I. KITSEE.

CABLE TELEGRAPH SYSTEM.

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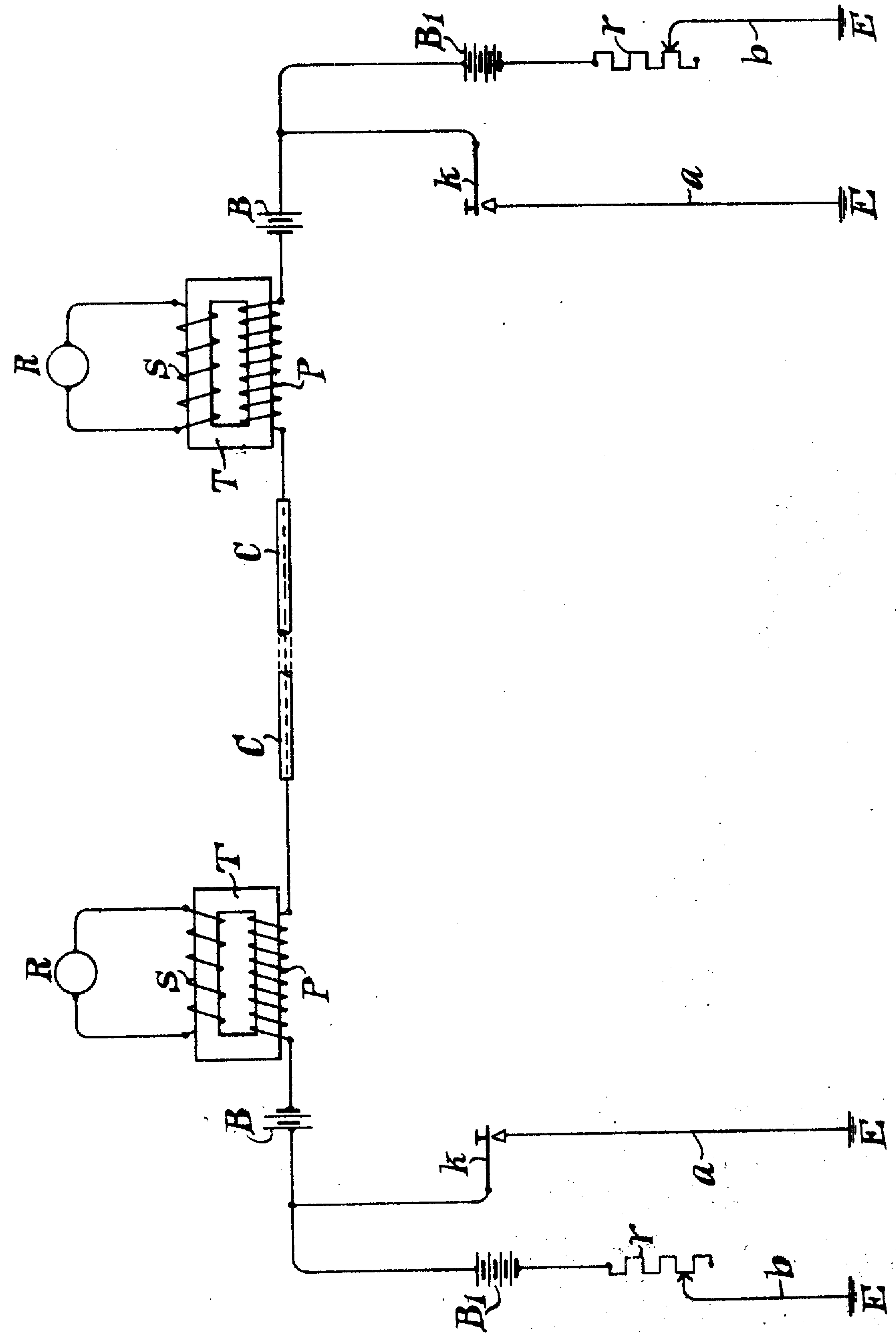
1,089,479. Patented Mar. 10, 1914.



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CABLE-TELEGRAPH SYSTEM.

1,089,479. Specification of Letters Patent. **Patented Mar. 10, 1914.**

Application filed January 14, 1909, Serial No. 472,159. Renewed January 13, 1914. Serial No. 811,906.

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-Telegraph System, of which the following is a specification.

