tape having the message thereon in enciphered form, identical in all respects with the tape produced by the perforator P. If this tape is placed in the tape transmitter B' at the receiving station, and the duplicate of the key tape 11 is placed in the transmitter B of the equipment at that station and in the same position relative to the message tape that it bore during the perforation of that tape at the transmitting end, the printing mechanism will decipher and print the message in plain characters. This operation may be illustrated by supposing that the letter C, the first character of the enciphered message, is placed in the transmitter B', while the letter G on the key tape 11 is placed in the transmitter B just as it was at the beginning of the enciphering of the message above described. The presence of the character C in the transmitter B' means that the contacts 2'', 3'' and 4'' are moved to their positive bus-bar, and the presence of the letter G in the transmitter B means that the contacts 2', 4' and 5' are moved to their positive bus-bar. Accordingly the circuit of the magnet 51 of the printer will be unenergized, since both ends of its winding are connected to ground; the magnet 52 will be unenergized since both ends of its winding are connected to battery; the magnet 53 will be energized since it is connected to battery at contact 3'' and to ground at 3'; the magnet 54 will be unenergized since both of its terminals are connected to battery, and the magnet 55 will be energized since one terminal is connected to battery at 5' and the other terminal to ground at 5''. That is to say, the magnets of the printer will show the combination — — + — + which is the code symbol for the letter H, the first letter in the original or unciphered message as it was set up in the contacts of the transmitter when the message was enciphered. The printer will

therefore print the letter H, and subsequent characters of the message will be deciphered in a similar manner, so that one receiving the message may read it without being skilled in any way beyond the ability to place the received tape and the key tape properly in the transmitters B' and B respectively.

Manifestly the printer Q may be used for enciphering instead of the perforator P, by shifting the switch 57; in which case the printer should be such as to make a printed record of every set of impulses received.

Fig. 2 shows a modification of the arrangement of Fig. 1, differing in that the perforator magnets and the printer magnets instead of being directly in circuit are operated by a set of five relays 61, 62, 63, 64 and 65 located in the circuits connecting the enciphering and deciphering transmitter B and the transmitter B' or the keyboard transmitter A as the case may be; and further in using contacts of the distributor commonly associated with printing telegraph sets in place of the timing switch 43 shown in Fig. 1.

In Fig. 2 the conductors 26' and the conductors 27' correspond to the conductors 26 and 27 respectively of Fig. 1 and the perforator P' and printer Q' correspond to the perforator P and printer Q of Fig. 1. The conductor 67 corresponds generally to the conductor leading from the contact 44 of the timing switch 43 in that it runs to the energizing magnets of the transmitters B and B' when the apparatus is arranged for coöperation of these elements. A continuous contact 68 of the distributor is connected to the battery 69 and the rotating arm 70 carries a brush 71 which successively closes the battery circuit from the ring 68 to the contacts 72, 73 and 74. The impulses going out from the contact 72 operate the magnets of the transmitters B and B' and those going out from the contacts 73 and 74 energize the operating magnets 28' and 56' of the perforator and printer respectively and such of the selecting magnets 21', 22', 23', 24' and 25' or the magnets 51', 52', 53', 54' and 55' as at the moment have had their circuits closed by the relays 61, 62, 63, 64 and 65. The circuits leading from the contacts 73 and 74 are provided with switches 75 and 76 respectively, either of which may be closed to connect its corresponding instrument with the proper distributor contact. Each of the switches 75 and 76 is associated with a companion switch 75' and 76' respectively which holds closed the circuit of the release magnet 77 of the distributor so that the arm 70 will rotate freely to act as a timing switch. The interposing of relays 61, 62, 63, 64 and 65 as shown in Fig. 2 makes the use of the gang switch 57 of Fig. 1 unnecessary, since the magnets of the instruments not in use will

not be energized in any event, unless the corresponding switch 75 or 76 is closed. It also has the advantage that the circuit is better adapted to the wiring now used in printing telegraph apparatus. The selecting magnets of existing printers are usually connected to a common ground as indicated in Fig. 2, and the arrangement shown in Fig. 1 would require a rewiring of this apparatus since each of the magnets must be connected to a separate conductor running to one of the contacts of the ciphering and deciphering transmitter B.

