No. 711,942. Patented Oct. 28, 1902.

A. C. CREHORE.

TELEGRAPHY.

(Application filed Oct. 21, 1901.)

(No Model.) 2 Sheets—Sheet 1.

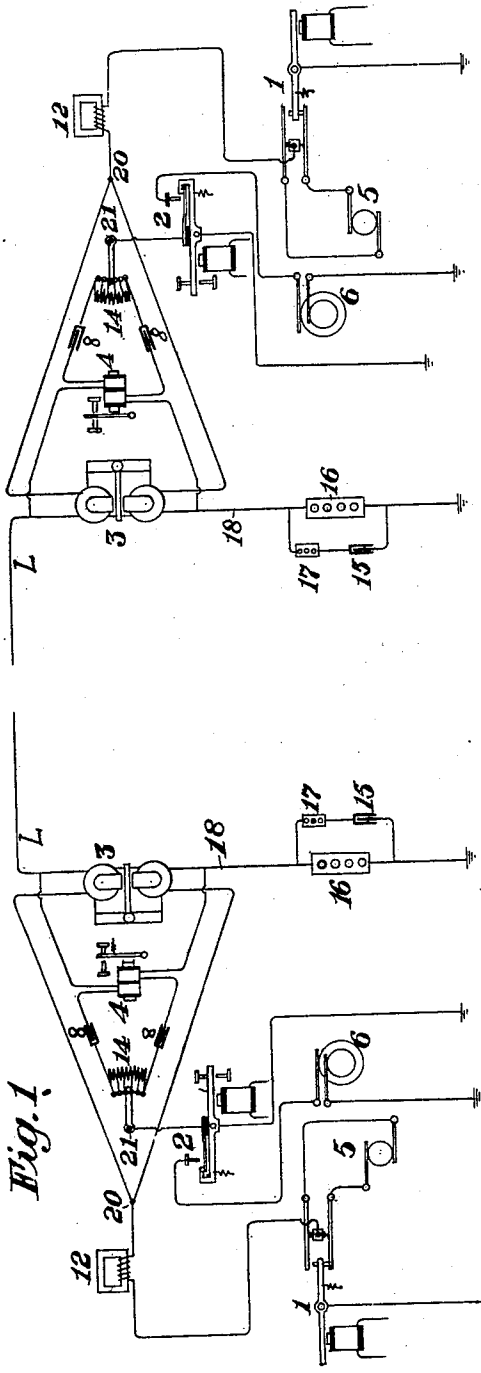


Fig. 1.

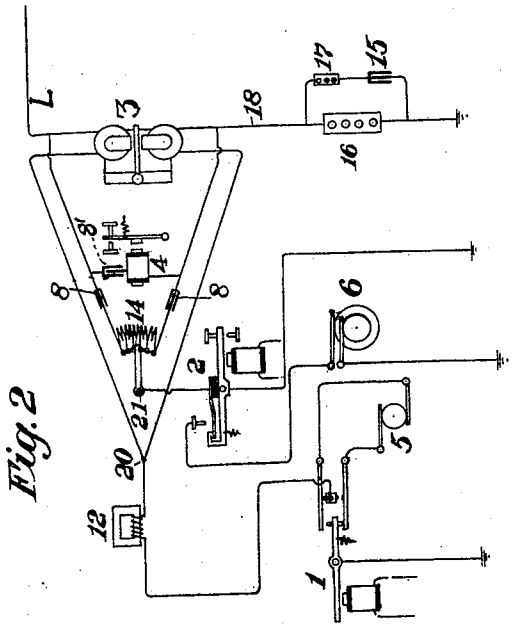


Fig. 2.