My invention relates to telegraphy and particularly to cable or submarine telegraphy, or telegraphy over any long line or cable which manifests the evil effects resulting from the great capacity of the line or cable.

At present, it is the common practice in cable telegraphy to impress upon the cable impulses of one polarity to represent telegraphic dots, and impulses of the other polarity to represent telegraphic dashes; and it follows that frequently impulses of the same polarity succeed each other on the cable. And it is common practice in such a system to serially connect a condenser between the cable terminal and earth, and to include in the cable the coil of a siphon recorder.

The condenser connected in the cable has the undesirable effect of reducing the energy available at the receiving station, thus reducing the certainty and amplitude of operation of the receiving instrument. But, while a condenser reduces the available energy, it is employed, and, in fact, regarded as a necessity, for the reason that it tends to shield the receiving instrument from earth currents; and because it tends to shield the receiving instrument from current fluctuations of low period in the cable, such fluctuations being due, according to some authorities, to the residuum of the impressed signal current, and according to other authorities, to such residuum of impressed current impulses and to the varying temperature of the cable itself. And the condenser is employed for the further reason that it tends to increase the speed of the impulses, that is, reduces the time during which a transmitted impulse increases at the receiving end to a sufficient amplitude to properly energize the receiving instrument.

Inasmuch as the cable has a relatively great capacity, it having, in fact, great distributed capacity with resistance, an impressed impulse is flattened or smoothed out and does not allow an impulse to reach the receiving instrument immediately, but only after a lapse of some very appreciable time. In fact, in some cables in commercial use, it requires several seconds before the current reaches the full value at the receiving end, and accordingly a sensitive instrument is employed so that it responds to the first part of an arriving impulse and the current never does reach its full value at the receiving station, but another or different impulse is transmitted.

Inasmuch as several impulses of the same polarity are transmitted in succession, the first impulse transmitted to a cable without a terminal condenser will find the cable clear and will, therefore, actuate the receiving device to greatest amplitude and quite promptly; but the succeeding impulse of the same polarity, will not find the cable clear, but will be superposed upon the residuum of the wave resulting from the first impulse, and these impulses, therefore, in effect, blend or run together producing a less distinct impulse at the receiving end. For this reason also a terminal condenser is used in present systems where successive impulses of like polarity occur.

By my tests on a submarine cable extending from New York city to Canso, Nova Scotia, I find that the terminal condenser offers great opposition to the flow of current to the cable, such opposition being equal, if not greater, than the case where a resistance of 10 megohms is connected in circuit with a cable having 10,000 ohms. And I have found that the moving or shifting zero effect, which is still present with the use of a terminal condenser, is due to the great capacity of the terminal condenser. A terminal condenser of much smaller capacity will more or less completely eliminate the shifting or moving zero current but, in consequence, reduces to a still greater degree the amount of current that can be impressed upon the cable. Thus, instead of using a terminal condenser of 25 microfarads capacity, for example, when a condenser of only one microfarad is substituted, there is no shifting zero effect; but in such case the effect of the transmitted impulse upon the distant receiving instrument is practically *nil* with the transmitting voltage commonly used at present, and with a condenser of such small capacity it requires a transmitting potential of more than 150 volts to produce effective signals on the distant siphon recorder. And when successive impulses of the same polarity are transmitted under such circumstances at the normal speed, the third and succeeding received impulses produce a record which cannot be read. Furthermore, the employment of a pressure of a potential of 150 volts in connection with a cable is considered bad and unsafe practice, and to reduce the speed of transmission is out of the question. I have also found that when a coil or winding of comparatively great resistance or impedance is connected in the cable, the earth currents or shifting zero currents are greatly diminished, and are the more diminished as the resistance or impedance is the greater. I have found also that when a source of current is at all times in communication with the cable, that the shifting zero effect is greatly diminished. But to insert sufficient resistance or impedance for such purposes is impracticable for other reasons, and in consequence, I inserted in the cable the primary of a transformer, the secondary of the transformer being connected to the receiving instrument from the cable and causing it to be subjected only to distinctly defined impulses, of relatively short duration. I found that such arrangement has the advantages of shielding the receiving instrument from earth currents, and the further advantage of removing the receiving instrument from the influence of the fluctuating current in the cable. I found also that the primary coil or winding of the transformer must bear, within limits, certain relations to the resistance of the cable itself, and that certain relations between the primary and secondary coils produce better effects.

