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F. W. JONES.

TELEGRAPHY.

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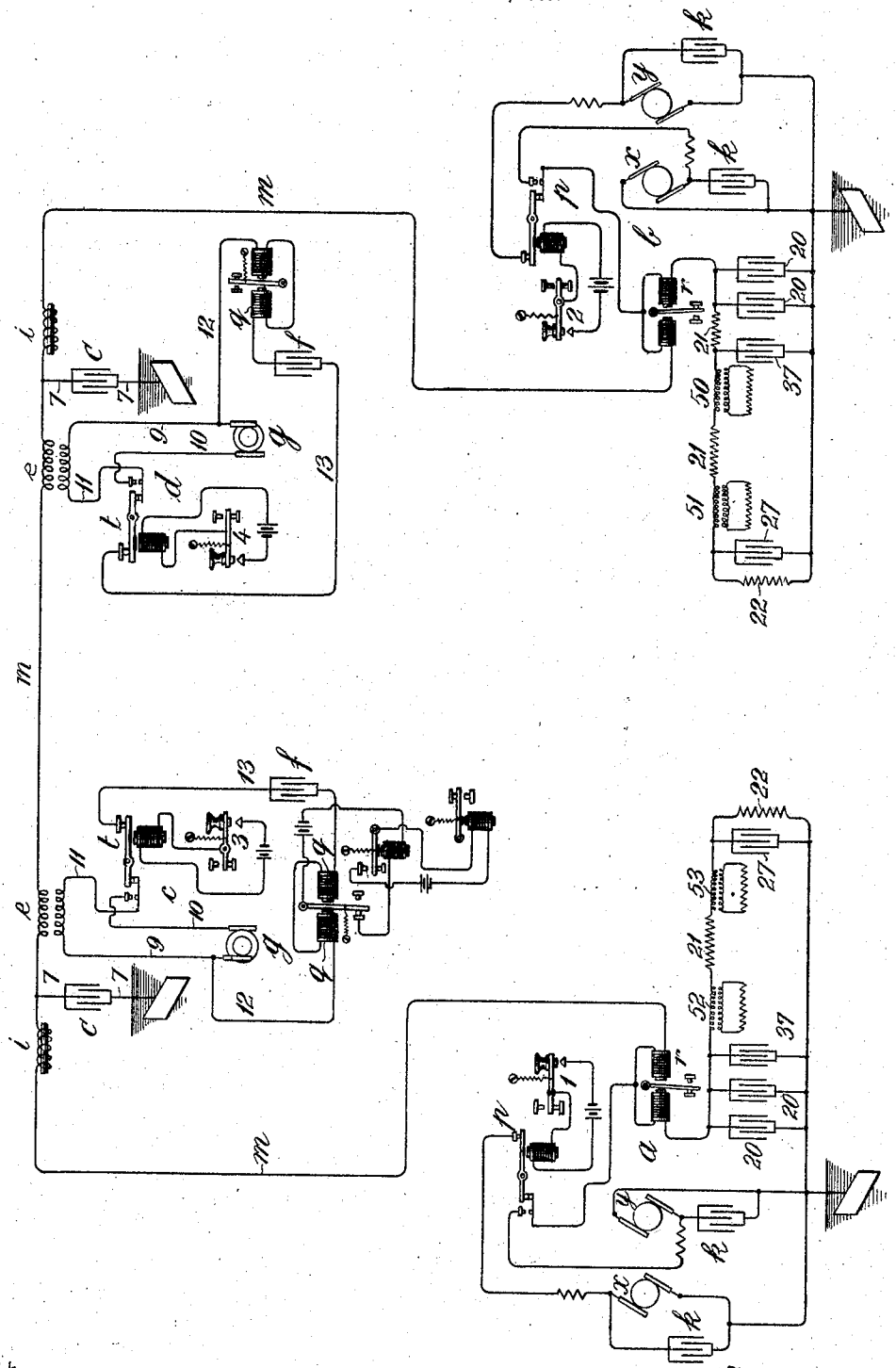

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TELEGRAPHY.

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To all whom it may concern:

Be it known that I, FRANCIS W. JONES, a citizen of the United States, residing in the city of New York, in the county and State of New York, have made certain new and useful Improvements in Telegraphy, of which the following is a specification.

My invention relates to multiple telegraphs of the class in which one or more sets of signals are transmitted by varying a continuous current, each elemental part of the code or signal being composed of a straight current impulse of one or the other polarity, such elements varying in length or duration, and one or more additional sets of signals transmitted by varying the length and succession of groups of short and rapid current alternations, each elemental part of the code or signal being composed of short and rapid current alternations divided into groups of varying length and predetermined succession. In other words, one set of signals may be transmitted by a code like the Morse code, where dots and dashes are formed of straight current impulses varying in length and succession, while the second set of signals may be transmitted by the same code, the dots and dashes being formed of groups of rapid alternations of current of varying length and succession.

