(No Model.)

C. E. SCRIBNER.

MEANS FOR PREVENTING INDUCTION IN CABLES OF MULTIPLE SWITCHBOARDS.

No. 488,034. Patented Dec. 13, 1892.

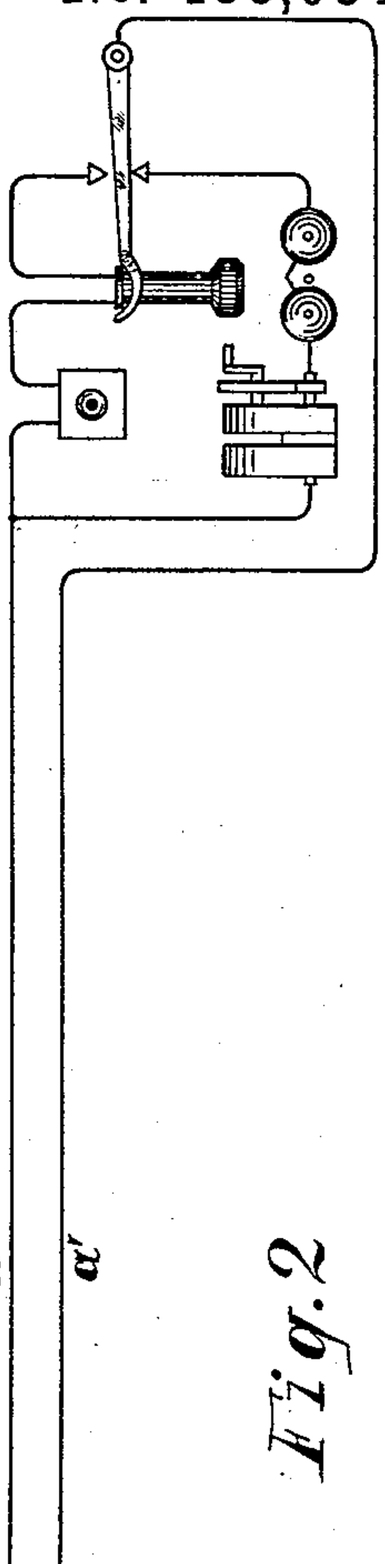

Fig. 1

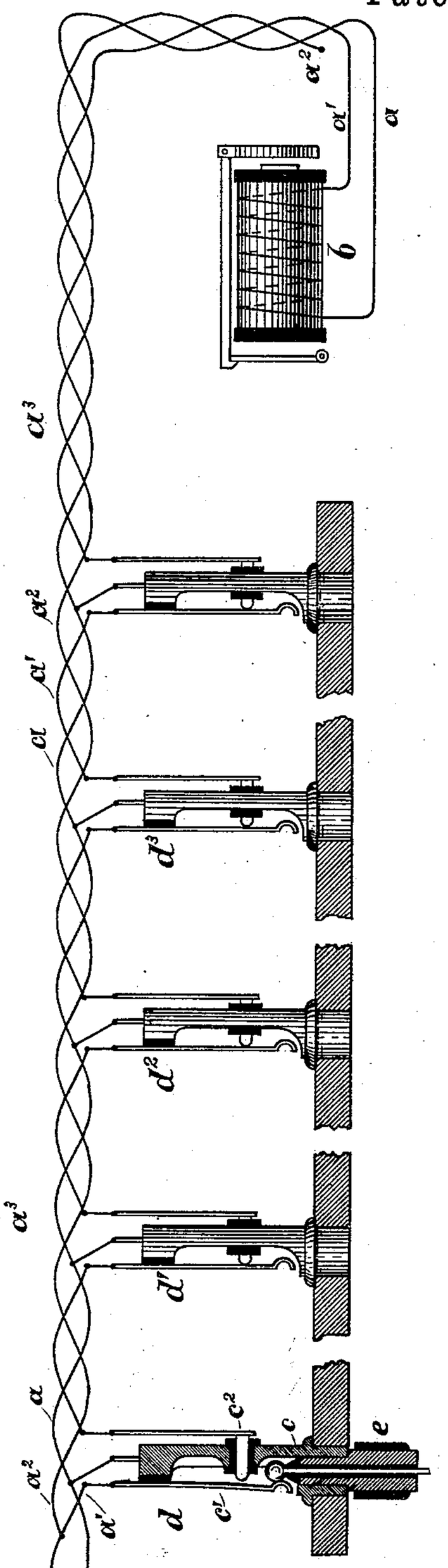

Fig. 2

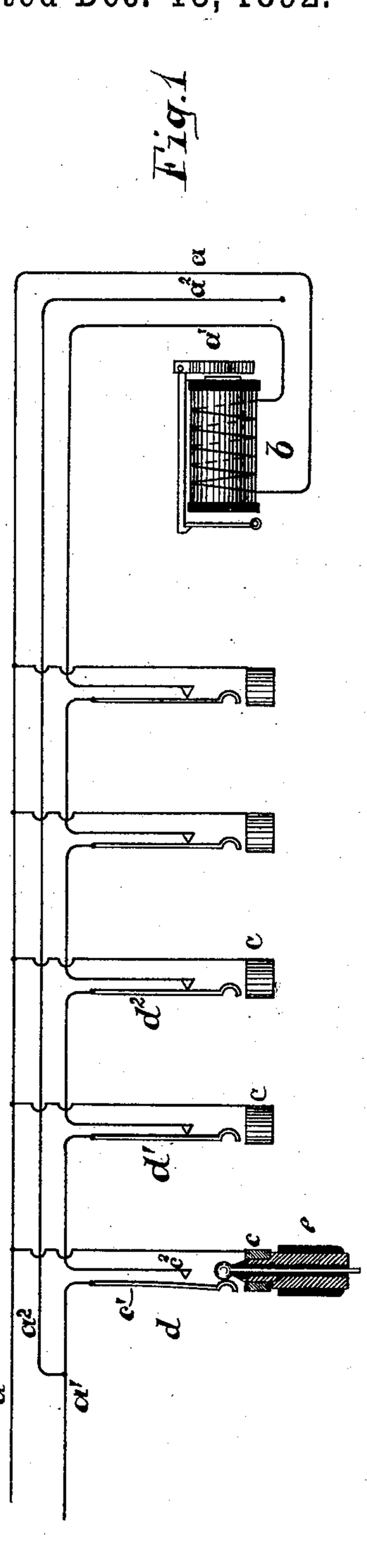

Fig. 3

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UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

MEANS FOR PREVENTING INDUCTION IN CABLES OF MULTIPLE SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 488,034, dated December 13, 1892.

Application filed March 5, 1892. Serial No. 423,919. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Means for Preventing Induction in Cables of Multiple Switchboards, (Case No. 295,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to multiple-switchboard systems for telephone-exchanges, more especially to the cables comprising the different line-wires and their connections to the spring-jacks and annunciators of the switchboard.

The object of my invention is to prevent cross-talk or induction between the different line-wires of the cables.

Heretofore considerable trouble has been experienced in multiple switchboards from this source, and various devices have been tried to avoid the cross-talk or induction. Among these is that of twisting the wires which constitute the different sides of the line-circuit together in a pair, by which arrangement it was sought to cause both sides of the telephone-line circuit to be practically at the same distance from the neighboring wires or line-circuits. Since the currents in the two wires which constitute the two sides of a line-circuit would be equal and opposite in direction, their inductive influence upon neighboring conductors would then be zero. It is well known in the art that the induction or cross-talk between the wires in a cable is largely electrostatic and not electro-magnetic, since cross-talk is still produced between two parallel wires, one of which is electrified from one end, their farther extremities being open. A certain slight current of course flows in the electrified conductor to charge and discharge the same; but this current is so small that its electro-magnetic effect is negligible. In that class of multiple switchboards in which the individual annunciator is connected in a normally-closed loop of the line-circuit, adapted to be opened at that one of the spring-jacks to which a connection is made to disconnect the annunciator from the line-circuit, this electrostatic induction or cross-talk becomes prominent. It is not avoided by twisting the two wires which constitute the sides