(No Model.) 2 Sheets—Sheet 1.

G. T. WOODS.

RAILWAY TELEGRAPHY.

No. 373,383. Patented Nov. 15, 1887.

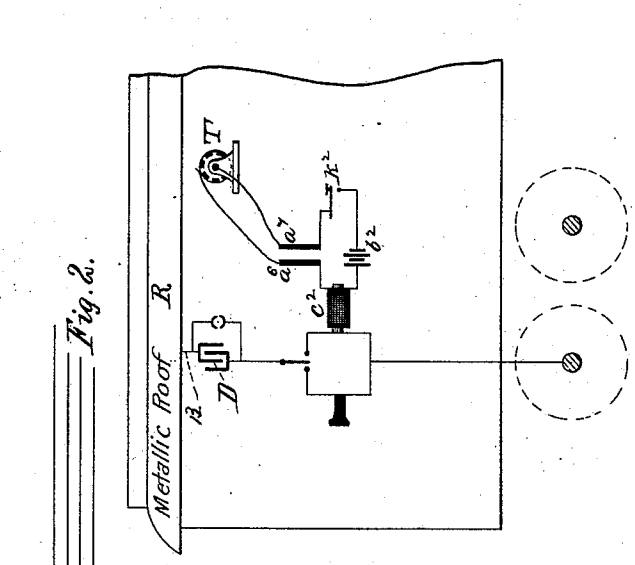

Fig. 2.

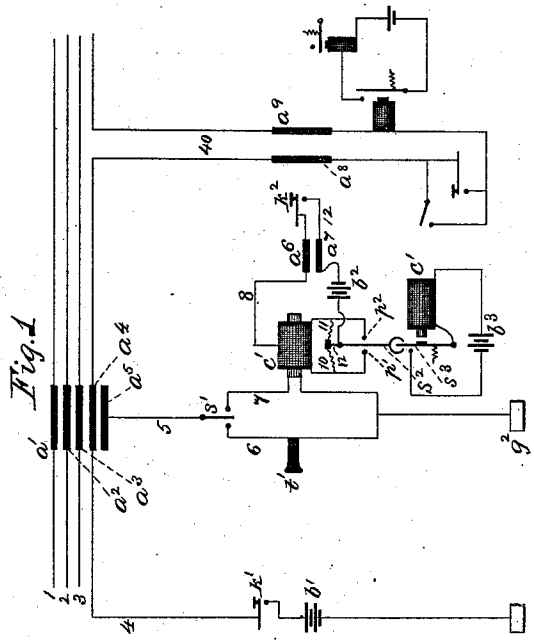

Fig. 1.

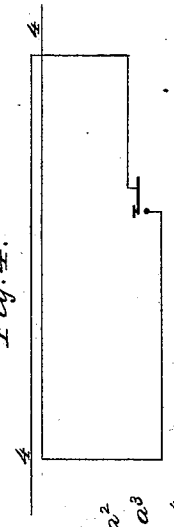

Fig. 4.

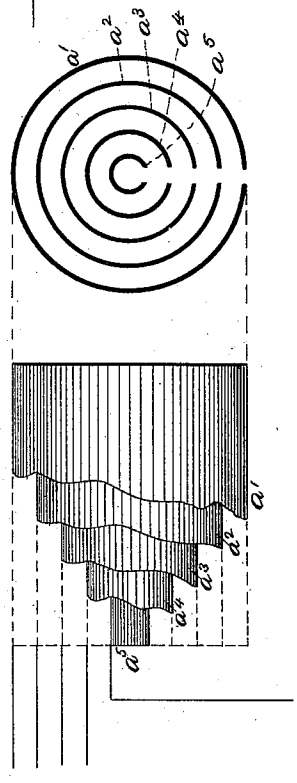

Fig. 3.

Witnesses:
W. C. Tirdinston.
C. L. Kerr.

Inventor:
Granville T. Woods
by R. H. Rosea
his Attorney.

(No Model.)