In my aforementioned tests I employed transformers whose primaries had a resistance as low as a fraction of an ohm and others ranging in resistance to more than 30,000 ohms. Low resistance primaries were found to be entirely ineffective even when the convolutions and resistance were increased, as when the resistance was approximately 500 ohms; and I found that with the cable in question, a primary having less than a thousand ohms with corresponding number of convolutions would not be sufficiently effective. I found also that the secondary winding should have less convolutions than the primary and less resistance than the primary. The ratio may vary, but I obtained satisfactory results where the ratio of the primary to secondary was as 4 to 1, the transformer being thus a step-down transformer. I found further that a transformer with closed magnetic circuit was preferable. From these tests on the cable aforementioned, I found that the resistance of the primary of the transformer should be at least one-half the resistance of the cable itself; and that the secondary should have at most a number of convolutions only one-half the number of convolutions of the primary winding; and that the transformer should preferably be of the closed magnetic circuit type.

My invention resides, therefore, in a cable system in which the terminal condensers are omitted and the cable conductively connected to earth, and the receiving instrument isolated from the cable as by connection in the secondary of a transformer, the cable being always in communication with a source of energy. And my invention resides further in employing opposed sources of energy of different potentials at each station, and a resistance connected in series with the cable between the same and the earth connection, and preferably approximate the earth connection, a signaling key being used to shunt the source of higher electro-motive force and the resistance. And it is a further feature of my invention that the sources of energy at the opposite ends of the cable be opposed to each other with respect to the cable.

My invention resides in the features hereinafter described and pointed out in the claims.

For an illustration of one of the forms my invention may take, reference is to be had to the accompanying drawing, which is diagrammatic representation of a cable telegraph system.

In the drawing, C represents the line or cable, such as a submarine cable, having great capacity. At each end of the cable is provided a transformer T, preferably of the closed magnetic circuit type, whose primary P is connected serially with the cable, and whose secondary S is connected to the signal translating instrument R, which may be a siphon recorder, polarized relay, or other suitable device. The transformer is preferably a step-down transformer, that is the primary P has greater number of convolutions than the secondary S.

A source of energy B, as, for example, a plurality of storage or other cells, is connected serially in the line with and in opposition to the source B^1, of similar cells, but of approximately twice the voltage. And between the source B^1 and earth E intervenes a resistance r, which may be adjustable. I prefer that r have a resistance of one ohm for each volt of the potential of the source B^1. Thus, if B^1 have a potential of 20 volts, I prefer that r have a resistance of approximately 20 ohms.

From a point between the sources B and B^1 is connected an operator's key k to earth E, or the conductor a may be joined to the conductor b.

It will be noted that the source B at one station is connected in opposition to the source B at the other station, and that at each station the sources B and B^1 are opposed to each other.

By the arrangement shown, the line or cable C is always in communication with a source of energy which tends to keep the cable constantly charged. By the depression of an operator's key k the source B^1 is short circuited through the resistance r and an impulse of a given polarity is, in effect, transmitted over the cable and traverses the primary P of the distant transformer. This impulse is due to the fact that when the source B^1 is short circuited the home source B, combined with the opposed sources B^1 and B at a distant station, gives an unbalancing of electro-motive forces and current flows. Upon raising the operator's key k again a further impulse flows, but of opposite polarity because the home source B^1 overcomes B and sends a current to cable tending to oppose and balance the combination of B^1 and B at the distant station. With the keys k open at both stations and with the combination of sources at one station opposed with respect to the cable to the combination of sources at the other station, there is nevertheless a current flowing to cable due to leakage, as I have found. In consequence, by the depression and opening of the operator's keys k impulses of opposite polarity are, in effect, transmitted over the cable. The well defined impulse thus transmitted causes a distinct and well defined impulse in the secondary S to affect or control the signal translating instrument R. And any earth currents or zero shifting currents have no effect upon the instrument R, which is isolated or out of direct communication with the line or cable C.

By the system above described, a positive impulse always succeeds a negative impulse on the line, thus increasing the speed of transmission, and the cable is in conductive communication with the earth, instead of through a condenser, and the receiving instrument is isolated from direct communication with the line or cable.

While I have stated some proportions or quantities which render the signaling rapid and effective, I do not wish to be limited to such proportions and quantities except in so far as expressed in the claims.

