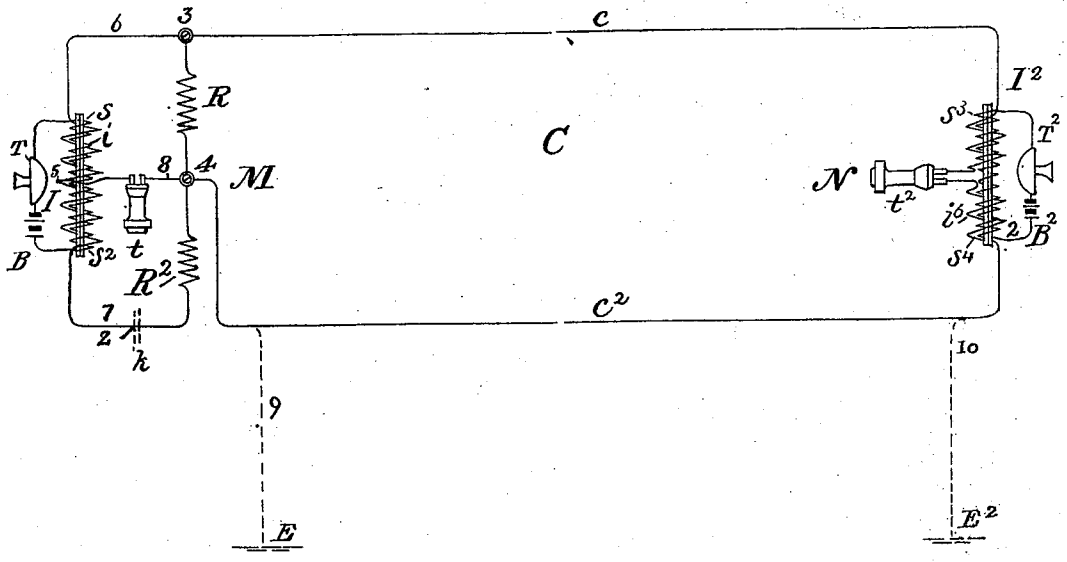
(No Model.)

T. SPENCER.

STATION APPARATUS FOR TELEPHONIC AND TELEGRAPHIC CIRCUITS.

No. 501,472. Patented July 11, 1893.



Attest.

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STATION APPARATUS FOR TELEPHONIC AND TELEGRAPHIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 501,472, dated July 11, 1893.

Application filed February 20, 1893. Serial No. 463,115. (No model.)

To all whom it may concern:

Be it known that I, THEODORE SPENCER, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Station Apparatus for Telephonic and Telegraphic Circuits, of which the following is a specification.

My present invention relates to systems of telephonic and telegraphic transmission and more particularly to an improved arrangement of circuits and apparatus for the prevention of disagreeable and harmful side tones or undesired signals in the home receiving instrument during the actual operation of its associated transmitter.

The operation of telephone transmitters, when connected in the usual way, not only reproduces the sounds uttered as is desired in the receiver at the distant station, but necessarily produces also a kind of echoing sound, technically called "the side tone" in the home receiver. Prior to the advent of the powerful transmitters now used on long distance telephone lines, the side tone was insignificant, and was not productive of any practical inconvenience. But since powerful transmitters have been introduced, the noise in the ear of the sender has become so much louder, as to be unpleasant, and in fact disagreeable; and for this reason, as well as in consideration of the additional circumstance that it renders the ear of the user less sensitive to incoming currents, or in other words puts the ear "out of adjustment" for the sounds which should be observed, it is highly desirable that the side tone should be eliminated.

To accomplish this elimination, is the principal object of my invention, and to accomplish it without the necessity of using a condenser (a device involved in all similar previously proposed methods, as far as I am aware), is another object thereof.

