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CABLE DUPLEX REPEATING SYSTEM.

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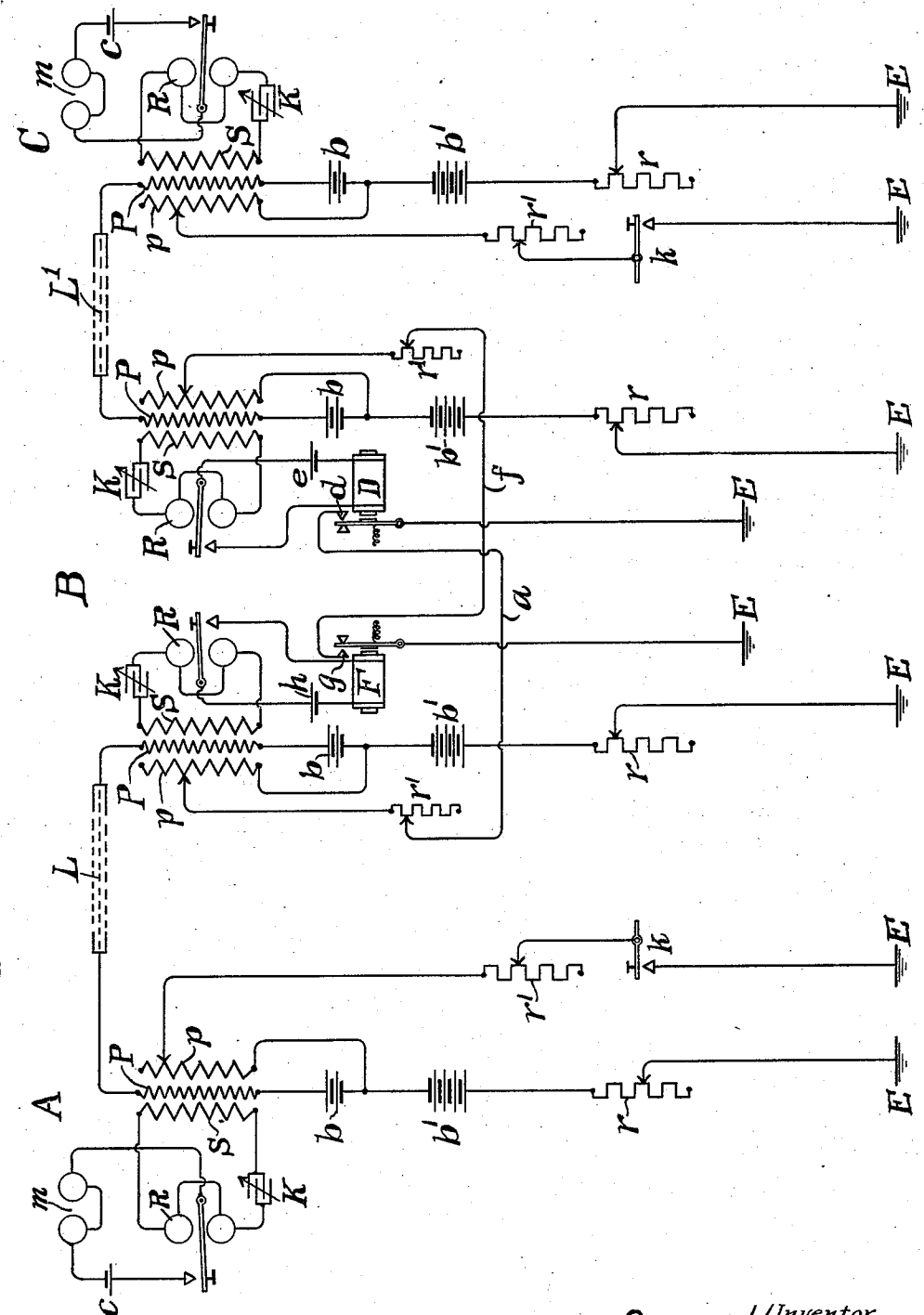
1,014,488. Patented Jan. 9, 1912.



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UNITED STATES PATENT OFFICE.

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CABLE DUPLEX REPEATING SYSTEM.

1,014,488. Specification of Letters Patent. Patented Jan. 9, 1912.

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To all whom it may concern:

Be it known that I, ISIDOR KITSEE, a citizen of the United States, residing in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a new and useful Cable Duplex Repeating System, of which the following is a specification.

My invention relates to electric telegraphy and more particularly to duplex telegraphy over long lines or circuits, such as long land lines, submarine, subterranean, or aerial cables, or, in fact, any circuit or conductor, especially when having great capacity.