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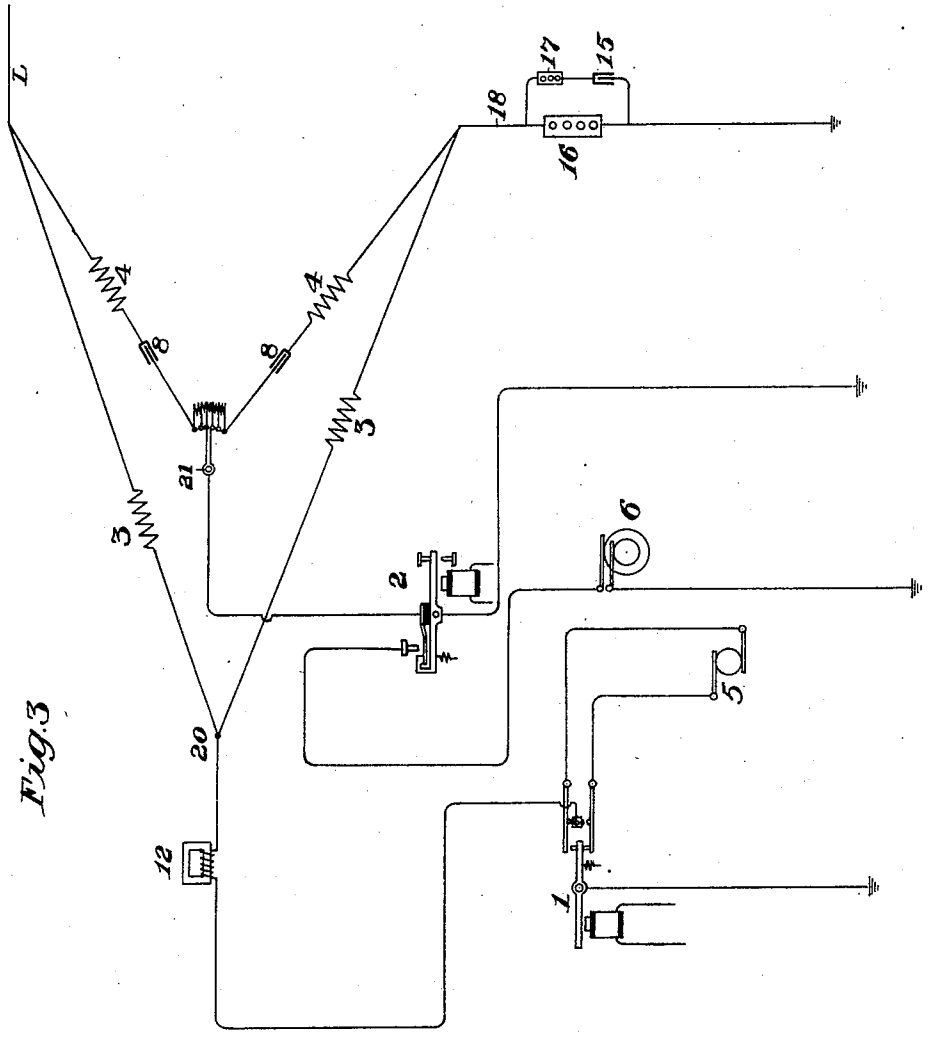


Fig. 3

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UNITED STATES PATENT OFFICE.

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TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 711,942, dated October 28, 1902.

Application filed October 21, 1901. Serial No. 79,386. (No model.)

To all whom it may concern:

Be it known that I, ALBERT C. CREHORE, a citizen of the United States, and a resident of Tarrytown, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Telegraphy, of which the following is a specification.

My invention relates to those systems of telegraphy known as "quadruplex telegraphy," wherein one line serves for the transmission of four messages independently of one another, two in one direction and two in the opposite direction.

In quadruplex telegraphs as at present generally constructed it is the practice to transmit in the same direction from the terminal station by changes of current tension and changes of polarity of a continuous current. In these systems great difficulty is frequently experienced in maintaining the adjustment of the instruments upon all four "sides" of the system, and, as is well known, the "fourth side" is generally weak and uncertain in operation. Moreover, in this class of telegraphs special provision has to be made for preventing a kick in the instrument, which responds to changes of tension whenever a reversal of the polarity of the current takes place on what is ordinarily termed the "No. 1" side of the system.

The aim of the present invention is to provide a quadruplex system which shall be free from most of the difficulties hitherto experienced in working quadruplex telegraphs, wherein the receiving instruments at each station are rendered insensible or irresponsive to outgoing signals by the well-known bridge or differential system of duplexing; to which end the invention consists of a novel quadruplex-telegraph system wherein the transmissions from one station over one side of the system are effected by the use of a continuous current, and the transmission for the other side is effected by the pulsatory currents superposed upon the continuous currents, the pulsatory-current apparatus being, however, connected to the line and having its receiving apparatus balanced or rendered neutral to outgoing signals in such manner that any disturbance of the exact balance of the main and artificial lines shall not produce any disturbance on the continuous-current side from the working of the pulsatory-current side, as hereinafter more fully set forth. In other words, in carrying out the invention I utilize as the means for the double transmission from each end of a quadruplex line that system of telegraphy known as the "superposed-current" system, wherein one message is sent by currents from a generator adapted to generate momentary currents of short duration and sharply defined or having a high rate of change of electromotive force and hereinafter termed "pulsatory" currents, and the other message is sent over the same wire simultaneously by currents which, generally speaking, are of longer duration and hereinafter termed "continuous" currents and upon which the pulsatory currents are superposed.

