R. E. PIERCE.

SECRET SIGNALING SYSTEM.

APPLICATION FILED DEC. 13, 1918.

1,312,574.

Patented Aug. 12, 1919.

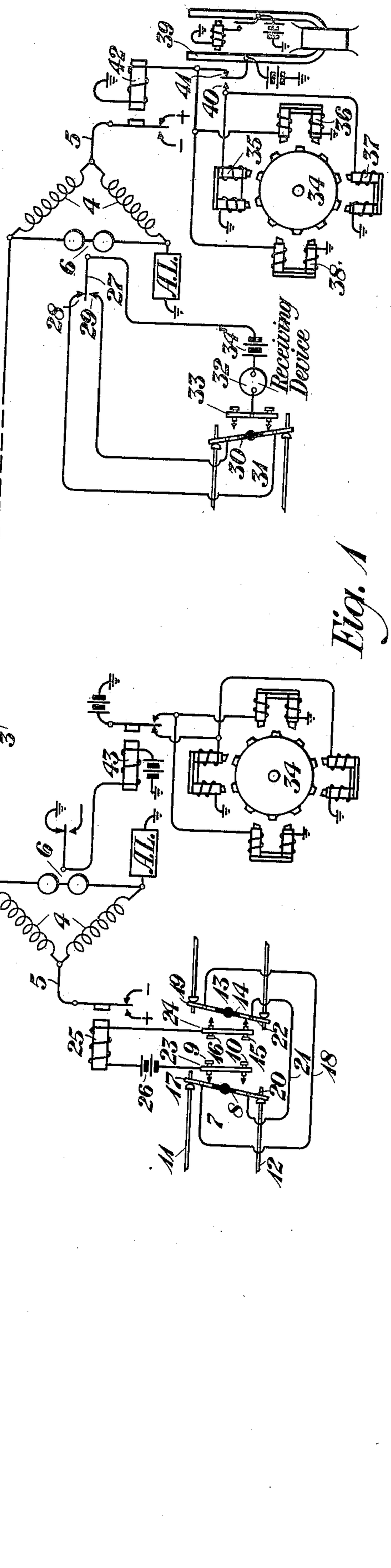

Fig. 1

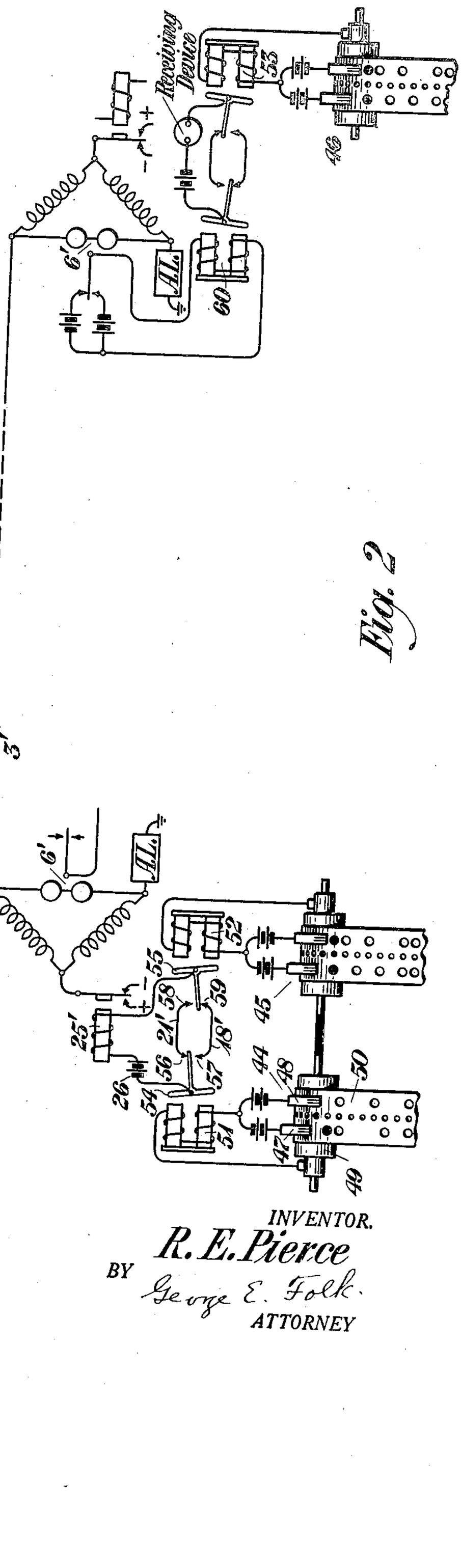

Fig. 2

INVENTOR.

R. E. Pierce

BY George E. Folk.

ATTORNEY

UNITED STATES PATENT OFFICE.

RALPH E. PIERCE, OF LARCHMONT, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SECRET-SIGNALING SYSTEM.

1,312,574. Specification of Letters Patent. Patented Aug. 12, 1919.

Application filed December 13, 1918. Serial No. 266,632.