2 Sheets—Sheet 2.

G. T. WOODS.

RAILWAY TELEGRAPHY.

No. 373,383. Patented Nov. 15, 1887.

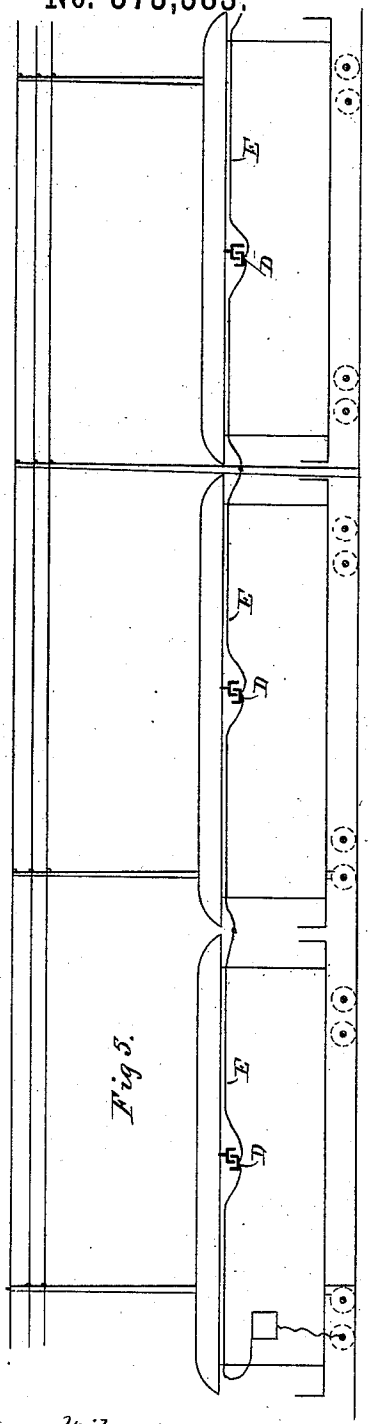

Fig. 5.

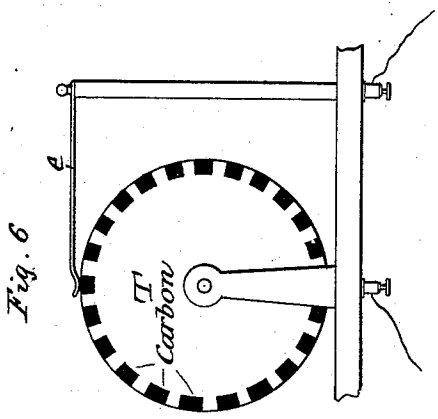

Fig. 6

Witnesses:
W. C. Jirdinston.
C. L. Kerr.

Inventor:
Granville T. Woods
by Lemuel Gross
his Attorney.

UNITED STATES PATENT OFFICE.

GRANVILLE T. WOODS, OF CINCINNATI, OHIO, ASSIGNOR TO THE WOODS ELECTRIC COMPANY, OF SAME PLACE.

RAILWAY TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 373,383, dated November 15, 1887.

Application filed November 3, 1886. Serial No. 217,858. (No model.)

To all whom it may concern:

Be it known that I, GRANVILLE T. WOODS, a citizen of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Static-Conduction Telegraphy, of which the following is a specification.

My invention relates to systems and apparatus for static-conduction telegraphy generally, having reference in the present illustration of my invention to the application of the system to use upon railways where the traveling proximity of the cars to the ordinary lines of telegraph-wires adjacent to the track offers facilities for electrical conduction (or, more accurately, static conduction) between the car-roofs of a moving train or suitable apparatus carried thereon and the said telegraph-lines.

It is the object of my invention, as here illustrated, to utilize such wires as conductors for static currents where a number of said wires are grouped together, as is usually the case between principal stations, such utilization being wholly independent of their primary use for telegraph purposes and not interfering therewith, according to well-known laws.

