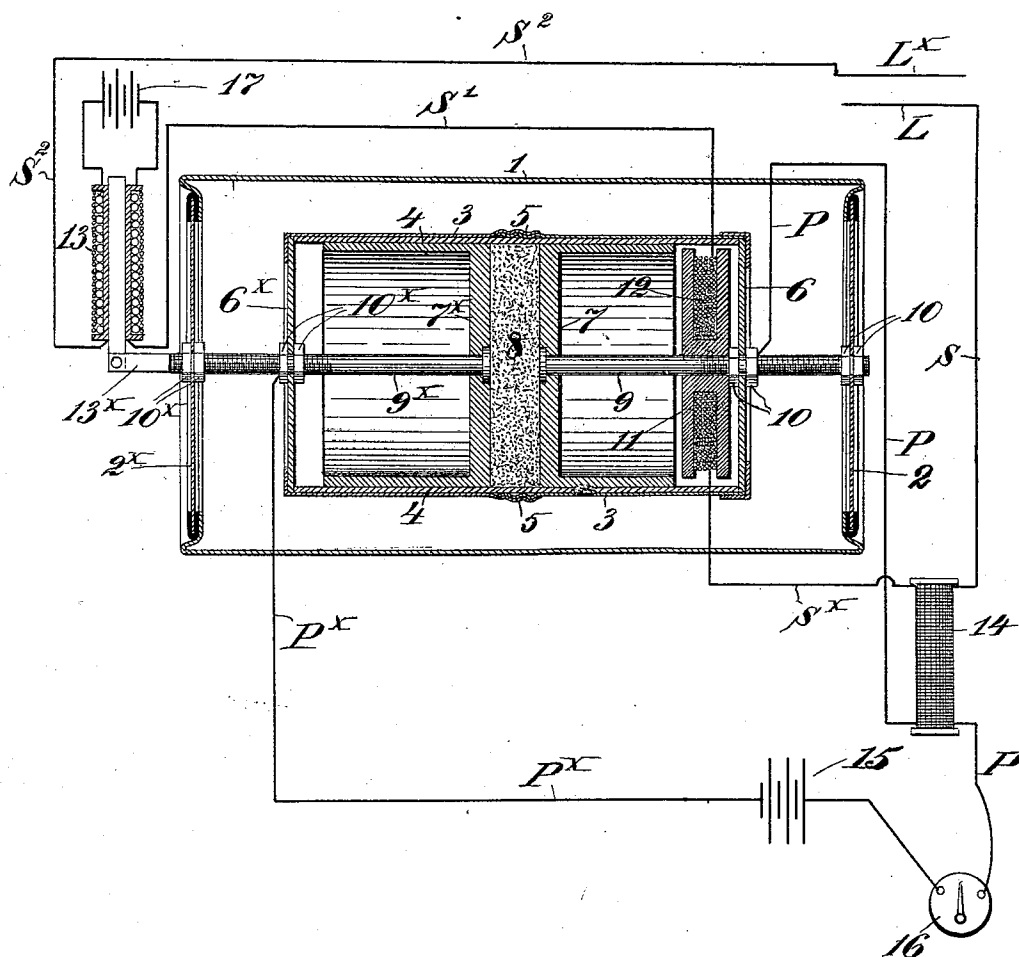


(No Model.)

W. H. & G. E. RUSSELL.
TELEPHONE.

No. 554,895.

Patented Feb. 18, 1896.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 554,895, dated February 18, 1896.

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To all whom it may concern:

Be it known that we, WILLIAM H. RUSSELL, residing at New City, Rockland county, and GEORGE E. RUSSELL, residing at Little Falls, Herkimer county, New York, citizens of the United States, have invented certain new and useful Improvements in Telephones, of which the following is a specification.

Our invention relates in the main to transmitting-telephones, and the object or purpose is to augment the capacity of the instrument, whereby the tones at the receiving-point shall be relatively louder and clearer than is the case with telephones as heretofore constructed, and conversely whereby in the employment of our instrument the person using the transmitter may speak in a lower tone of voice or may stand farther from the instrument than is possible with other telephones, so far as we are aware.