To all whom it may concern:

Be it known that I, RALPH E. PIERCE, residing at Larchmont, in the county of Westchester and State of New York, have invented certain Improvements in Secret-Signaling Systems, of which the following is a specification.

This invention relates to secret signaling systems, and particularly such as employ Morse or similar codes for transmitting the message characters.

It has been proposed heretofore to render Morse messages secret by altering or breaking up the current impulses representing the characters into an unintelligible series of impulses by means of a ciphering switch cooperating with the sending key, and under the influence of a separate Morse key, or other device operating in accordance with a different series of signals or impulses; the original character of the signal impulses being restored at the receiving end by a switching device operating in exact accord with the ciphering device at the sending end. In such a system, the dot and dash impulses of the original message are interrupted by the ciphering switch at indeterminate points, so that many instances of very rapid changes in current value will occur. Such high frequency changes require a transmission line capable of handling high frequency currents if the system is to be practical and many existing telegraph lines, over which it would be desirable to transmit secret messages, would be incapable of handling these high frequencies. According to the present invention, this difficulty is overcome by providing an arrangement whereby similar results as to secrecy are attained without producing any frequencies higher than that represented by the dot impulse in the code used.

The invention will be explained more in detail in connection with the accompanying drawing, in which Figure 1 represents diagrammatically one embodiment thereof, and Fig. 2 a modification, using a different sending equipment.

In general, the object of the invention is attained by using a perforated tape such for instance, as is commonly employed in the well-known Wheatstone transmitter, for creating the message impulses, and a similar tape for producing the enciphering impulses. At the receiving end a tape identical with that used for enciphering the message is employed for restoring the received impulses to the original form.

Referring to Fig. 1, the transmitting line 3 is provided at each terminal with the usual duplex set comprising ratio arms 4 and artifical line A. L. with the sending leads 5 connected in each case at the apex of the ratio arms, and the receiving relay 6 connected across the ratio arms between the main line and artificial line. An ordinary Wheatstone transmitter 7 is operated by a perforated tape in the usual manner. The tape is not shown in Fig. 1, but its character is well understood in the art, and is indicated in Fig. 2 in connection with a transmitter of a different type. It is characterized by perforations arranged in pairs to represent dots and dashes, a dot being indicated by a pair arranged in a line at right angles to the tape, and a dash by a pair in a diagonal line. Uniformly spaced perforations serve to advance the tape at an even rate in steps corresponding to the length of a dot. Only the oscillating bar 8 of the Wheatstone transmitter with one set of contacts 9 and 10 and the operating rods 11, 12 are here illustrated, it being understood that the contact bar 8 is oscillated through rods 11 and 12 under the control of the tape to represent dot and dash signals, in accordance with well known practice.

For enciphering the message, a similar Wheatstone transmitter may be employed, here indicated at 13 by the contact bar 14 and one set of contacts 15, 16, as in the case of the message transmitter. It also is operated under the control of a perforated tape in the usual manner, but it is not necessary that this tape contain Morse letter characters a mere jumble of dot and dash symbols being in fact, preferable. The operating mechanisms of the two transmitters 7 and 13 are preferably driven from a common shaft, so that the tapes in the two are stepped forward simultaneously.

In order that these two transmitters may coöperate to control the signals transmitted, the upper contact 17 of the bar 8 may be electrically connected by conductor 18 with the upper contact 19 of the bar 14, and the lower contact 20 of the bar 8 with the lower contact 22 of the bar 14 by conductor 21.

Obviously however, the upper contact of one bar might be connected with the lower contact of the other bar, if desired, with like results, providing a corresponding connection was made in the deciphering equipment at the receiving end. The contacts 9 and 10 are mounted upon a bar 23, and the contacts 15 and 16 upon a similar bar 24, between which the transmitting magnet 25 is connected, in series with a suitable source of current 26.

With the two Wheatstone transmitters 7 and 13 operating together, it will be clear that the transmitting magnet 25 will receive a current impulse only when the contact bars 8 and 14 are simultaneously against their upper contacts, or simultaneously against their lower contacts on the bars 23 and 24 respectively. When they are in the position shown in the drawing, no current impulse is transmitted. Manifestly, therefore, the duration of contact between the members 9 and 17 which would represent a dash in the ordinary Wheatstone transmitter, may be shortened into a dot impulse by interruption of the circuit at the terminals 16—19 of the enciphering transmitter. In the same way dot impulses may be lengthened to dash impulses or dash impulses themselves may be lengthened so that the message is entirely disguised in the impulses transmitted to the sending magnet 25. Moreover, since the dash length on a Wheatstone tape is just twice the dot length and the space lengths are just equal to the dot length or the dash length or some other integral multiple of the dot length, there will be no alteration in the current condition in the sending magnet 25, and hence in the line, at intervals shorter than that represented by the dot.