It is obvious that I may use on the continuous-current side of the system either changes of tension to effect the transmission or changes of polarity, the latter being what is frequently termed the "double-current" system. For the pulsatory-current side of the system I prefer to use for each signal a succession of pulsatory currents and to determine the length of the signal by the length of time during which the succession of currents is permitted to flow, although as well understood in the art the transmission by the pulsatory-current side of the double-transmission system working on the superposed-current plan might be effected by the use of two pulsations for each signal separated by an interval during which no pulsatory currents flow and of greater or less duration, according to the length of the signal to be transmitted.

It will be obvious that if the continuous-current side of my system be worked by changes of polarity an additional set of signals might be sent by using also changes of tension, or vice versa, the system then becoming, in effect, a sextuplex, but with the disadvantages attaching to a quadruplex, as hereinbefore stated. In a measure, however, the advantages of my present invention would be realized, because the third transmission or set of signals could be effected at all times without disturbing the continuous-current side of the system even though there should be any want of balance of the main and arti-

ficial circuit as to the latter side or sides of the system.

The main feature of my invention consists in using for the two sides of the system balancing branches derived from independent apexes or points of division to which are joined, respectively, the branch or ground connections containing, respectively, the transmitting apparatus for the two sides of the system.

My invention consists also in the combination, with the continuous-current transmitting apparatus joined to an apex from which diverge the balancing branches for the receiver, of independent balancing branches for the receiver of the pulsatory side and an inductance in the ground connection containing the continuous-current apparatus, as hereinafter more particularly described.

In the accompanying drawings, Figure 1 is a diagram of a quadruplex-telegraph apparatus having its parts connected up at each station in accordance with may present invention. Figs. 2 and 3 are diagrams illustrating modifications of the invention.

In carrying out the invention the generators of current may be of any desired character. For the continuous-current side of the system a continuous-current dynamo may be employed. The pulsatory-current generator is preferably an alternating-current dynamo-machine. In transmitting by the double-current system on the continuous-current side I may use a pole changer or reverser which reverses the poles of a generator in respect to the main line and earth, or I may use any other disposition of apparatus known in the art or suitable for the purpose.

While the drawings indicate the use of an alternating-current dynamo as the pulsatory-current generator and also show the same connected directly into the circuit, it is to be understood that the generator might be of any form known in the art and that the pulsations might be imposed directly or indirectly upon the circuit in any of the ways well known in the art.

Referring to Fig. 1 of the drawings, the continuous-current transmission is shown as effected by what is known as the "double-current" system, for which purpose there is provided a continuous-current generator 5 of any description—as, for instance, a continuous-current dynamo—and a pole-changing instrument 1, known as a "pole-changing transmitter," which may be operated by means of an electromagnet, as indicated, controlled as usual in the art.

3 typifies the receiver for the continuous-current side of the system. This instrument is rendered neutral as to outgoing signals in the usual way—as, for instance, by providing it with two windings, known as "differential" windings, one of which is in a branch leading from an apex or point of division 20 to the line L, while the other or balancing winding is in a branch from the same apex, connected to an artificial line containing the usual condenser 15 and adjustable rheostat 16 17, employed, as well understood in the art, for adjusting the resistance and capacity of the artificial line 18 so that it will equal that of the main line L.

The transmitting apparatus, comprising generator 5 and instrument 1, is connected on one side to earth, as usual, and on the other to the apex 20. In the latter connection I preferably interpose a suitable inductance 12, made, as well understood in the art, by winding a coil of wire upon a core whose magnetic circuit is preferably closed, so that the device may have a high impedance for pulsatory currents or currents having high rate of change and low resistance for the continuous current.

The transmitting apparatus for the pulsatory-current side of the system, as here shown, embraces the transmitting instrument 2 and pulsatory-current generator 6, typified as an "alternating-current dynamo." These devices are in an independent branch connected to earth and are joined, as shown, to an independent point of division or apex 21, from which branches are taken, respectively, to the line L and to the artificial line 18 through condensers.

The receiving instrument for the pulsatory-current side of the system is rendered neutral to outgoing signals by the balancing effects produced by means of the two branches leading from apex 21 to the lines L and 18 in any desired way—as, for instance, by the differential plan; but in each branch there is placed a condenser 8 to permit pulsatory currents to flow freely, while obstructing the flow of the continuous current. At the apex 21 an adjustable resistance 14 may be located, which is adapted, as indicated, to change the relative resistance of the branches as may be required and in a manner to increase the resistance in one branch and simultaneously decrease the resistance in the other, or vice versa.