Our telephone combines in one the instrumentalities of a carbon transmitter and a magnetic receiver, so arranged that the instrument may be employed either as a carbon transmitter, as a purely magnetic transmitter, or as a magnetic receiver.

The invention is adapted to both long and short distance telephones, and we believe it to be particularly well adapted for the former where the line-resistance is excessive.

The drawing illustrates an embodiment of our invention in a transmitting-telephone which includes all of the features in the form we prefer to combine them. The drawing is somewhat diagrammatic; but it will be readily understood by any one familiar with telephone installations and constructions.

1 is an outer resonant sounding box or case, in the respective ends of which are fitted diaphragms 2 and 2^x, adapted for transmitting articulate sounds, and which, for distinction, we will call the "vibrator - diaphragms." These diaphragms are supported on the outer faces of inturned flanges on the case 1.

Within the case 1 is a lesser resonant case 3, which we prefer to make of cylindrical form and which, for convenience of description, we will call the "cylinder." This cylinder we prefer to make of sheet metal with a lining 4 of some insulating material. For convenience of assembling the parts the cyl-

inder 3 may be made in two parts or sections and be screwed together at 5. The ends of this cylinder are closed by disks or heads 6 and 6^x, preferably of mica, said disks being seated on the inner faces of circumferential inturned flanges formed on the respective ends of the cylinder.

Within this cylinder are snugly fitted cup-like carbons 7 and 7^x, placed bottom to bottom, and between the disk-like bottoms is placed a granular non-magnetic conducting material 8, preferably flake graphite or granulated carbon.

Fixed at one end in the bottom of the carbon 7 is a permanent bar-magnet 9 of steel. This bar-magnet is screw-threaded at its outer end where it extends out through the disk 6 and vibrator-diaphragm 2, and it has clamping-nuts 10 on its screw-threaded end arranged in pairs and embracing the respective disk and diaphragm. On the magnet 9, as a core, is mounted a spool or bobbin 11, on which is a single winding or coil 12.

Fixed at one end in the bottom of the carbon cup 7^x is a soft-iron bar 9^x, which extends out through the disk 6^x and the back diaphragm 2^x, and is screw-threaded to receive clamping-nuts 10^x which embrace the said disk and diaphragm, as clearly shown.

By reason of the construction above described we not only produce a sound-amplifier, through the medium of the resonant outer casing, the resonant-cylinder, and the hollow resonant-carbons, but we provide for a nice adjustment of the tension on the diaphragms and the compression on the granular material 8. To effect the compression on the latter the nuts which embrace the mica disks 6 and 6^x are driven outward on their respective bars 9 and 9^x, which tends, from the resistance offered by said disks, to force the carbons 7 and 7^x toward each other and to thus compress the granular material between them. This operation tends, of course, to draw inwardly the vibrator-diaphragms 2 and 2^x at their centers and increase the tension thereof, and this tension is afterward regulated by the nuts 10 on the respective bars, which nuts embrace and clamp the respective diaphragms. After the compression and tension are thus regulated the clamping-nuts are set tightly on

the respective disks and diaphragms in order to prevent the rattling of the parts.

Adjacent to the rear diaphragm 2^x is situated a compound induction-coil or magnet 13—that is to say, a magnet or inductorium comprising as its parts a permanent magnet—forming a core, a spool, and on the spool a primary winding and secondary winding similar to or like those of an ordinary induction-coil. One pole, 13^x, of the core of the magnet 13 is in magnetic contact or connection with the back diaphragm 2^x, and this contact is preferably effected through the indirect medium of the bar 9^x, for the reason that direct contact with the diaphragm might interfere with its vibrations. Preferably the pole 13^x will be merely put in contact with the bar 9^x so that it may, under some circumstances, be displaced, but these parts may be connected permanently together, in which case the bar 9^x and diaphragm 2^x become normally-magnetized armatures.

14 is an ordinary induction-coil, such as is now used in transmitting-telephones, and 15 is a battery or other generator, such as is also used with telephones.

