2 Sheets—Sheet 1

E. GRAY.

Speaking-Telephone.

No. 204,560. **Patented June 4, 1878.**

Fig 1.

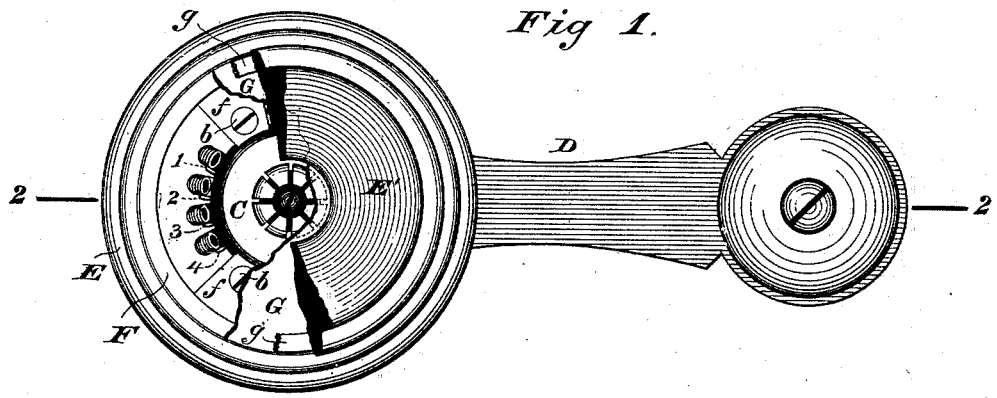


Fig 2.

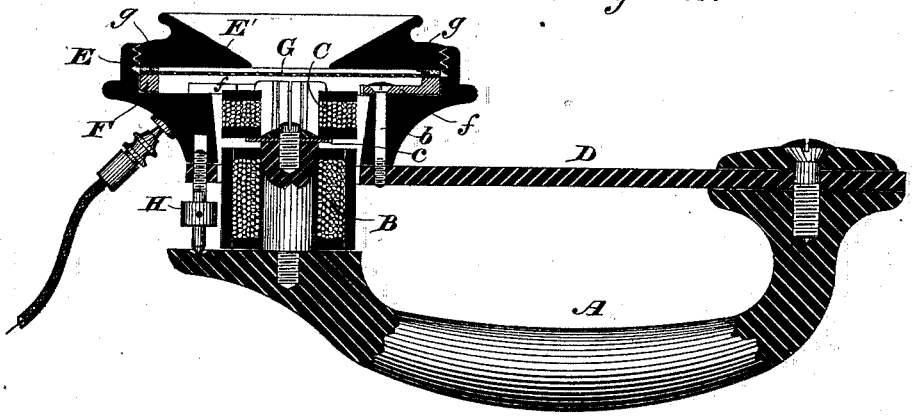
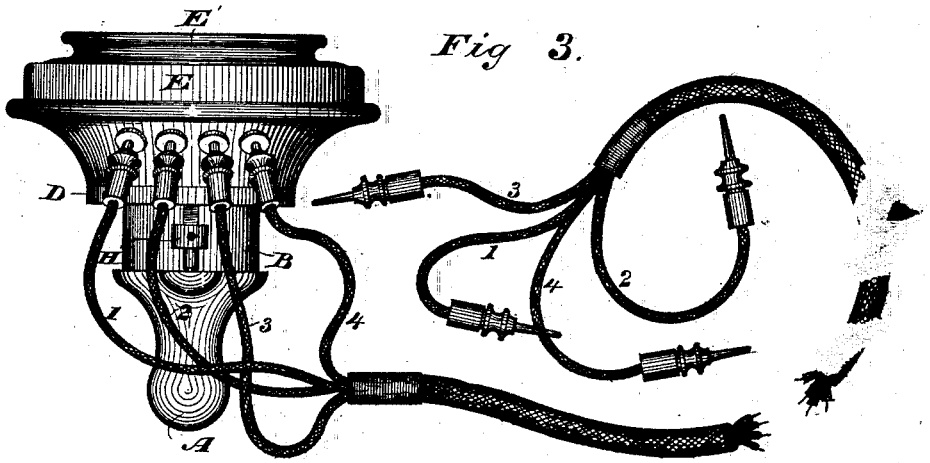


Fig 3.



WITNESSES

Wm A Skinkle

Geo. W. Breck.

INVENTOR

Elisha Gray

By his Attorneys

Baldwin, Hopkins & Peyton

2 Sheets—Sheet 2.

E. GRAY.

Speaking-Telephone.

No. 204,560. Patented June 4, 1878.