My invention resides in a duplex telegraph system, and particularly for use over lines or circuits of the character above described, in which impulses, preferably alternating in polarity, are impressed upon the line or cable and the reception of signals effected by means of a transformer in whose secondary circuit is connected a condenser and the receiving apparatus, there being a third coil on the transformer, or associated therewith, for rendering the receiving apparatus at a given station unresponsive to impulses transmitted from that station.

My invention resides also in a duplex repeating telegraph system, particularly for use over lines or cables of the character above described, in which impulses, preferably alternating in polarity, are impressed upon the line or cable at one station and received at another station, by receiving apparatus of the general character above described, such receiving apparatus controlling the re-transmission of the signal or message upon a second line or cable, the re-transmitted signal or message being received at the distant receiving station upon receiving apparatus of the general character above described. And it is characteristic of my duplex telegraph system and my duplex repeating telegraph system that there is no "artificial line" employed.

My invention resides also in further features hereinafter described and claimed.

For an illustration of one of the forms my invention may take, reference is to be had to the accompanying drawing, in which three stations A, B, and C are connected by lines or cables L and L′, having great capacity. For example, A may represent New York, B a repeating station at Canso, Nova Scotia, and C Penzance, England.

At each station there is connected between the line or cable and earth E the primary P of a transformer, the opposed sources of energy b and b', and the adjustable resistance r. And associated with each primary P is a transformer secondary S in whose circuit are connected the relay, siphon recorder, or other device R and an adjustable condenser K. The instrument R is of the polarized type, especially where impulses of different polarities are employed.

At stations A and C, the instrument R is shown as a polarized relay controlling a local circuit including a source of energy c and a sounder, recorder, or other instrument m. And at stations A and C there is associated with the transformer winding S a second primary winding p, in inductive relation to such winding S, the winding p being adjustable as to its number of turns and having one terminal connected to a point between the energy sources b and b', and its other terminal connected through the adjustable resistance r' and the operator's key k to earth E.

At the repeating station B, the primary p of the transformer associated with the line or cable L has one terminal connected at a point between the energy sources b and b' and its other terminal connected through the adjustable resistance r' and conductor a with the contact d of a relay D whose armature is normally retracted and whose winding is connected in circuit with a source of energy e and the contacts of the relay R associated with the second cable or line L′. And, similarly, the primary p of the transformer associated with line or cable L′ has one terminal connected to a point between the energy sources b and b', and its other terminal connected through the adjustable resistance r' and the conductor f with the contact g of a relay F whose armature is normally retracted and whose winding is included in circuit with a source of energy h, and the contacts of the relay R associated with line or cable L.

By way of example merely, as found in signaling between New York and Canso over a cable, having 2,100,000 KR, the transformer used was of a closed magnetic circuit step-down type, the primary P having

a resistance of 30,000 ohms, more or less, while the secondary S had a winding of less turns and of a resistance of 800 ohms, more or less, the transformer being a step-down transformer.

The operation is as follows: At station A, for example, the impulses received from the cable or line L traverse the primary P to earth E and induce in the secondary S a current which controls the relay or other instrument R, either to directly or indirectly produce a record or translate a signal. By suitably adjusting the condenser K the zero shifting current of the cable has no effect upon the instrument R, thus rendering the received signals clearer and more easily read and contributing to more rapid transmission of signals or messages. While a message may be received at station A from the cable L, the operator at A may, independently and without regard to such message being received, operate his key *k* to transmit messages over the line or cable L in the opposite direction. When the operator closes his key *k* he closes a circuit in shunt to the source *b'* so that an impulse of a certain polarity is transmitted over the cable to the distant station. Simultaneously, however, an impulse traverses the primary *p* which is of such number of turns and so disposed and has its circuit so adjusted that the inductive effect of the impulse transmitted through primary P is neutralized by the opposing inductive effect of the primary *p*, so that the receiving apparatus at station A is rendered entirely independent of the impulses controlled by the operator's key *k*. So it is that a message may be received while another is being transmitted from the same station, without confusion.