To this end my invention consists, primarily, in the interposition in the conducting-wire of an ordinary telegraph-line of a metallic plate constituting part of the conducting-line and combining therewith a second plate connected to earth through apparatus suitable for receiving and transmitting signals by static currents as contradistinguished from the voltaic currents employed in ordinary telegraphy, the two plates arranged to constitute a "condenser" or static conductor for an auxiliary system of electrical transmission in which the telegraph-wire is used as a general conductor without impairment of its ordinary use; secondly, in interposing in each of a group of said telegraph-lines a conducting metallic plate, said plates being suitably insulated from each other, but brought in proximity in such relation as, while not impairing the voltaic conducting power of the lines, to constitute, with an additional plate having an earth-connection, a condenser for the transmission of static currents to and from said conducting-lines at terminals and other stations; also, in arranging the two branches of the ordinary local loop in any given telegraph-line between the main line and the key in such relation as to constitute a condenser or static conductor without impairing the voltaic conductivity of the line.

It also consists in the combination and arrangement of condensers and a common conducting-line upon the several cars composing a train, whereby the accumulated effect received for any number of cars through their metallic roofs may be concentrated at the receiving-instrument.

It consists, further, in certain improvements in the construction and arrangement of the apparatus employed, tending to simplicity and general efficiency in the operation of a system of static-conduction telegraphy, and, lastly, in certain other details, more fully pointed out hereinafter.

In the accompanying drawings, illustrating my invention and forming part of this specification, Figure 1 is a diagram view of a system of telegraph-lines and the apparatus of a terminal or other station; Fig. 2, a continuation of the said diagram, representing a car and its induction apparatus between stations and the telegraph-lines continued; Fig. 3, a detail side and end view of a preferred form of condenser-plates; and Fig. 4, a diagram of the local loop condenser, shown without conducting-plates interposed; Fig. 5, a diagram view of a train of several cars, showing the metallic roofs connected through condensers to a common conductor; Fig. 6, a detail of the rotary tension-changer.

Referring, now, to the drawings, the small figures 1 2 3 4 designate the several wires constituting a group of telegraph-lines, carried upon poles in the usual manner at the side of a railway-track.

a (series a' a^2 a^3 a^4) designates plates of metal interposed in the several lines, respectively, each plate constituting part of the conducting-line, and a^5 a similar plate, to which is attached a line-wire, 6, leading ultimately to the ground g^2. These several plates are suitably arranged to constitute a condenser for uses to be explained, and to this end may be flat plates placed in series side by side in contact with interposed insulating-sheets, or, preferably, plates curved to cylindrical form with one side

open and arranged concentrically with interposed insulations, as indicated in Fig. 3.

In Fig. 1 is indicated the arrangement of apparatus at the terminal station of one of the telegraph-lines, 4, (shown by its ground g', battery b', and key k'.) In such case the plates a are at the line side of the telegraph apparatus and constitute part of the apparatus for transmission or reception of signals, constituted and circuited as follows: The line 5 is provided with a hand-switch, s', by which it is connected alternately to ground g^2 through line 6, including a telephone-receiver, t', or through line 7, including the secondary of an "induction-coil," c'. The outer terminals of the primary of this coil terminate in contacts p' p^2 at the vibrating limits of a pivoted vibrating arm, s^2, constituting a pole-changer in a local circuit traced as follows: from a point midway in the secondary of coil c' by a third terminal, 8, through plate a^6, key k^2, line 12, plate a^7, (the plates a^6 a^7 constituting a condenser,) battery b^2, vibrating arm s^2, alternately through contacts p' p^2 in opposite directions from the respective outer terminals of the primary in coil c' to the third or central terminal, 8.

