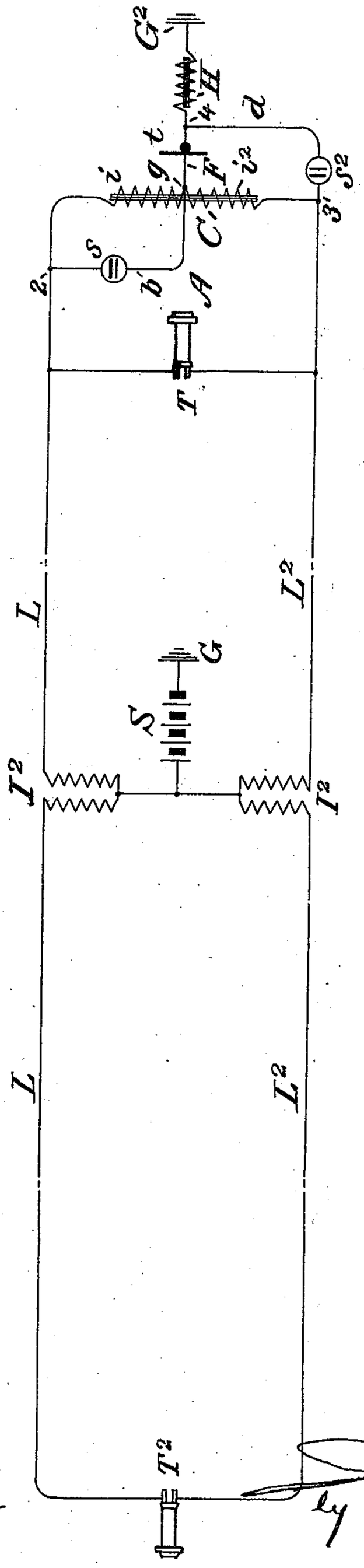
(No Model.)

# J. S. STONE.

## TELEPHONE CIRCUIT.

No. 551,060. Patented Dec. 10, 1895.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 551,060, dated December 10, 1895.

Application filed July 6, 1895. Serial No. 555,149. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN S. STONE, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Telephone-Circuits, of which the following is a specification.

This invention relates to telephone-circuits, and in particular to that class wherein the transmitters at sub-stations are supplied with current from a central or common source, such as a battery or dynamo.

The invention is applicable to inductively neutral metallic main telephone-circuits which have their two main conductors arranged in parallel to jointly constitute a low-resistance main-line conductor of a supply-circuit which may utilize the earth as a return-conductor and which includes the main or central source of transmitter-current. The said two main conductors arranged in series or end to end thus serve as the two sides, respectively, of the main conversation-circuit and in parallel together form the sole main-line conductor of the current-supply circuit. It involves a plan or system of arranging the sub-station circuits and apparatus and the relation sustained by the circuits of such system to the conductors of the main conversation and supply circuits.

The drawing is a diagram exemplifying the application of the invention to a pair of metallic telephone-circuits connected for conversation between their respective substations.

The main source of current is indicated as being common to both and placed at a station which both enter and where they are united.

The two main conductors of each main metallic telephone-circuit connected in parallel to form the single-line conductor of the supply-circuit are at one end united in the usual way to one pole of the main source of current-supply, which at its other pole is connected with the ground or other return-conductor, and at their sub-station end are respectively connected with the two ends of a retardation or impedance coil, from the middle of which a conductor extends through the station-transmitter to the complementary earth terminal of the supply-circuit, or if such circuit be provided with an independent return-conductor to the sub-station end thereof. Two electrolytic polarization or Planté batteries are connected in independent shunt-circuits round the two halves of the impedance-coil winding, or, in other words, extending from different sides of the transmitter to the two main conductors, respectively.

In this system the main conversation-circuit and the transmitter-supply circuit employ the same main-line conductors which form parallel branches of the main line of the latter circuit, the two electrolytic batteries being in series in the talking-circuit, the two sections of the impedance placed, respectively, in the two parallel branches of the supply-circuit, and the station-transmitter in both circuits placed between the two batteries in the former and in the terminal earth conductor of the latter. The invention thus provides at the sub-station two branch circuits extending, respectively, from the middle of the impedance-coil to the two main conductors, one of which contains an electrolytic or Planté battery only, while the other contains the remaining Planté battery and the transmitter. An auxiliary impedance-coil is in practice interposed at some point in the earth terminal conductor of the supply-circuit to further bar the passage that way of voice-currents.

The current of the main source passes over the two main conductors and the two sections of the impedance-coil in parallel and through the transmitter, but no appreciable part of it passes through the electrolytic cells in the branch circuits, these being, practically, impervious to the passage of such steady currents; but the vibratory or voice currents developed in the operation of the transmitter traverse the branches containing the said electrolytic branches freely, the impedance of this path being very low in comparison to that through the supply current retardation coil or coils, especially when these are supplemented by the auxiliary coil in the earth branch, and I may therefore state that the transmitter-supply current cannot pass through the electrolytic cells which are in function similar to large condensers, but passes freely through the impedance-coils, while the voice-currents which freely pass through the electrolytic cells and flow in the

metallic circuit, cannot pass through the impedance coils to the supply-circuit, and are therefore maintained in their legitimate circuit without waste.

