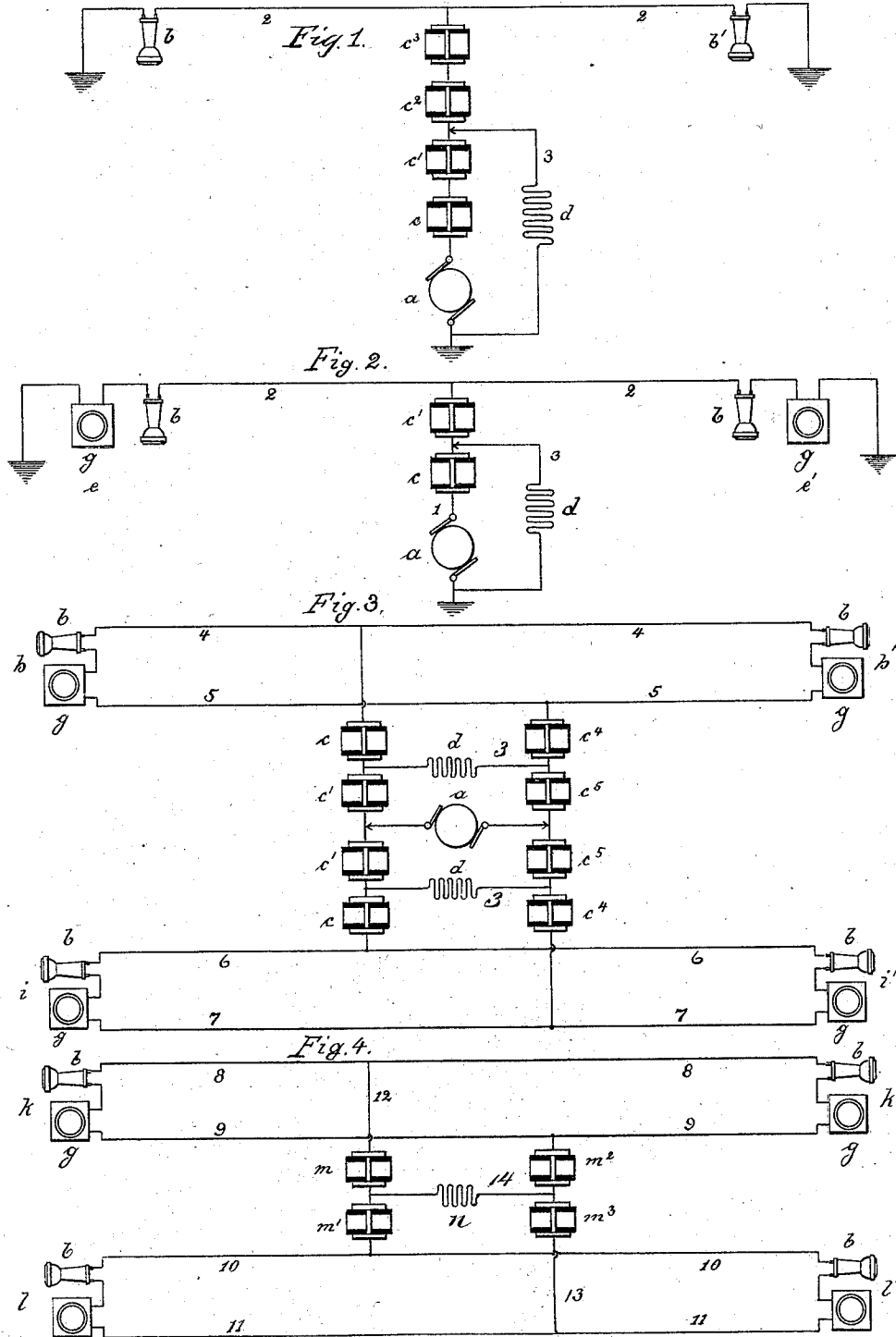


(No Model.)

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APPARATUS AND CIRCUIT FOR TELEPHONES.

No. 559,410.

Patented May 5, 1896.



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UNITED STATES PATENT OFFICE.