16 is a point-switch between the generator and the induction-coil 14, and 17 is a generator which supplies the primary coil of the compound inductorium 13.

The circuits are as follows: From one pole of the generator 15 the current flows by a wire P, to and through the primary winding of the induction-coil 14, thence to the bar-magnet 9, thence through it, through the carbon 7, the graphite 8, and the carbon 7^x to the bar 9^x, through said bar to the wire P^x, and thence to the other pole of the generator 15. The induced current flows from the line L, by wire S, to the induction-coil 14, thence through the secondary winding on said coil, thence by a wire S^x to the bobbin 11, thence through the winding 12 on the said bobbin, thence by a wire S' to the compound inductorium 13, thence through the secondary winding on said coil, and thence by a wire S² to the line L^x. Thus the secondary windings of the induction-coil 14, the winding 12 of the bobbin 11, and the secondary winding of the compound magnet 13 are connected in series. It is only necessary that, when a battery is used, the primary circuit shall include the carbons, but for convenience we employ the bars 9 and 9^x in the circuit.

As to the operation of our instrument, it will be seen that we obtain resonance and reduce the rattling sounds partly by mechanical means, as above described; but we also amplify the sound and reduce the buzzing sounds by a strong induction or superinduction of both the instrument and the line by the magnetic instrumentalities we have described. For example, the magnetic force of the permanent magnet in the inductorium 13 is greatly increased by the current from the battery 17, and the bar 9^x and diaphragm 2^x thus become powerful magnets, while the in-

duction in the secondary coil on the magnet 13 is also greatly increased. The magnet 9 increases the induction in the coil 12, and the secondary coils of the inductoriums 13 and 14 and the coil 12 are in series with the line. These three elements or features we denominate the "magnetic series," and we find that when applied to a transmitter they materially amplify sounds. This we believe to be caused by superinduction when the instrument is used as a carbon-transmitter. The vibrations of the diaphragm 2, which will, by preference, be presented to the mouthpiece of the telephone, produce variable pressures on the carbon, and this produces an "undulatory current," so called, in the primary circuit. This undulation is communicated to the induced current in the secondary circuit and the line, and said current is superinduced by the magnetic series of devices described, such superinduction overcoming obstacles on the line and serving, in conjunction with the resonant construction described, to amplify sounds and reduce or neutralize the buzzing and shrillness so often observed in telephones. This we believe to be the principle upon which the magnetic and electric features of our telephone are based.

Should the battery 15 break down or be switched out the instrument will operate satisfactorily as a purely magnetic transmitter, which also serves as a receiver; or, by a switch, the carbon might be cut out of the primary circuit, when the battery would still serve to induce a current in the line and the secondary windings of the magnetic series.

If the bar 9^x be made a permanent magnet and the magnet-core 13^x be moved out of contact with said bar, the sound will still be amplified, but not to so great an extent as where the construction described is employed.

Either of the diaphragms 2 or 2^x may be used to transmit the voice, and of course the magnet 13 may be applied to either of the diaphragms; but the construction shown is preferred. Our construction permits a more powerful electric current to be employed than can be used in any telephone with which we are familiar, and hence it is peculiarly well adapted to long lines. This, as we have stated, we believe to be due to the powerful magnetic superinduction of the line in conjunction with the resonant mechanical construction described.

We employ no springs and no delicate contacts in our telephone, and hence there is nothing liable to get out of order and nothing requiring constant adjustment and care.

While we prefer to embrace the granular material 8 between two carbon disks, or the disk-like bottoms of two carbon cups, good results may be produced by embracing the granular carbon between aluminum disks on the respective bars 9 and 9^x. We may also produce good results by making the bar 9 of soft iron, in which case it will be excited by the current flowing through the winding 12,

and also by using soft iron for the core of the inductorium 13; but the result in these cases is much inferior to that produced by the construction described.

- 5 We prefer to set the margins of the diaphragms 2 and 2^x in soft rubber or rubber cement.