By my invention a circuit of low resistance is provided for the supply-current without introducing an induction-coil at the sub-station and without any disturbance of the balance of the metallic talking-circuit, for the impedance of the electrolytic cells to disturbing induced currents being, practically, negligible and such current coming upon the line conductors will pass freely to earth at the sub-station through the electrolytic battery branches of the two conductors.

In the drawing, S is the common battery or source of supply having one of its poles grounded at G. L $L^2$ are the two main conductors of the main talking or conversation circuit, both connecting as parallel divisions or branches of a single conductor with the source S, as shown, to form the sole main conductor of the transmitter-supply circuit and united at a sub-station A to the two ends of an impedance-coil, retardation-coil, or electromagnetic resistance C.

A conductor F extends from a point *g* at the middle of the impedance-coil dividing the same into two sections, one for each main conductor, to the earth terminal or return conductor of the supply-circuit at $G^2$ and includes the transmitter *t*. Obviously two mechanically separate impedance-coils may, if desired, be employed, instead of a single coil divided electrically into sections by the centrally-connected leading-out wire F.

A branch circuit or conductor *b* extends from the point *g* at one side of the transmitter to a point 2 on the main conductor L, and in the said branch is connected an electrolytic or Planté battery *s*, and a shunt-circuit for varying currents is thus established round one section *i* of the impedance-coil. Another branch *d* unites the point 4 at the opposite side of the transmitter to the point 3 on the other main conductor $L^2$ and contains the second electrolytic battery $s^2$, forming another shunt-circuit round the second section of coil $i^2$. T is the receiving-telephone of the substation, shown as bridged between the main conductors L $L^2$; but of course it may be connected with the circuit in any of the well-known ways which do not disturb the balance.

As shown, the two main telephone-circuits are connected at a central station by means of a split repeating-coil; but this is not essential to the invention. $T^2$ is the receiving-telephone at the other subscriber's station.

H is an auxiliary impedance-coil placed in the ground or return wire of the supply-circuit to aid in confining the voice-currents to the main talking-circuit and also to assist in maintaining the balance of the circuit.

The electrolytic batteries employed in this invention may be small unformed or partly formed Planté cells, in which two leaden plates are immersed in acidulated water, and the number of cells in each of the two batteries depends upon the resistance of the corresponding section of the impedance-coil. It may generally be stated that the number of cells for each battery should be so proportioned that their natural potential shall approximately equal the fall of potential through the coil or section of coil which is shunted by such battery.

In the operation of this invention the passage of the supply-current through the transmitter in accordance with well-understood principles determines a steady difference of potential at its terminals as long as the transmitter-resistance remains unchanged; but as soon as the transmitter resistance is varied corresponding potential differences occur. These varying potential differences cause a succession of complete redistributions of the potential of the low-impedance conversation-circuit, which is composed of the two conductors L $L^2$ of the main line in series, and their terminal connections leading through the transmitter *t*, the electrolytic batteries *s* $s^2$, and, as shown, through the two right-hand windings of the split repeating induction-coil $I^2$. As a consequence, vibratory or voice-currents corresponding to the variations in the resistance of the transmitter are developed in and traverse the said low-impedance metallic conversation-circuit to operate the telephone-receiver at the distant station. As shown in the drawing, the said receiver is in a second circuit inductively connected with that which contains the transmitter, and in that case, in the usual manner, the voice-currents of the circuit engaged in transmitting are inductively reproduced in the second circuit to operate the receiver thereof.

The receiving-telephone $T^2$ only of the other sub-station apparatus is shown.

Having described my invention, I claim—

1. In a centralized battery telephone system, the combination with two main line conductors extending to a substation, forming severally the two conductors of a metallic talking circuit, connected in parallel with one another to constitute the single main line conductor of a supply circuit having a ground or independent return conductor, and containing the main source of current supply; of a retardation or impedance coil having its two ends united to the two substation ends of the said main conductors and its middle to their common earth terminal or return conductor, the substation transmitter connected in said terminal conductor, and two electrolytic or polarization batteries connected in independent shunt circuits extending from different sides of the said transmitter to the two main conductors respectively.

2. In a centralized battery telephone system, two main conductors forming severally the outgoing and return conductors of a metallic talking circuit, extending between a transmitting and a receiving station, and jointly constituting parallel branches of the

single line conductor of an earth return transmitter current supply circuit extending between the same stations; in combination with two electrolytic batteries, impedance coils, the telephone transmitter, and the earth terminal conductor of the supply circuit all at the substation, the said batteries being placed in series in the talking circuit, the impedance coils one in each parallel line conductor branch of the supply circuit, and the telephone transmitter in both circuits, between the two batteries in the former, and in the terminal earth conductor of the latter.

3. In a centralized battery telephone system, the two conductors of a metallic talking or conversation circuit extending between a transmitting and a receiving station, connected in parallel as the single conductor of an earth return supply circuit containing the main source of current supply, and united at the transmitting station with the two ends of a retardation or impedance coil; in combination with two branch circuits extending respectively from the middle of the said impedance coil to the two main conductors, one containing an electrolytic battery only, and the other containing a similar electrolytic battery and the telephone transmitter; an earth terminal connection extending from the latter branch at a point between the said battery and said transmitter, and an auxiliary impedance coil interposed in the said earth branch or in the complementary earth terminal of the supply circuit, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of July, 1895.

JOHN S. STONE.

Witnesses:

ACHILLES DE KHUTINSKY,

GEO. WILLIS PIERCE.