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APPARATUS AND CIRCUIT FOR TELEPHONES.

SPECIFICATION forming part of Letters Patent No. 559,410, dated May 5, 1896.

Application filed January 8, 1895. Serial No. 534,212. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. SCRIBNER, residing at Chicago, in the county of Cook, and FRANK R. McBERTY, residing at Downer's Grove, in the county of Dupage, State of Illinois, citizens of the United States, have invented a certain new and useful Improvement in Apparatus and Circuits for Telephones, (Case No. 374,) 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.

Our invention relates to telephonic systems; and it consists in means for preventing the transmission to a telephonic circuit or the propagation in a closed circuit of rapidly alternating or pulsating currents such as are capable of producing sounds in a telephone.

Heretofore when it has been necessary to prevent the transference or propagation of undulatory or telephonic currents or of rapidly-alternating currents to or in telephone-circuits this has been imperfectly effected by including impedance-coils in the circuits. For example, in the case of a telephone-circuit supplied by current from a dynamo, whose current is characterized by rapid fluctuations which produce a sound in a telephone, an impedance-coil has been included in one or both conductors uniting the dynamo with the telephone-circuit. This expedient is to a certain extent effective in preventing the fluctuations in the dynamo-current from reaching the telephone-circuit, provided the impedance-coils have very great self-induction, and hence a high actual resistance; but it has not been practicable to entirely prevent the characteristic sound of the dynamo in the telephone.

Our invention is based upon the discovery that the propagation of undulations in a continuous current or of a rapidly-alternating current from a source through a conductor may be prevented by including in the conductor two coils having high actual resistance or a moderate impedance and closing a shunt about the source of current from a point intermediate of the two coils. In the before-mentioned case of a telephone-circuit sup-

plied with current from a dynamo giving an undulatory current we include in the conductor joining the dynamo with the telephone-circuit two impedance-coils of low actual resistance and moderate impedance, and from a point intermediate of the two impedance-coils to the opposite pole of the source of current we connect a shunt of comparatively high resistance. With this device we find that the noise in the telephone characteristic of the dynamo is perfectly eliminated, the effectiveness of the device depending somewhat upon the actual resistance of the shunt. The same appliance may be used in preventing cross-talk between two telephone-circuits whose line conductors are united for any purpose. Either of the telephone-circuits is then treated as a source of noise-producing current, and in each branch from a line conductor of one line to the line conductor of the other line two impedance-coils are included in series, the points intermediate of the two impedance-coils in each of these conductors being connected together through a shunt of proper resistance.

It will be obvious that the use of this device is not confined to telephonic systems. It is of general application, and may be used in any case in which it is desired to prevent the propagation of a fluctuating current from a source through a conductor.

We have illustrated our invention in the accompanying drawings.

Figure 1 of the drawings is a diagram for the purpose of illustrating the effect of applying the shunt at different points of the conductor, including the impedance-coils. Fig. 2 represents a telephone-line supplied with current from a dynamo, the circuits being provided with the apparatus of our invention. Fig. 3 shows a metallic-circuit modification of the same system, two telephone-lines being connected to the same source of current. Fig. 4 represents two telephone-lines whose conductors are connected together, the circuits being provided with our apparatus for preventing cross-talk between the lines.