At station B the impulses received from the cable L, as transmitted from station A, pass through the primary P to earth E. The receiving apparatus in the circuit of the secondary S then controls by the relay R, controlling relay F, the latter controlling the transmission of impulses to the second line or cable L'. Thus the armature of the relay F follows the movements of the key *k* at station A, that key impressing upon the cable L impulses alternating in polarity. The armature of the relay F in engaging the relay contact *g* causes the transmission to the cable L' an impulse of a given polarity, and also causes an impulse through the primary *p* which neutralizes the effect of the line impulse upon the secondary S of the transformer associated with the cable L' at station B, so that signals may be received by such receiving apparatus without confusion with the transmitted impulse. When the armature of the relay F leaves contact *g* an impulse of opposite polarity is sent to line and the primary *p* neutralizes the effect of such impulse upon the secondary S. And the impulses received from cable L' at station C pass through the primary P to earth E and control the translation of a signal or message in the circuit of the secondary S, as heretofore described in connection with station A. Similarly, the actuation of the operator's key *k* at station C sends to line impulses of opposite polarities which, by the primary *p*, do not affect the receiving apparatus at station C. Thus, while the receiving apparatus at station C is receiving a signal or message from station A, retransmitted at station B, a non-interfering message may be transmitted by the key *k* at C through the cable L' and then retransmitted by the receiving apparatus associated with cable L' at station B to the cable L and then received at station A, as heretofore described. In this re-transmission from cable L' to cable L, the receiving instrument or relay R at station B controls the relay D whose armature makes and breaks contact, following key *k* at station C, to transmit to cable L impulses alternating in polarity, the primary *p*, of the transformer associated at station B with the cable L, serving to neutralize the effects of the re-transmitted impulses, so as to render the receiving apparatus at station B, associated with cable L, independent of and uninfluenced by the impulses re-transmitted from cable L' to cable L.

From the foregoing description, it is apparent that, without any artificial line or cable, messages may be simultaneously interchanged between stations A and C without any confusion whatsoever, the re-transmission at station B being in both directions and without confusion. The employment of a transmitter which impresses impulses alternating in polarity upon the line enables much more rapid transmission. The duplexing of the cable or cables doubles the commercial capacity of the cable and this capacity is still further increased by the employment of impulses of alternate polarity, as described.

As above pointed out, the employment of a condenser K in the secondary receiver circuit eliminates the effect of the zero shifting current present on every cable of any considerable length.

The opposed sources of energy *b* and *b'* are of different values, *b'* being, for example, of twice the voltage or pressure of *b*. And, by way of example merely, at station A the source *b'* may have a potential of 48 volts, while *b* has a potential of 24 volts. And at station B, the source *b'*, associated with cable L, may also have a potential of 48 volts, while its associated source *b* has a potential of 24 volts. And for a longer cable L', the sources *b'* at stations B and C may have a potential of 96 volts, by way of

example merely, while the associated sources *b* may have a potential of 48 volts.

It is preferred that the transformers be of the step-down type with a ratio of turns in the primary P to the turns in the secondary S being quite great.

At station B the relays F and D are employed because the relays R, R at this station, as well as the other stations, are very sensitive and not suitable for controlling large amounts of energy. The energy required to operate the relays F, D is, however, quite small and easily handled by the sensitive relays R, R and then the relays F and D are easily able to control the re-transmission of larger amounts of energy.

What I claim is:

1. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus comprising a transformer for and having its primary associated with each line, means controlled by each transformer secondary for impressing current upon the other line, and a neutralizing winding in inductive relation with the secondary circuit of each transformer.

2. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus comprising a transformer having its primary associated with one line, and means controlled by the transformer secondary for impressing impulses upon the other line.

3. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus comprising a transformer for each line and having its primary associated with said line, and means controlled by each transformer secondary for transmitting impulses to the other line.

4. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus comprising a transformer for each line and having its primary associated with said line, and means controlled by the secondary of each transformer for impressing impulses upon the other line through the primary of the transformer associated with said other line, and a winding in inductive relation with the secondary circuit of each transformer for neutralizing the effects upon the secondary circuit of impulses transmitted to line through the transformer primary.

5. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus comprising a transformer for and having its primary associated with each line, means controlled by each transformer secondary for impressing impulses of alternate polarity upon the other line, and a winding in inductive relation with the secondary circuit of each transformer, said primary being traversed by current controlled by the secondary of the other transformer.

6. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus for repeating signals in either direction between said lines, and terminal apparatus associated with each line comprising means for transmitting to line impulses alternating in polarity, and receiving apparatus comprising a transformer having its primary associated with the line, and receiving apparatus controlled by the transformer secondary circuit.

7. In a duplex repeating telegraph system, the combination with the lines, means at the remote terminals of said lines impressing thereon impulses alternating in polarity, and re-transmitting apparatus comprising a transformer for each line and having its primary associated therewith, and means controlled by the secondary of each transformer for impressing impulses alternating in polarity upon the other line.

8. In a duplex repeating telegraph system, the combination with the lines, of re-transmitting apparatus comprising a transformer having its primary associated with one line, and means controlled by the transformer secondary for impressing impulses alternately in polarity upon the other line.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

ISIDOR KITSEE.

Witnesses:
DANIEL WEBSTER, Jr.,
A. E. STEINBOCK.