The object of my invention is to increase the carrying capacity of a conductor or circuit and the effectiveness of transmitted impulses at the receiving-station.

I provide a telegraph-circuit having terminal stations equipped with balanced apparatus in the form of a polar duplex, where signals are transmitted by reversals of straight current impulses, to which I sometimes add a neutral side or set of signals, where variations in current strength are employed for a second set of signals. On such a duplex or quadruplex circuit I superpose one or more sets of signals to be transmitted and received by throwing upon the line groups of short and rapid reversals of current, the groups being divided into relatively long and short groups with suitable spaces between groups to represent the Morse or similar code. At each such point or station there is a local or separate circuit containing an alternating-current generator and a suitable receiving instrument, each in a branch by itself and both inductively connected with the main line or circuit through the medium of a transformer. Between each terminal station and the first or adjacent transformer I place a suitable condenser in a branch line connected to earth or the return-conductor. Between the point of connection of this condenser branch and the terminal station I place an inductance, which may be an electromagnet or a coil with a movable core, by which the inductance may be graduated. To compensate for the presence of these added instruments in the main line or circuit, the artificial lines at the terminal stations are provided with devices which impart the same capacity, resistance, and inductance occurring or appearing in the main line, and these electrical and electromagnetic characteristics are arranged in the artificial line in the same succession and with the same effect in which they appear in the neutral line. By this means I am enabled to operate between intermediate points or stations simultaneously with the exchange of two or four communications between terminal stations, and thus increase the carrying capacity of the wire or circuit.

The accompanying drawing illustrates my invention.

a and *b* are two terminal stations. At each station there is a balanced polar relay *r*, having one coil in the main line and a differential coil in the artificial line. There is a pole-changing transmitter *p* controlling two straight-current-machine generators *x* and *y* of opposite polarity. There is a condenser *k* in a branch circuit around each generator to form a path around the generators for any alternating impulses that may pass the branch 7 at the substation. The instruments at station *a* are the same as those at station *b*, except as regards the artificial line to be described.

1 and 2 are Morse keys, each controlling a local circuit and the pole-changing transmitter *p*.

c and *d* are two intermediate stations.

If we assume that station *a* is New York and station *b* is Boston, station *c* Bridgeport and station *d* Hartford, we shall have a concrete idea of the arrangement and relative position. The apparatus at stations *c* and *d* is alike.

e is a transformer having one coil in the main line *m* and the other coil in a local circuit 9 10 11. *g* is a generator of short and rapid alternations of current in the same local circuit.

t is a continuity-preserving transmitter operated by the key 3, the same key at station *d* being designated 4.

The generator *g* has one brush connected to the primary of the transformer *e* by the wire

9. The other brush of g is connected to the contact-stop of the transmitter t by the wire 10. The spring-contact of the transmitter t is connected to the opposite terminal of the transformer by the wire 11.

q is a polarized relay. One terminal is connected to one brush of the generator g by the wire 12. The other terminal of relay q is connected to one plate of the condenser f. The other plate of said condenser is connected to the back contact-stop of the transmitter t by the wire 13. The relay q is a polarized relay and when subjected to alternating currents its tongue stands at an intermediate point between the stops. Upon a cessation of current the spring provided for it holds the tongue against the closed contact-stop. This relay operates the so-called "bug-trap"—that is, a repeating-sounder in a local circuit operating a reading-sounder through a second local circuit, all as well understood.

21 and 22 represent sectional resistance in the artificial line to balance the ohmic resistance of the main line.

20 represents condensers to give the artificial line the natural capacity possessed by the main conductor m.

C is a condenser in a branch 7, connecting with main line and earth or return-conductor. There is such a branch 7 in close proximity to each station adjacent to a terminal station—that is, the condenser branches 7 are placed upon opposite sides of the stations c d.

i is an inductance preferably having an adjustable iron core. The function of this inductance is to choke or retard impulses from the generator g and confine such impulses to the section of the line m between the condenser branches 7.

In the artificial line 37 is a condenser having the same capacity as the condenser in the branches 7.

The ohmic resistance between stations a and c is neglected. The ohmic resistance between the stations c and d is one thousand ohms, and I connect the condenser 37 at station b on the opposite side of the resistance 21, amounting to one thousand ohms, so that the discharge of the condenser will encounter the same constants in the artificial line that the discharge of the condenser branch 7 encounters in the natural line, the effect on the relay r being equal and opposite as regards time and quantity.