The best mode of arranging our invention

may be described in connection with Fig. 1. In this figure a indicates a source of fluctuating current, as a dynamo, one of whose poles is grounded. The remaining pole of the source of current is connected through conductor 1 with a telephone-line 2, whose terminals are grounded through telephones b and b' . If conductor 1 were continuous, obviously a very considerable noise would be produced in telephones b b' ; or if coils of high actual resistance or of moderately great impedance were included in the circuit the sound in the telephones would still be readily perceptible. In carrying out our invention impedance-coils c c' c^2 c^3 are included in conductor 1, and a shunt-conductor 3, including a non-inductive resistance d , is provided, one of its terminals being connected to the grounded pole of dynamo a and the other with conductor 1 intermediate of impedance-coils c' and c^2 . The impedance-coils may be of any suitable resistance and of moderate impedance. For example, they may be cores of iron one-half inch in diameter and two inches long, each core being wound with several hundred turns of wire having a total resistance of five or ten ohms. The coils may have much greater or much less resistance or impedance without altering the general character of the results obtained, however. The resistance d may be of one hundred ohms. The apparatus being thus arranged it will be found by experiment that with the shunt 3 omitted a considerable sound will be heard in telephones b b' . If now the shunt be applied to the terminal of coil c next to the source a , the noise in the telephones will be slightly diminished. If it be applied to conductor 1 between coils c and c' , the sound in the telephones will be considerably diminished. Let the shunt then be applied to conductor 1 between coils c' and c^2 , which point is practically at the center of the resistance and impedance in conductor 1, and the telephones will be found to be perfectly silent. Continuing the experiment, let the shunt be applied to conductor 1 between coils c^2 and c^3 . The sounds will now reappear in the telephones. Finally, with the shunt applied to the distant terminal of coil c^3 , the noise in the telephones will be found to be nearly or quite equal to that observed when the shunt was applied directly about the source a of current. The impedance of the telephones b b' themselves is of some effect in determining the point of application of the shunt to obtain perfect silence in the telephones; but since their impedance is small compared with that of the coils c c' c^2 c^3 the proper point for the application of the shunt may be generally stated to be at the center of the impedance in conductor 1; or, if high-resistance coils be employed in place of these impedance-coils, at the center of the resistance in the conductor 1.

The resistance-coil d in the shunt may be varied through a wide range without seriously

altering the results obtained. If this resistance be made very high, the noise is not completely eliminated from the telephone-circuit, although there is still much less noise when the shunt is placed at the proper central point of the resistance than when it is placed at either extremity of the conductor 1.

A practical application of our device is shown in Fig. 2, wherein the dynamo a is connected through a conductor 1, including two impedance-coils c and c' with a telephone-line circuit 2, which extends between two stations e and e' and includes at each station a telephone-receiver b and a microphonic transmitter g in series in the line-circuit. The purpose of the dynamo a in this system is to supply current to the line-circuit through the microphones g , these microphones when thus supplied operating in a manner well understood in the art of telephony. The shunt-circuit 3 is connected between earth and conductor 1, the latter connection being made between impedance-coils c and c' . A constant current flows from the source a through the impedance-coils c and c' , and thence dividing through the two microphones g at the substations and to earth. Obviously, variations of resistance in one of the microphones cause a variation of the current in the other branch of the circuit, and thus cause the sounds which act upon the microphone to be reproduced in the telephone at the distant station.

In Fig. 3 the same device is represented as applied to two metallic-circuit telephone-lines. One line comprises direct and return conductors 4 and 5, including a telephone b and a microphone g at each of two stations h and h' . The conductors of the other line are designated 6 and 7. They include similar apparatus at substations i and i' . The conductors 4 and 6 of the two line-circuits are each connected through two impedance-coils c and c' with one pole of the source a of current. The remaining conductors 5 and 7 of the two lines are each connected through other impedance-coils c^4 and c^5 with the remaining pole of dynamo a . A shunt 3, including the usual resistance-coil, has its terminals connected with the two branches extending to the different sides of each line-circuit at points intermediate of the two impedance-coils in the branches. It will be observed that this modification differs from the form shown in Fig. 2 only in the inclusion of impedance-coils in both conductors from a line to the terminals of the source of current supply and in the connection of the shunt at symmetrical points in these branches. This change in the circuits to adapt the apparatus to metallic circuits does not result in any difference in the operation or effect of the device, but it is found that silence may be obtained in the telephones with a somewhat higher resistance in the shunt-circuit than in the modification shown in Fig. 2. The differ-

ence in favor of this form is not great, however.