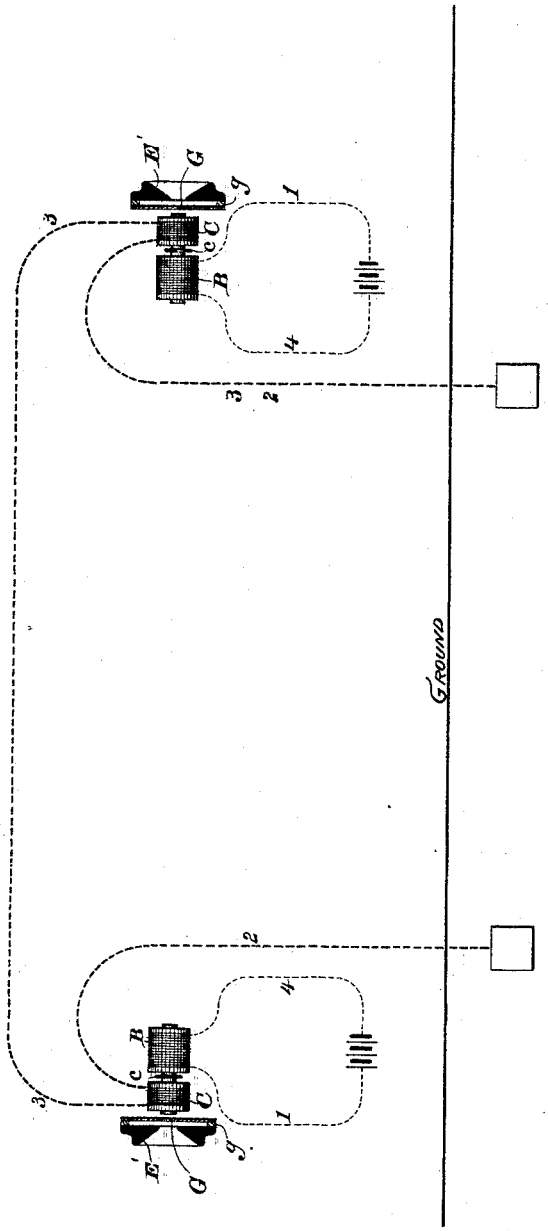


Fig 4.

WITNESSES

Wm A Skinkle

Geo W Breck

INVENTOR

Elisha. Gray.

By his Attorneys

Baldwin, Hopkins & Peyton

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. 204,560, dated June 4, 1878; application filed May 17, 1878.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Speaking-Telephones, of which the following is a specification:

My present invention relates to and constitutes an improvement upon speaking-telephones heretofore invented by me, for which sundry applications for Letters Patent of the United States are now pending.

Its objects are, first, to secure a more perfect transmission of the articulations; and, secondly, to secure a convenient form of instrument for handling.

The subject-matter claimed will hereinafter specifically be designated.

The accompanying drawings represent all my improvements as embodied in one instrument in the best way now known to me. Obviously, however, some of the improvements may be used without the others, and in machines differing in their details of construction from the one herein represented.

Figure 1 represents a plan or top view of the instrument, with portions broken away to show the parts beneath. Fig. 2 represents the apparatus, partly in section, on the line 2 2 of Fig. 1. Fig. 3 is an end view of the apparatus, showing a mode of connecting the wires; and Fig. 4 is a diagram illustrating the arrangement on circuit.

In this instance the instrument is shown as consisting of a base-plate or handle, A, made of iron or steel. An ordinary electro-magnet, B, wound with a low resistance and adapted to a local battery of, say, three cells, is secured to one end of this handle. A supplementary electro-magnet, C, with a resistance of one hundred Ohms, more or less, according to the length of the line that is used, having a tubular core radially slotted for the greater portion of its length, of about three-eighths of an inch in length, is mounted upon the magnet B, substantially in the same axial plane, but separate from it and kept from contact therewith by a plate or washer, *c*, of some non-magnetic substance, such as thin paper, for instance, the two magnets being bound together by a non-magnetic metal screw, such as brass, for instance.

Under this construction the supplementary magnet C, which has no electrical connection with any other part of the apparatus, is acted upon inductively by the magnet B, as hereinafter more fully explained.

A stiff spring-plate, D, of iron or steel, is secured by one end to the handle A, its other end being perforated so as to form an eye, through which the magnet B passes.

A cup or casing, E, of hard rubber or other suitable material, is mounted upon the loop or eye of the spring-plate D, being secured thereto by means of a ring, F, provided with internal spurs *f*, through which iron or steel screws *b* pass into the spring-plate D, thus securing magnetic connection between the plate D and ring F

A thin sheet-metal diaphragm, G, preferably made of iron, and nickel-plated to prevent corrosion, rests upon the ring F, and is clamped thereon by the mouth-piece E', which screws into the cap E, an annular washer, *g*, of soft paper or other analogous material, being interposed between the diaphragm and mouth-piece or screw-cap, which allows increased freedom of movement to the diaphragm and prevents the introduction of vibrations foreign to those produced by the voice.