What I claim is:

1. In a telegraph system, the combination with a line or cable having great capacity, of opposed sources of energy of different potentials conductively connected to said line or cable and to earth, a signaling instrument for shunting one of said sources of energy, similar opposed sources of energy and a similarly disposed signaling instrument at the opposite end of said line or cable, the sources of energy at the opposite ends of the cable opposing each other with respect to said cable, and electro-magnetic receiving apparatus.

2. In a telegraph system, the combination with a line or cable having great capacity, of opposed sources of energy of different potentials conductively connected to said line or cable and to earth, a signaling instrument for shunting one of said sources of energy, and similar opposed sources of energy and a similarly disposed signaling instrument at the opposite end of said line or cable, the sources of energy at the opposite ends of the cable opposing each other with respect to said cable, a receiving instrument, and an inductive connection between said receiving instrument and said line or cable.

3. In a telegraph system, the combination with a line or cable having great capacity, of opposed sources of energy at each terminal, the sources of energy at one terminal being opposed with respect to the cable to the sources of energy at the other station, and a signaling instrument at each station for shunting one of said opposed sources of energy.

4. In a telegraph system, the combination with a line or cable having great capacity, of opposed sources of energy of different potentials at each terminal of said line or cable, the sources of energy at one terminal being opposed with respect to the line or cable to the sources of energy at the other terminal, and a signal transmitting instrument at each station for shunting the source of greater potential.

5. In a telegraph system, the combination with a line or cable having great capacity, of a conductive connection from each terminal of the cable to earth, opposed sources of energy of different potentials and a resistance serially included in each of said connections, the sources of energy at one terminal of the line or cable being connected in opposition to the sources at the other terminal of said line or cable, and a signaling instrument at each terminal for shunting one of said sources of energy and said resistance.

6. In a telegraph system, the combination with a line or cable having great capacity, of a conductive connection from each terminal of the cable to earth, opposed sources of energy of different potentials and a resistance serially included in each of said connections, the sources of energy at one terminal of the line or cable being connected in opposition to the sources at the other terminal of said line or cable, and a signaling instrument at each station for shunting said resistance and the source of energy of greater potential.

7. In a telegraph system, the combination with a line or cable having great capacity,

of terminal apparatus at each station comprising a signal translating instrument conductively isolated from said line or cable, and a conductive connection from said line or cable to earth through opposed sources of energy of different potentials, the sources of energy at each terminal being connected in opposition with respect to the cable to the sources of energy at the other terminal, and a signaling instrument at each terminal for short circuiting one of said sources of energy.

8. In a telegraph system, the combination with a line or cable having great capacity, of terminal apparatus at each terminal comprising a signal translating instrument conductively isolated from said line or cable, and a conductive connection from said line or cable to earth through opposed sources of energy of different potentials, the sources of energy at each terminal being connected in opposition with respect to said line or cable to the sources of energy at the other terminal, and a signaling instrument at each terminal for shunting the source of energy of greater potential.

9. In a telegraph system, the combination with a line or cable having great capacity, of apparatus at each terminal comprising a signal translating instrument conductively isolated from said line or cable, and a conductive connection from said line or cable to earth through opposed sources of energy of different potentials and a resistance, the sources of energy at one terminal being connected in opposition with respect to the cable to the sources of energy at the other terminal, and a signaling instrument at each terminal for shunting one of said sources of energy and said resistance.

10. In a telegraph system, the combination with a line or cable having great capacity, of apparatus at each terminal comprising a signal translating instrument conductively isolated from said line or cable, and a conductive connection from said line or cable to earth through opposed sources of energy of different potentials and a resistance, the sources of energy at one terminal being connected in opposition with respect to the cable to the sources of energy at the other terminal, and a signaling instrument at each station for shunting said resistance and the source of energy of greater potential.

11. The combination with a line or cable, of opposed sources of energy of different powers at different stations, the combined sources at one station opposing and balancing the combined sources at another station, and a key for controlling the sources at each station.

12. The combination with a line or cable, of opposed sources of energy at one station, opposed sources of energy at another station opposing and balancing the sources at the first station, and a key in a circuit in shunt to a source at each station.

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

ISIDOR KITSEE.

Witnesses:
ELEANOR T. McCALL,
A. E. STEINBOCK.