It is, of course, necessary in rendering the receiving telephone impervious to sounds caused by the outgoing currents, to provide also that it shall remain fully responsive to incoming currents from the distant station transmitter. In my invention the receiving telephone is made neutral and irresponsive to outgoing voice currents by connecting it between substantially equi-potential points of the circuit with respect to outgoing currents; and unequal action between the two sides of the source of current due to the static capacity of the external circuit is prevented by a high resistance uniting or placed between the terminals of said circuit. This resistance is made sufficiently high to prevent any substantial depreciation of the operating current receivable from the distant station. The arrangement is such that the regular telephone instruments are combined with the high resistance uniting the main circuit terminals in parallel with the secondary helix of the regular induction coil, and combined also with a lesser resistance approximately equal to the joint resistance of the greater resistance and the main circuit, this lesser resistance being interposed between one end of the said secondary and its corresponding main line terminal; the receiving telephone moreover being connected in a branch circuit between the central point of the induction coil secondary and the main line terminal with which the lesser resistance is connected. Excellent results have accrued from this arrangement.

The drawing accompanying this specification is a diagram indicating the circuit arrangement, the several appliances involved, being all standard appliances familiar to those skilled in the art to which my invention appertains.

C is a main telephone circuit, shown in conformity with the best practice, as being a metallic circuit having direct and return conductors c, c^2. It is evident that for the return conductor, the earth in a manner well understood may, if desired, be substituted; and to show such an alternative arrangement earth terminal wires are indicated in broken lines 9 and 10 leading respectively to earth at E and E^2 at the two terminal stations M and N concerned. The apparatus and circuit arrangements at station N are shown as being on the ordinary plan.

T^2 is the transmitter included together with the primary helix i^6 of the induction coil, I^2, in the local circuit, 2, of a battery, B^2.

The secondary coil is in the ordinary way, divided into two sections s^3 and s^4 between which is introduced the receiving telephone t^2.

My invention is shown as being applied at

station M. At that station 3 and 4 may be regarded as the terminals of the station apparatus with which are connected the incoming ends of the line wires or conductors c and c^2.

T is the transmitter, of any preferred variable resistance type, and is connected, as usual, in circuit with a current generator B and the primary helix i of a double secondary induction coil I.

I have obtained good results from an induction coil having a length of six inches between the heads, a primary helix wound to the usual resistance of four tenths of an ohm, and a divided or split secondary helix, the halves whereof, s and s^2 being each wound with fourteen hundred turns of No. 28 wire, so as to have each a resistance of about twenty-two ohms. This secondary helix considered as a whole, is by means of conductors 6 and 7 connected in serial circuit with the main or external circuit, the said conductors being attached to the terminals 3 and 4, conductor 6 being connected directly with terminal 3, and conductor 7 through an interposed resistance appliance, (preferably an ordinary resistance coil) R^2, with terminal 4. A high resistance R which I term the shunt resistance directly unites the terminals 3 and 4. In actual practice a resistance of fifteen hundred ohms has proved satisfactory; a less magnitude than this would be liable to shunt too much of the incoming current from the receiving telephone while a materially greater magnitude is under ordinary conditions unnecessary and therefore undesirable. The resistance R is thus placed in parallel circuit with, or shunts the secondary helix and with respect to the currents developed in said secondary helix, it is also in parallel with or shunts the main circuit C.

As previously indicated, a second resistance, R^2, is interposed in circuit with the secondary helix of the induction coil I, and is located between the half s^2 thereof and the circuit terminal 4. This resistance which I term the equalizing resistance has a lesser value than R, and six hundred ohms has been found to answer well. Generally the resistance R^2 may have a value approximately equal to, or in other words may balance, the joint resistance of R and an average main line circuit C.

The receiving telephone, t, is connected in a branch circuit 8 between a point 5 at the center of the secondary helix, and the point 4; and so placed is between points of substantially like potential with respect to outgoing currents and remains therefore unacted upon by its associated transmitter, it being evident that the two halves of the induction coil secondary reinforce one another with respect to the main circuit, but oppose one another in the home receiver t; the side tone thus being eliminated. For the current developed by s, passing let us say, to 3 meets between that point and 4 the joint resistance of the line and of resistance R, and thence finds return from 4 to 5 through the receiver t; while the current developed by s^2, circulating through the coils s^2, conductor 7, resistance R^2, and the telephone receiver, is of equal strength but in the telephone branch of opposite direction. The circuit through the telephone branch 8, however, is of such a low resistance, compared with other paths between the terminals or points 3 and 4, that it always receives the major portion of the voice currents arriving from the distant station, and consequently satisfactorily reproduces speech. The function of the resistance R during transmission is to prevent the advance in phase of the alternating current developed by the s half of the secondary helix, and circulating in the s branch of the circuit, and the consequent destruction of neutrality in the telephone; which advance would otherwise occur by reason of the capacity of the line and its varying charge and discharge.