By this mode of construction it will be observed that the two poles of the magnet are brought in close proximity to each other. The construction is such that the spring of the plate tends to hold the end of the supplementary magnet C in contact with the diaphragm G. To adjust it at the proper distance for the perfect transmission and reception of articulate sounds, I interpose an adjusting-screw, H, between the frame A and the spring-plate D, and, as the diaphragm is secured to the spring-plate, while the magnet is secured to the handle, it is obvious that the turning of the screw in one direction will tend to force the diaphragm and magnet apart, while its turning in the other will cause them to approximate, thus affording the nicest adjustment required.

The arrangement upon circuit is shown in Fig. 4, which represents two instruments, such as that above described, adapted for the reception and transmission of messages either way upon the line.

It will be observed that the line starts from the ground, passes through one supplementary magnet, C, then to the other magnet, and thence to the

ground, without any battery, while each magnet B has its own independent local circuit and battery.

In the drawings, 1 and 4 represent the local wires, and 2 and 3 the line-wires.

The operation of the apparatus is as follows: The batteries keep the magnets B always charged, and these charge the supplementary magnets C, inductively, while the line normally remains quiescent. When either diaphragm is thrown into vibration corresponding magneto-currents are induced upon the line in a well-known way.

Experience has demonstrated that a telephone constructed as above described possesses great practical advantages over any heretofore known to me—first, in eliminating sounds foreign to the articulate sounds being transmitted; and, secondly, in its capacity for taking up and reproducing the finer shades of vibrations, which are important elements in determining quality. It copies accurately all the overtones, without introducing any foreign ones, thus preserving accurately all the peculiar characteristics of the particular voice of the person who is speaking.

These advantages are due, first, to the introduction of the supplementary magnet; secondly, its peculiar construction and connection with the magnet B, whereby it is rendered responsive in the highest degree to the inductive effects of any movements in the diaphragm; and, thirdly, to the employment of the ring F, which contributes to the mass of the inductor without in any way trammeling its motion by its weight.

I do not broadly claim herein the combination, in an acoustic telegraph, of an electro-magnet with a polarized armature formed of a plate of iron, steel, or other material capable of inductive action, and a resonant tube or case. Neither do I broadly claim herein the combination, in an acoustic telegraph, of an armature-plate polarized by induction, a resonant case or tube, and an electro-magnet and circuit-connections whereby reversed currents are caused to act on the electro-magnet with varying intensity proportionate with an electric wave sent from the transmitting-station, as such subject-matter is shown in an application for Letters Patent filed by me January 17, 1878, of which this is a division.

I claim as of my own invention—

1. The combination, substantially as hereinbefore set forth, in a speaking-telephone, of a primary magnet, a supplementary magnet mounted thereon, and intermediate connections which isolate them both magnetically and electrically, so that the supplementary magnet is charged by induction only, and not by contact.

2. The combination, substantially as hereinbefore set forth, in a speaking-telephone, of an electro-magnet, a diaphragm, and an isolated supplementary magnet interposed between the primary magnet and the diaphragm.

3. The combination, substantially as hereinbefore set forth, of a handle with a magnet mounted thereon, a plate united to the handle and encircling the magnet without contact therewith, and a diaphragm mounted upon the encircling-plate, whereby the two poles of the magnet are brought near together.

4. The combination, substantially as hereinbefore set forth, of the handle, the magnet mounted thereon, the encircling-plate carrying the diaphragm, and the adjusting-screw interposed between the handle and plate to adjust the diaphragm relatively to the magnet.

5. The combination, substantially as hereinbefore set forth, of the plate, the box or casing mounted thereon, the ring supporting the diaphragm, and the screws connecting the ring and supporting-plate.

6. The combination, substantially as hereinbefore set forth, in a speaking-telephone, of a diaphragm with a soft-iron ring upon which it rests, whereby a greater inductive capacity is given to the diaphragm by increasing the mass of metal without encumbering its motions with additional weight.

7. The speaking-telephone hereinbefore described, consisting of the combination of a handle, a primary and a supplementary magnet mounted thereon, a diaphragm mounted independently of the magnets on a supporting-plate, and an adjusting-screw for regulating the relation of the diaphragm to the magnet.

8. In a speaking-telephone, the arrangement on circuit, substantially as hereinbefore set forth, consisting of the combination of a local battery at each end, charging a magnet, supplementary magnets isolated magnetically and electrically from the primary magnets so as to act by induction only, an earth-connection with each supplementary magnet, and a line-wire connecting the supplementary magnets, whereby the line remains quiescent until thrown into action by the vibrations of the inductor.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:

WM. D. BALDWIN,

JOHN F. PARET.