The vibrating switch-arm s^2 is automatically actuated as follows: The outer end of the arm is bifurcated around the outer end of the armature s^3 of an automatic circuit-breaker, C', in local circuit with battery b^3 in such mechanical relation as that each excursion of the armature s^3 carries the switch-arm s^2 between its opposite contacts, thus reversing the battery-current through the primary of coil c' automatically. The rapid alternate reversal of current through the induction-coil c' produces a strong induced current in the secondary which is transmitted to the conducting-lines 4 3 2 1 by the condensing-plates 5 4 3 2 1, in the order named from one to the other. The desired effect is not communicated to the telephone-lines collectively, but successively through one to the other. I also interpose between the terminal wires of the induction-primary a resisting-connection, 10 11, connected centrally with the pivotal end of the vibrating arm s^2, with a view of equalizing the alternate impulses and to prevent sparking by preventing an absolute breakage of the circuit. The successive increase in the relative amount of condensing surface of the curved plates shown in Fig. 3 also facilitates the successive charging of the conducting-lines. By way of further explanation on this point it may be noted, first, that the interposition of the plates a in the telegraph-lines diminishes the conductive resistance of the lines for voltaic currents, and consequently stations for the herein-described system of transmission may be multiplied to any desired extent without impairing the use of the wires for ordinary telegraphy; second, in the present system of charging the wires successively each wire in succession must receive its full charge before the next in series. This fact, as will be readily understood, reduces the amount of leakage to the ground by the supporting-insulators, since there will be a less number of such supports to a given current-impulse in a given period of charging action; but another factor in this connection, as I conceive, is that by the differences in potential among the group of wires at the outset of charging, the leakage instead of being to the earth, will take place from the wires most highly charged to those of lower potential, and that practically little leakage to the earth will occur, because an equilibrium of potential is never established among the group. In other words, by thus allowing the current to choose the number of wires it can fully charge the loss by absorption is greatly obviated and the current will be relatively stronger in relation to the conductive capacity of the wires, and hence will traverse the line farther, maintain a stronger transmitting force, and the discharges from the line to the car or to the station will be sharper.

It will also be evident that the lines of the conducting-group will discharge to the car in the same successive order as they were charged at the station, and vice versa—that is to say, the line first charged will first discharge to the car, and the discharges from the car will first charge the line whose plate at the receiving-station is nearest the ground-wire and its plate. To further illustrate by simile, a given quantity of water to be transmitted and its momentum utilized for motive purposes in an excessive number of incline conduits will be transmitted more quickly and with less loss by friction, evaporization, leakage, &c., by charging the conduits successively to their full capacity, so far as the quantity to be transmitted requires, rather than by dividing the entire quantity at the outset equally among all the conduits, thereby lessening the amount in each. In static currents, as is well known, we deal with electricity of comparatively low quantity; hence the necessity of economizing in transmission. Arranged as shown in Fig. 1, it is designed to send messages by the key k^2 and receive messages by the telephone-receiver t', and to avoid confusion of signals by overtaxing the ear of the operator I prefer to cut out the telephone-instrument t' by moving the switch s' before sending. The character of the signal transmitted by the apparatus thus shown and described will be a buzzing sound caused by the pole-changer, interrupted by breaks or periods of silence produced by the key k^2. Such signaling is easily distinguishable from the ordinary sound caused by telegraphing, and tends to greater accuracy by obviating confusion of sounds. I have also shown in Fig. 1 the arrangement of the line 4 at an intermediate station. In this case the line is severed, its ends brought down, as at 40, and passed through the usual key, sounder, and relay-circuit shown, (which needs no further description;) but between the main line and the key condenser-plates a^8 a^9 are interposed,

as shown, thus short-circuiting the static currents before reaching the key. This result—to wit, the short circuit of the static currents in relation to a key under these circumstances—may be accomplished by arranging the main-line wire 4 as indicated in Fig. 4, wherein the incoming wire of the loop is run for some distance parallel to and in the vicinity of the outgoing wire, thereby practically operating as a condenser to shunt the static currents from one to the other and transmit the same without hinderance.