The pulsating-current receiver 4 is preferably a polarized instrument in order that it may be more sensitive to the pulsating current.

As will be seen, the pulsatory currents transmitted to the distant station may flow freely through the condenser 8 to the line L, while the equal but opposing similar currents balancing the effects of the former flow through the other branch by condenser 8 to the artificial line 18. Moreover, such currents may not flow through the branches leading from the apex 20 for the continuous-current receiver or receivers. At the same time the continuous currents sent by transmitter 1 may flow and have their effect balanced in receiver 3 independently, since they may not pass by way of condensers 8 to earth.

It will be seen that in the arrangement shown there is a return path for the pulsatory current back to generator 6 independently of

the lines L and 18 by way of the branch to earth through the continuous-current apparatus. This path may be traced from the points of junction of the two condenser branches with the main line L and artificial line 18 back through the two coils of receiver 3 to apex 20 and by way of reactance or inductance 12 through the transmitting apparatus for the continuous-current side of the system and to earth. If the main and artificial lines L 18 are exactly balanced and the potential from generator 6 at the points of junction of the pulsatory-current branches with the lines L and 18 are substantially equal, then such pulsatory currents as may be able to force their way back to earth through the branch or earth connection afforded by the balancing branches for the continuous-current apparatus and the inductance 12 will be balanced on the receiver 3 and no disturbing action will result. If at any time a disturbance in the balance of resistance of the lines L 18 arises, so that more pulsatory current would flow back over one branch of the continuous-current side and through the other by the path already traced, the reactance of 12 operating to cut off the tendency of the pulsatory current to flow by such path will so reduce the value of any such want of balance that the instrument 3 will be practically unaffected by the pulsatory current at the same station. Hence if all balance of the lines L and 18 should fail, so that both the pulsatory-current and continuous-current receivers respond to their own transmitters, there will still remain a duplex-diplex system of telegraphing, for the continuous-current receiver will still not respond to the pulsatory-current transmitter at the same station because of the impedance or reactance afforded by inductance 12, and the pulsatory-current receiver will not respond to the continuous-current transmitter at the same station because of the condenser 8. Hence two messages may be still sent either in the same or in opposite directions, one by the pulsatory and the other by the continuous current. In this respect the apparatus possesses an important advantage over ordinary quadruplex or duplex systems, in which the failure of balance renders it necessary to work the line single only.

Instead of balancing the outgoing signals by the differential method it is obvious that the bridge method might be employed, as indicated in Fig. 2, in which case each branch from the apex 21 to lines L 18 contains a condenser 8, and the instrument 4 is located in a bridge from the line L to artificial line 18, as shown, said bridge, however, containing a condenser 8′ to prevent the continuous currents from being short-circuited from the continuous-current receiver in receiving messages. The condensers 8, while having the function already described, operate also by their location to prevent the incoming pulsatory currents from being short-circuited around the instrument 4.

The independent branch containing the pulsatory-current-transmitting apparatus need not be connected directly to earth in the manner shown in Figs. 1 and 2, but may be connected through the continuous-current transmitter in the manner shown in Fig. 3, wherein the terminal of the branch instead of leading directly to earth leads to the circuit or connection between the continuous-current transmitter and the inductance 12. In this diagram the receivers are indicated in skeleton, their two coils being shown separated from one another as located in the separate branches leading from the apexes 20 21, respectively, and as indicated by the numerals 3 4. This is substantially the arrangement illustrated in Fig. 1. The inductance 12, Fig. 3, operates in the same manner as the inductance already described.

What I claim as my invention is—

1. In a multiplex-telegraph apparatus for multiple transmission in opposite directions, the combination substantially as described, of pulsatory-current and continuous-current transmitting and receiving apparatus, independent balancing branches for the continuous-current and pulsatory-current receivers, independent ground branches or connections for the continuous-current and pulsatory-current transmitting apparatus respectively, and independent apexes or points of division to which said ground branches are connected and from which the aforesaid balancing branches for the continuous-current and pulsatory-current receivers respectively are derived.

2. In a quadruplex-telegraph apparatus the combination for the two sides of the double transmission at each station, of continuous-current and pulsatory-current apparatus, balancing branches for both sides of the system, ground branches or connections from which said balancing branches are derived, and an inductance in the ground branch or connection for the continuous-current side as and for the purpose described.

Signed at New York city, in the county of New York and State of New York, this 16th day of October, A. D. 1901.

ALBERT C. CREHORE.

Witnesses:
J. GALLWITZ,
E. L. LAWLER.