The arrangement here described, therefore, provides a simple and effective means enabling anyone who can operate an ordinary typewriter keyboard and place tapes in a transmitter to encipher or decipher a message and record the result on a perforated tape or in printing, the enciphered message being in a form in which it may be entrusted with perfect safety to any convenient channel for transmission. The enciphering and deciphering can therefore be done in the utmost privacy by the originator and receiver of the message respectively, wherever he may be located, and it is unnecessary to extend the terminals of telegraph lines to all of the various points at which it might be desired to originate secret messages, as the tape or other record can easily and safely be transferred by messenger to or from telegraph offices where the transmission is by standard equipment.

Obviously the invention may be embodied in a variety of forms quite different from that herein described. The several pieces of apparatus composing the embodiment here used as illustrative are in themselves old and therefore readily available and form a convenient means of practising the invention. Manifestly however, the control may be mechanical throughout instead of electrical and if electrical the invention is not limited to the specific circuit arrangements shown and described. Various modifications will suggest themselves to those skilled in the art, without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. An apparatus for enciphering and deciphering messages comprising a group of elements adapted to represent successively the characters of the message, a second group of elements adapted to represent successively a series of ciphering characters and means controlled by the joint effect of said groups of elements for indicating the characters of the enciphered or deciphered message.

2. An apparatus for enciphering or deciphering messages comprising two groups of movable contacts, means for moving one of said groups of contacts to represent suc-

cessively the message characters, means for moving said other group to represent successively a series of ciphering characters and mechanism controlled by said two sets of 5 contacts jointly for indicating the characters of the enciphered or deciphered message.

3. A mechanism for enciphering or deciphering messages comprising a group of 10 contacts movable to produce sets of electrical conditions representing the message characters in accordance with a predetermined code, a second group of movable contacts, a series of ciphering characters, a controlling device for said second group of 15 contacts for moving them to represent a series of ciphering characters, and means under the influence of electrical connections made by said two groups of contacts jointly, for 20 locally indicating the characters of the enciphered or deciphered message.

4. A mechanism for enciphering or deciphering messages comprising means for representing the message characters by a 25 series of sets of electrical conditions respectively representing the message characters in accordance with a predetermined code, means for concurrently representing a series of ciphering characters by a series of sets of 30 electrical conditions and mechanism under the combined effect of successive sets of electrical conditions in said two series respectively for locally recording the resulting enciphered or deciphered message.

5. An apparatus for enciphering and deciphering messages comprising a group of 35 members which may be operated to repre-

sent characters of the message or of the enciphered message in accordance with a predetermined code, a second group of mem- 40 bers which may be operated to represent a series of ciphering characters, perforating mechanism and printing mechanism and means controlled by the arrangement of said two groups of members jointly for operat- 45 ing either of said mechanisms to indicate the enciphered or deciphered message.

6. In mechanism for enciphering and deciphering messages, a keyboard transmitter having electrical contacts operable to represent characters in accordance with a pre- 50 determined code, a perforator also operable from said keyboard for recording characters on a tape in accordance with said code, a tape transmitter having a group of contacts 55 controllable by a perforated tape for representing electrically the characters on said tape, a ciphering and deciphering transmitter having a group of electrical contacts 60 controllable by a key tape to electrically represent the characters thereon, an electrical perforator mechanism, an electrical printing mechanism, means for connecting the controlling magnets of either of said mechanisms on one side to said group of 65 electrical contacts and means for connecting either of said mechanisms on the other side to the contacts of either the keyboard transmitter or the tape transmitter.

In testimony whereof, I have signed my 70 name to this specification this sixth day of December, 1918.

RALZEMOND D. PARKER.