of the line-circuit together in a pair, because a greater or less length of one of the wires—that one which is connected to the line-spring of the spring-jack ordinarily in use being continued through the line-springs and back contacts of the different spring-jacks in series—is interrupted or opened at some point in the length of the cable corresponding to the particular spring-jack at which connection may be established to the line. The other one of the twisted pair is thus left a continuous conductor extending the full length of the switchboard to an individual annunciator at one of the boards and then returning to the particular spring-jack at which connection is made, its electrostatic inductive effect upon the other lines of the cable being wholly unbalanced throughout the greater portion of its length.

My invention consists in a third wire connected at one extremity to that side of the line-circuit which is adapted to be opened when connection is made to a line twisted with the wires constituting two sides of the line-circuit into a triple strand extending through the cable connected to the spring-jacks and to the annunciator and terminating in an open extremity. In the normal or disconnected condition of the line this triple strand will have no inductive influence upon neighboring conductors, since the electro-magnetic effect of each side of the closed loop, including the annunciator, will be balanced by the oppositely-directed and equal current in the other side of the loop-circuit, and the electrostatic effect of the third or open wire and the side of the loop, including the line-springs of the spring-jacks, will be balanced by the equal electrification of the side of the loop connected to the test-rings. When, however, a connection is made to the line—for example, to the last jack in the switchboard—the electrostatic effect of the continuous line-wire which is connected to the test-rings will be completely balanced by the opposite elec-

trification of the third or extra wire of the strand which is connected to the other side of the line-circuit.

My invention is illustrated in the accompanying drawings.

In Figure 1 of the drawings I have shown a simple diagram disclosing the arrangements of the wires in the cable with reference to each other. In Fig. 2 I have shown a substation with the customary apparatus thereat connected by telephone-lines to the exchange, the different spring-jacks upon different sections of multiple switchboard and the individual annunciator of the line being shown complete and the wires being shown as twisted together into a triple strand.