In telephonic systems arranged for the supply of current to the substation microphones from a central source of current connected with the lines our invention, applied as in the foregoing cases, is of especial advantage. If the former method of preventing fluctuations of the current from the common source were adopted—that of including coils of high resistance and impedance in the connections from the source of supply to the lines—a high electromotive force would be required in the source of current in order to obtain a sufficient volume of current through the telephone-lines. With our invention the coils c c' may, as before stated, be of comparatively low resistance, and hence the source a may be of comparatively low electromotive force. A very considerable saving in first cost of apparatus and a reduction in the loss of energy in the impedance-coils through which current is distributed to the lines are thus effected by our invention.

Fig. 4 represents two metallic-circuit telephone-lines, which are connected together for the purpose of operating signals or to fulfil any other similar requirement such as frequently arises in telephone-exchange practice. In this figure two line-circuits 8 9 and 10 11 are represented extending between substations k k' and l l' . The conductors 8 and 10 of the different lines are united by a cross-wire 12, including two impedance-coils m and m' . The remaining conductors 9 and 11 are united by a similar cross-wire 13, including two other impedance-coils m^2 m^3 . With this simple circuit cross-talk would exist between the different line-circuits—that is, sounds produced in the microphone at station k would be heard in the telephones at stations l and l' , and either line-circuit which was in use for telephonic communication would become a source of disturbance for the other line. The shunt 14, either including a resistance-coil n or without this coil, is connected between conductors 12 and 13 intermediate of the impedance-coils in these branches. The disturbance in either line is thus prevented from being propagated through conductors 12 and 13 to the other line—that is, the lines become free from cross-talk.

Many other modifications of our invention to adapt it to different purposes and conditions are possible and may readily be made by one skilled in the art. It is clearly not limited to use in telephonic systems, since it applies in the most general manner to pulsating and alternating currents of widely-different periods.

We claim as new and desire to secure by Letters Patent—

1. The combination with a source of variable current, of a closed circuit therefor including a translating device, a conductor having considerable self-induction included be-

tween one pole of the source of current and the translating device, and a shunt including a resistance-coil connected from the other pole of said source of current to the center of the conductor having self-induction, whereby the propagation of fluctuations in the current through the translating device is prevented, substantially as described.

2. In combination, a circuit including a translating device, two parallel branches across said circuit, a source of variable current included in one of said branches, a conductor having considerable resistance in the other of said branches, a conductor having large self-induction in the said circuit between the points of connection of the parallel branches therewith, and a conductor having approximately equal self-induction included in the said circuit between the translating device and the point of connection of the branch including the resistance-coil, substantially as described.

3. The combination with a source of fluctuating current and the circuit thereof, a translating device in the circuit, a conductor having considerable self-induction included between the translating device and the source of current, and a shunt-circuit including non-inductive resistance connected from the central point of the said conductor to the opposite pole of the source of current, whereby a constant current devoid of fluctuations is supplied to the translating device, substantially as described.

4. The combination with a source of fluctuating current, of a circuit including a telephone, branches uniting the different poles of a source of current with the different sides of the telephone-circuit, one or more conductors having considerable self-induction included in one of said branches, and a shunt including a non-inductive resistance connected from a point between the extremities of the said self-inductive conductors to the opposite pole of the source of current, substantially as described.

5. The combination with a source of fluctuating current, of a circuit including a telephone and a microphonic transmitter, branches uniting the different poles of the source of current with the different sides of the telephone-circuit, a self-inductive conductor included in one of said branches, and a shunt-circuit about the source of current, one terminal of said shunt being applied to the branch including the self-inductive conductor in such position that the self-inductions in the portions of the circuit on opposite sides of the point of application of the shunt are practically equal, substantially as described.

6. The combination, two closed telephone-circuits, a source of telephonic current in one of said circuits, a telephone-receiver in the other circuit, two branches each uniting one side of one telephone-circuit with the corresponding side of the other telephone-circuit,

two impedance-coils included in each of said
branches, and a conductor uniting the said
branches connected with each of them at
points intermediate of the two impedance-
5 coils, whereby cross-talk between the lines is
prevented.

In witness whereof we hereunto subscribe

our names this 20th day of December, A. D.
1894.

CHARLES E. SCRIBNER.
FRANK R. McBERTY.

Witnesses:

ELLA EDLER,
DUNCAN E. WILLETT.