50 is a transformer having its secondary closed upon itself through a resistance such that the electromagnetic effect in the artificial line at b substantially reproduces the effect of the transformer e in the line m at station d. The resistance between stations d and c is represented by one thousand ohms, and the resistance 21 in the artificial line at station b is one thousand ohms. The device 51 is a transformer with one coil closed on itself to give the same effect as is due to the transformer e at station c. The condenser 27 has the same capacity as the condenser C in branch 7 at station c, and the resistance 22 at station b is of the same amount as the resistance of the line m between station c and the earth at station a. Referring now to station a, the relative position of the apparatus in the artificial line is somewhat different. The condensers 20 are the same; but the condenser 37, having the same capacity as the condenser C, branch 7, is not separated by an artificial resistance interposed between it and the condensers 20, for the reason that station c is negligibly near the station a. The transformer 52 has its secondary closed through a resistance to compensate for the transformer e at station c. The resistance 21 compensates for the resistance of the conductor m between stations c d. The transformer 53 with one coil closed through a resistance compensates for the transformer e at station d. The condenser 27 at station a compensates for the condenser C in branch 7 at station d, and the resistance 22 in the artificial line at station a is equal to the resistance of the conductor m between station d and the ground at station b.

In the operation of this apparatus the terminal stations a and b simultaneously exchange signals and messages by reversals in the polarity of straight-current impulses, the transmitters p operating to connect first the generator x and then the generator y to line, thus marking the beginning and termination of the elements of a code-signal. The relay r is balanced and neutral to outgoing signals while responding to incoming signals from the distant terminal station, the artificial line at each terminal station being equipped with characteristic devices in effect and in relative position such that transmitted impulses are equal in the opposing coils of the home relay r. An additional set of signals is simultaneously exchanged with those just described between the stations c and d. The generators g are continuously operating. When the key 3 at station c is closed, the generator g is placed on a closed circuit 9 10 11, including the primary of the transformer e. Impulses are reproduced in the line m and in the transformer e at station d, appearing in the local circuit which normally includes the branches 11 13, condenser f, polarized relay q, wires 12 and 9. The dots and dashes due to the operation of the keys 3 or 4 are composed of groups of alternating impulses of varying length. The alternations on the line m travel over a circuit including the condenser branches 7 and the earth or return conductor between said branches. These impulses do not pass the condenser branches 7 because of the presence of the inductance i.

What I claim, and desire to secure by Letters Patent, is—

1. Two intermediate stations having means for exchanging signals by dividing an alter-

nating current into groups of varying length said means consisting of an intermediate section of a main telegraph-line, two condensers, each having one plate connected to said line and one to the ground and two inductances in the line, outside of and adjacent to said condensers; and at each station a local circuit inductively connected with the line, including a suitable relay, an alternating generator and a transmitting device; in combination with two terminal stations having means for simultaneously exchanging two sets of signals by dividing a continuous current into impulses of varying length said means consisting of a connection with said main line and an artificial line, at each terminal; a differential relay having one coil in each line, a transmitter branch connected to the main and artificial lines including a transmitting device, suitable generator and means in said artificial line for establishing a coincident balance of electrostatic and electromagnetic effects, said means consisting of the following devices connected with respect to said artificial line in the order named, *i. e.* a condenser 20 to balance the static capacity of the line, a resistance 21 to balance the resistance of the line between stations *b* and *d*, an inductance 50 to balance inductance *i* at station *d*, a resistance 21 to balance the resistance of the line between stations *d* and *c*, an inductance 51 to balance inductance *i* at station *c*, a condenser 27 to balance condenser C at station *c* and a resistance 22 to balance the line-resistance between stations *c* and *a*.

2. Two intermediate stations having means for exchanging signals by dividing an alternating current into groups of varying length said means consisting of an intermediate section of a main telegraph-line, two condensers, each having one plate connected to said line and one to the ground and two inductances in the line, outside of and adjacent to said condensers; and at each station a local circuit inductively connected with the line, including a suitable relay, an alternating generator and a transmitting device; in combination with two terminal stations having means for simultaneously exchanging two sets of signals by dividing a continuous current into impulses of varying length said means consisting of a connection with said main line and an artificial line, at each terminal; a differential relay having one coil in each line, a transmitter branch connected to the main and artificial lines including a transmitting device, suitable generator and means in said artificial line for establishing a coincident balance of electrostatic and electromagnetic effects, said means consisting of the following devices connected with respect to said artificial line in the order in which the same effects occur in the main line *i. e.* a condenser to balance the static capacity of the line, a sectional resistance to balance the sectional resistances of the line between stations, inductances to balance the inductances at the intermediate stations, and condensers to balance the condensers in the branch lines at the intermediate stations.

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