The car is provided with transmitting and receiving apparatus similar to that described, the circuit being from the group of telegraph-wires 1 2 3 4 to the metal roof R of the car, used as a condenser-plate; thence by wire 12 through a condenser, D, to ground at the wheel-bearings. I have shown the apparatus in Fig. 2 with a slight modification consisting of a rotary tension-changer, T, substituted for the automatic pole-changer already described. Either the pole-changer device or the rotary tension-changer may be used, or both may be used in the same general system of transmission. I have shown the tension-changer as part of the car apparatus merely for convenience of illustration without duplicating parts in the drawings. Where this is used, an ordinary induction-coil, c^2, is employed, (in contradistinction to the "three-way" coil shown in Fig. 1,) or an ordinary "sparking-coil" may be used. In the arrangement of the circuit in this case the condenser a^6 a^7 is interposed between the tension-changer T and the coil c^2 at one side and the key k^2 at the other, and the battery b^2 between the key and the coil.

The tension-changer T is constructed substantially in the form of the ordinary rotary circuit-breaker, with brush-contact *e* for the circuit-wire resting against the cylindrical surface, in which surface, instead of the usual insulations, blocks of carbon or other high-resistance material are inserted at regular intervals peripherally. It may be kept in rotation by clock-work, or by electro-motive force in the usual manner. I employ the condenser D upon the car in the ground-line to equalize the static discharges.

It is to be understood that each intermediate and each terminal station is to be provided with apparatus such as shown in Fig. 1. I prefer this form of apparatus, also, for use upon the cars, as producing better results than that shown in Fig. 2.

In the diagram, Fig. 5, each car is supposed to be furnished with a metallic roof, constituting a condenser in relation to the group of telegraph-wires. I place in each car a conducting-wire, E, in sections corresponding with the length of the car and provided with suitable connecting-links between contiguous cars, and interpose between each said section and the car-roof a condenser, D. The cars will then be connected in series as between themselves and in multiple arc as respects the telegraph lines.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. In combination with a line of telegraph, a condenser-plate interposed in and constituting part of the conducting-line, with a second plate provided with a ground-connection, said plates being arranged in such relation as to constitute a condenser or static conductor for the transmission of static currents to and from the telegraph-line, and static apparatus interposed in said ground-connection for the reception and transmission of signals, substantially as set forth.

2. In combination with a group of wires carried above the earth in the usual manner and for the usual purposes of ordinary telegraphy, metallic plates interposed in each of said wires as part of the conducting-line, and arranged to constitute together a condenser or static conductor, and an additional plate arranged as part of said condenser and provided with an earth-connection through suitable apparatus for receiving from and transmitting to said group of wires static impulses, substantially as and for the purpose set forth.

3. The combination, in a railway-telegraph, of a group of ordinary telegraph-wires employed as a conducting medium for static currents independently of their ordinary use by voltaic currents, with a series of condenser-plates arranged individually in electric series in connection with the wires of said group, and a ground-connection and instruments for receiving and transmitting messages by charging and discharging said plates and wires in series, as contradistinguished from charging and discharging in multiple arc, substantially as set forth.

4. The combination, in local-circuit apparatus for transmitting signals to a conducting-line in a system of inductive or static conduction telegraphy, of a local battery, condenser, key, induction-coil, automatic pole-changer, and line-connections, substantially as set forth.

5. In combination with a line of telegraph-wire and its instruments, provided with auxiliary transmitting and receiving apparatus and static conductors, whereby it is used also for the transmission of signals by static conduction, a short-circuit condenser-shunt interposed between a local key and the main line in the local-station loop for short-circuiting the static currents, the elements of said condenser being in the branches of said loop, respectively, as continuations of the main line without break in the metallic continuity of said branches, substantially as set forth.

6. The combination, in a system of electrical transmission by static impulses of a local primary circuit, battery, transmitting-instruments, and induction-coil, of an automatic tension-changer in said primary circuit, substantially as set forth.

7. In a railway-telegraph system, in com-

bination with its wires arranged in static proximity to the metallic roofs of a railway-train, an independent conductor normally continuous throughout the train, but in separable sections upon the several cars, and a metallic connection with interposed condensers between the metallic roof of each car and its section of the common conductor, substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

GRANVILLE T. WOODS.

Witnesses:
E. L. KERR,
C. D. KERR.