In former attempts to neutralize the receiving telephone at the transmitting station by the use of a double secondary winding and branch circuit, it has been requisite to introduce a condenser k, as indicated in broken lines at some point z in the conductor 7.

By the arrangement of circuits involved in my invention the condenser, always an expensive and not always a satisfactory appliance, can be dispensed with.

I have mainly described my invention as being well adapted for use in connection with systems in which the receiving instrument is a magneto telephone; that instrument being probably as sensitive as any known to changes of current. I do not however intend to restrict the invention to its telephonic application since the mode of rendering the receiving instrument neutral to outgoing currents, or to the currents developed by the home transmitter, and the arrangement of apparatus whereby it is carried into effect, is manifestly capable of application to other systems of electrical intelligence transmission, or communication, and is equally efficient and useful in duplex telegraphy.

I claim—

1. The combination in an electric circuit of a receiving telephone, and a transmitting telephone at the same station; with means for preventing the side tone in the said receiver when the transmitter is operated, said means comprising balancing resistances and circuit connections for the said receiver whereby the said receiver is connected between substantially equi-potential points of the circuit with respect to outgoing currents, regardless of variations in the electric condition of the main circuit conductors.

2. The combination in an electric telephone circuit of a station apparatus, comprising a receiving telephone, a transmitting telephone, and an induction coil therefor, having its secondary helix serially connected in said circuit; with means for rendering the said receiver

null or irresponsive to the outgoing currents developed by the said transmitter, the said means consisting of a greater resistance uniting directly the terminals of the circuit, and shunting said secondary helix; a lesser resistance interposed between one of the said circuit terminals and its corresponding secondary helix terminal; and a branch circuit including the receiving telephone connected between the same circuit terminal and the center of the said secondary helix, substantially as hereinbefore described.

3. In an electric telephone station apparatus, the combination of main circuit terminals; a telephone transmitter and an induction coil therefor, having its secondary helix looped to said main circuit terminals; a high resistance directly uniting the said circuit terminals in parallel with the said secondary helix; a lesser resistance approximately balancing the joint resistance of the greater resistance and the external circuit, interposed between one end of the said secondary helix and its corresponding main circuit terminal; and a receiving telephone in a branch circuit connecting the said corresponding main circuit terminal with the center of said secondary helix; whereby the said receiving telephone is rendered neutral or irresponsive to the voice currents of its associated transmitter, while remaining perfectly responsive to incoming voice currents, substantially as specified.

4. In a system of electrical communication, a circuit arrangement for rendering the receiving instrument irresponsive to the sending of its associated transmitter, consisting, of the external circuit; a high resistance uniting the terminals thereof and connected in parallel therewith or as a shunt thereof; three other resistances connected in series between the said terminals, two of which are substantially equal to one another, and the third substantially equal to the joint resistance of the external circuit and its shunting resistance; and a bridge or branch conductor uniting a point between the said two equal resistances to a point at the junction of the shunt resistance and the equalizing resistance, and including the said receiving instrument; substantially as and for the purposes specified.

5. The combination in an electric circuit of a receiving telephone and its associated transmitter so connected in such circuit that the operation of said transmitter determines equality of electrical potential at both terminals of said receiver, the line being arranged as one factor of a joint resistance constituting an element of the balanced potential, whereby disturbances of the said balance due to the varying electrostatic condition of the line are minimized, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 8th day of February, 1893.

THEODORE SPENCER.

Witnesses:
GEO. WILLIS PIERCE,
JOSEPH A. GATELY.