At the receiving end, the polar relay 6 moves its armature 27 between the contacts 28 and 29 in accordance with the impulses coming in over the line. These contacts are connected respectively to the opposite ends of contact bar 30 of a Wheatstone transmitter 31, which is in all respects like the enciphering transmitter 13 at the sending end. It is operated under the influence of a perforated tape identical with the tape in the transmitter 13. The receiving device 32 is connected between the bar 33 of the Wheatstone transmitter and the armature 27 of the polar relay 6, in series with a suitable source of current 34′. In the receiving device, as in the transmitting mechanism, it will be seen that impulses will exist only when the armature 27 and the contact bar 30 are resting upon corresponding contacts. If, then, the deciphering transmitter 31 and the enciphering transmitter 13 are run in synchronism and adjusted to proper phase relation, under the control of identical tapes started at the same point, the mutilation of the message characters accomplished by the transmitter 13 will be exactly counteracted by the operation of the transmitter 31, so that the message characters will be restored to their original form, and recorded at the receiving device 32.

In order to insure perfect synchronism between the enciphering and deciphering transmitters, synchronizing impulses may conveniently be transmitted back over the line, as here shown, from the receiving to the sending end through the channel provided by the duplex equipment above referred to, although the synchronizing may be done over the message channel in any of the ways well known in the art. There are several known methods for synchronizing devices at opposite ends of the line. In this instance, I have illustrated a phonic wheel mechanism similar to that commonly used for synchronizing the distributers of multiplex printing telegraph sets. It comprises an armature 34 and a number of driving magnets 35, 36, 37 and 38 which are alternately energized in pairs as indicated on the drawing. At the controlling end of the line, the wheel is under the immediate influence of a tuning fork 39, which alternately energizes the set of magnets through contacts 40 and 41, and at the same time supplies the current impulses to the magnet 42 for transmitting the synchronizing impulses over the line 3 to the phonic wheel at the other end of the line. These travel the duplex channel, and are received in the usual manner and applied to the phonic wheel, preferably through a relay 43, as here indicated. This device, as is well known, produces perfect synchronism in the driving mechanism of the instruments at the opposite ends of the line. The proper phase relation between the transmitters 13 and 31 may be secured by adjusting one of them, preferably that at the receiving end, with respect to its driving device.

In the modification indicated in Fig. 2, brush transmitters 44, 45 and 46 are substituted for the Wheatstone transmitters of Fig. 1. These are also well known in the art and are here indicated merely by the brushes 47 and 48, which make contact with a roller 49 through the openings in the tape 50 to energize the polar relays 51, 52 and 53. As indicated, the brushes are staggered an amount to correspond with the length of the dot impulse which is equal to one feed interval as represented by the center line of perforations. The dash impulse is correspondingly longer by reason of the staggered relation of the dash perforations in the tape. The armatures 54 and 55 of the polar relays 51 and 52 vibrate between contacts 56, 57 and 58, 59 respectively, which are interconnected by conductors 18′ and 21′ in the same manner as contacts 9, 10, 15 and 16 in Fig. 1. The sending relay 25′ is connected between

the armatures 54 and 55 in series with a suitable source of current 26′ so as to receive current when the armatures 54 and 55 are upon corresponding contacts but not otherwise.

At the receiving end of the line, the relay 6′ is here indicated as operating a secondary relay 60 which coöperates with the tape transmitter 46 to decipher the received impulses in the same manner as the receiving apparatus shown in Fig. 1. If desired, the armature of the relay 6′ might itself replace the armature of the relay 60 in this controlling circuit.

The synchronizing devices are not indicated in Fig. 2, but may be the same as those shown in Fig. 1, or any other desired equivalent apparatus.

The invention herein described provides perfect secrecy by the use of the running key for ciphering and deciphering, and at the same time all currents of a frequency higher than that represented by the dot impulses in the chosen code are avoided, thus improving the quality and speed of signals attainable over a given line.

The invention is, of course, not limited to the illustrative forms here specifically shown and described, as various modifications will readily 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. In a signal transmitting system, mechanism for representing message characters in dot and dash symbols in which the dot, dash and space lengths are all integral multiples of the same time interval, mechanism for producing at the same rate and in phase with the message symbols an arbitrary series of symbols similarly related in their time intervals, and means for combining the effects of symbols simultaneously produced by the two mechanisms to give a series of electrical impulses representing the enciphered message.

2. In a signal transmitting system, mechanism for making and breaking electrical contacts to represent the message characters in dot and dash symbols wherein the dot, space and the dash lengths are integral multiples of the same time interval, mechanism for making and breaking a second set of electrical contacts to produce an arbitrary series of dot and dash symbols similarly related in their time intervals, and produced at a rate corresponding to the rate at which the message symbols are produced, and means for combining the electrical effects concurrently produced by said two sets of contacts to transmit current impulses over the line.

3. In a signal transmitting system, mechanism for producing message characters in dot and dash symbols with the dot, space and dash lengths integral multiples of the same time interval, mechanism for producing at the same rate and in phase with the message symbols an arbitrary series of dot and dash symbols similarly related in their time intervals, means for combining the effects of simultaneously existing dot and dash symbols to produce a series of electrical dot and dash impulses representing the enciphered message, mechanism at the receiving station for producing the same series of arbitrary symbols produced at the sending end and a receiving device for combining the effects of the received impulses and said arbitrary series of symbols to give the message characters.

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

RALPH E. PIERCE.