Referring to Fig. 1, the two sides of the line-circuit a a' are continued in a conducting-loop to the individual annunciator b, which may be placed upon any section of switchboard desired. The side a of the loop is connected to the test-rings c of the different spring-jacks d d' d^2, &c., upon the different sections of switchboard. The side a' of the loop is connected to the line-spring c' of the first spring-jack, whence it is normally closed to the back contact c^2 of the same spring-jack d, whence it passes to the line-spring of the jack d', and so on through the line-spring and back contact of the spring-jack upon each section of multiple switchboard. The wire a^2 is connected at one end to the side a' of the loop before it has been connected to the first spring-jack, so that the wire a^2 is always connected to one side of the line-circuit like the wire a. This wire a^2 terminates at or near the annunciator b in a blind or open extremity. In the normal or disconnected state of the line the different line-springs c' are closed upon their respective contacts c^2, no plug e being inserted in any spring-jack of the line. A current—as, for example, the signaling-current—upon the lines a a' finds circuit over wire a' through the different spring-jacks of the line to the annunciator b, returning by the parallel wire a. The electro-magnetic effect of these parallel wires upon any neighboring conductor is zero, since the inductive effect of each is balanced by the oppositely-directed induction of the other. When, however, a connection is established to the line by inserting a plug e into one of the spring-jacks, as spring-jack d, the side a' of the loop is interrupted. Any inductive effect which would be possible from the strands a, a', and a^2 thereafter must be electrostatic, since all three strands are open at different points, respectively, in the length of the cable. Conductor a is now extended into a continuous conductor to the side a' of the loop and including all of that side of the loop to the back contact c^2 of jack d. The electrostatic effect of this wire upon neighboring conductors is, however, completely balanced by the conductor a^2, which extends opposite the conductor a throughout its entire length. The electrostatic capacity of the conductor a and the appended portion of conductor a' is of course greater than that of the conductor a^2; but the conductor a^2 will be electrified to the same potential as the conductor a, its sign being opposite, and hence it will completely balance the electrostatic effect of conductor a a and the appended portion of side a'. This statement is entirely true only when the conductors a^2 a are at a great distance from the other conductors extending parallel to them, or when, as in the practical case, the conductors a and a^2 are twisted together in a strand, when they become of practically-equal distance from a conductor placed anywhere in their neighborhood. This arrangement is shown in Fig. 2. The wires a, a', and a^2 are twisted together into a triple strand a^3 throughout the length of the cable from the first spring-jack of the swithboard to the individual annunciator upon one of the boards. Both the electro-magnetic effect of currents in the loop a a' and the electrostatic effect of the open conductors when a connection exists to the line are thus avoided.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with a normally-closed conducting-loop having one of its sides arranged to be opened, of a conducting-wire connected at one end to that side of the loop which is adapted to be opened at such point as to be disconnected from the permanently-closed side of the loop when the normally-closed side is opened and extending parallel with the permanently-closed side of said loop, whereby the electrostatic inductive effect of the permanently-closed side of the loop is neutralized when the loop is opened, substantially as specified.

2. The combination, with a normally-closed conducting-loop having one side, including contact-pieces, adapted to open the loop when separated, of a third wire connected at one extremity to that side of the loop which is adapted to be opened and to a point thereof whereby it is separated from the permanently-continuous branch of the loop when said loop is open, said third wire extending parallel and near to said permanently-closed side of the loop, substantially as described.

3. The combination, with a normally-closed loop having its two sides twisted together in a double strand, of contact-points included in one side of the loop, adapted to open the loop when separated, and a third wire connected to that side of the loop which is adapted to be opened at a point, whereby it is separated from the permanently-closed side when the said loop is open, said third wire extending parallel and near to said double strand, substantially as described.

4. The combination, with a normally-closed loop having means for opening one of its sides, of a third conducting-wire connected at one extremity to a point of that side of the loop which is adapted to be opened, such that said

third wire is disconnected from the permanently-closed side of the loop when said loop is opened, the said three wires being twisted into a triple strand, substantially as specified.

5. The combination, with a telephone-line extending to an exchange and a loop through an annunciator thereat and including in one of its sides line-springs and back contacts of several spring-jacks in series at the exchange, of a third wire connected to that side of the loop which is directly connected to the line-springs at a point before the said side has been connected to the first line-spring of the series and extending to the annunciator, terminating thereat in an open extremity, said three wires being twisted in a triple strand, substantially as specified.

6. In combination, several telephone-line circuits extending in separate loops through individual annunciators, one side of each loop including the line-springs and contact-points of several spring-jacks, a separate wire connected at one extremity to that side of each line which is adapted to be opened at a point such as to be separated from the permanently-closed side when the loop is opened, the wire constituting the two sides of the loop and the extra wire of each line-circuit being twisted into a triple strand, the different strands being made up into a cable, substantially as described.

In witness whereof I hereunto subscribe my name this 16th day of February, A. D. 1892.

CHARLES E. SCRIBNER.

Witnesses:
FRANK R. MCBERTY,
GEORGE L. CRAGG.