Having thus described our invention, we claim—

- 10 1. In a telephone, the combination of a resonant outer case 1, and vibrator-diaphragms 2 and 2^x, mounted in the respective ends of said case, of an inner case or cylinder 3, disks 6 and 6^x mounted in the respective
15 ends of said inner case, a bar 9, fixed rigidly but adjustably to the disk 6 and diaphragm 2, and extending into the case 3, a bar 9^x, fixed rigidly but adjustably to the disk 6^x and diaphragm 2^x and extending into
20 the case 3, disks fixed on the inner ends of said bars 9 and 9^x, and granular carbon between said disks, whereby pressure on said granular carbon and tension on said vibrator-diaphragms may be regulated, substantially
25 as set forth.

2. In a telephone, the combination with a resonant outer case, the vibrator-diaphragms 2 and 2^x mounted in the respective ends of
30 said case, an inner case or cylinder, disks 6 and 6^x mounted in and forming heads of said cylinder, cup-like, resonant carbons 7 and 7^x, mounted bottom to bottom in said cylinder, granular, non-magnetic conducting material between the disk-like bottoms of said carbons,
35 a bar 9, secured rigidly to the carbon 7 at its inner end, said bar extending out through the disk 6 and diaphragm 2 and secured rigidly but adjustably to the same, and a bar 9^x, secured at its inner end to the carbon 7^x, said bar extending out through the disk 6^x and diaphragm 2^x and secured rigidly but adjustably
40 to the same, substantially as set forth.

3. In a telephone, the combination with the outer resonant case 1, having inturned flanges
45 at its ends, the vibrator-diaphragms, 2 and 2^x, mounted in the respective ends of said case, the inner case or cylinder 3, having inturned flanges at its ends, the disks 6 and 6^x mounted in the respective ends of said cylinder, the bar 9, screw-threaded at its outer end
50 and extending through the disk 6 and diaphragm 2, the clamping-nuts 10, on said bar and embracing the said disk and diaphragm, the bar 9^x, screw-threaded at its outer end
55 and extending through the disk 6^x and diaphragm 2^x, the clamping-nuts 10^x on said bar and embracing the said disk and diaphragm,

the disks on the inner ends of the respective bars 9 and 9^x, and the granular carbon 8 between said disks, substantially as set forth. 60

4. The combination with a telephone having a casing, a vibrator-diaphragm, a composite carbon element, a cylinder inclosing said carbon elements, a bar-magnet rigidly connecting and supporting said diaphragm, cylinder and contained carbon, and a coil or
65 winding 12 on said bar-magnet, of a generator, an inductorium 14, a primary circuit including the generator, the carbon and the primary winding of said inductorium, and a
70 secondary circuit including the secondary winding of said inductorium, the winding 12, and the line, substantially as set forth.

5. The combination with a telephone having a resonant case 1, two diaphragms 2 and 2^x, at the respective ends of said case, a bar-magnet connected at one end with the diaphragm 2, and having at the other end a disk,
75 the iron bar 9^x, connected at one end with the diaphragm 2^x, and having at the other end a disk, said disks being inclosed in an inner cylinder and opposed, face to face, granular carbon between the faces of the disks on said bars, and a coil or winding 12 on the bar-magnet 9, of a generator, an inductorium 14,
85 a primary circuit including said generator and granular carbon and the primary winding of the inductorium, an inductorium 13, having a permanent magnet for a core and said core in contact with the bar 9^x, and having its primary winding in circuit with a generator, the said generator, and a secondary circuit including the secondary windings of the inductoriums 13 and 14, the winding 12,
90 and the line, substantially as set forth. 95

6. A transmitting-telephone having a resonant case, two vibrator-diaphragms mounted in the ends of said case, a cylinder extending centrally within said case, two cup-like carbons positioned within said cylinder and having their disk-like bottoms arranged face to face, granular carbon between said bottoms, a bar connecting each vibrator-diaphragm rigidly with a carbon cup, and means for regulating the compression on the granular carbon
100 between the cups, substantially as set forth. 105

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

WILLIAM H. RUSSELL.
GEORGE E. RUSSELL.

Witnesses:

PETER A. ROSS,
JAS. KING DUFFY.