No. 843,296. PATENTED FEB. 5, 1907.

A. L. PARCELLE.

TELEPHONE RELAY OR REPEATER.

APPLICATION FILED OCT. 12, 1900.

FIG. 1.

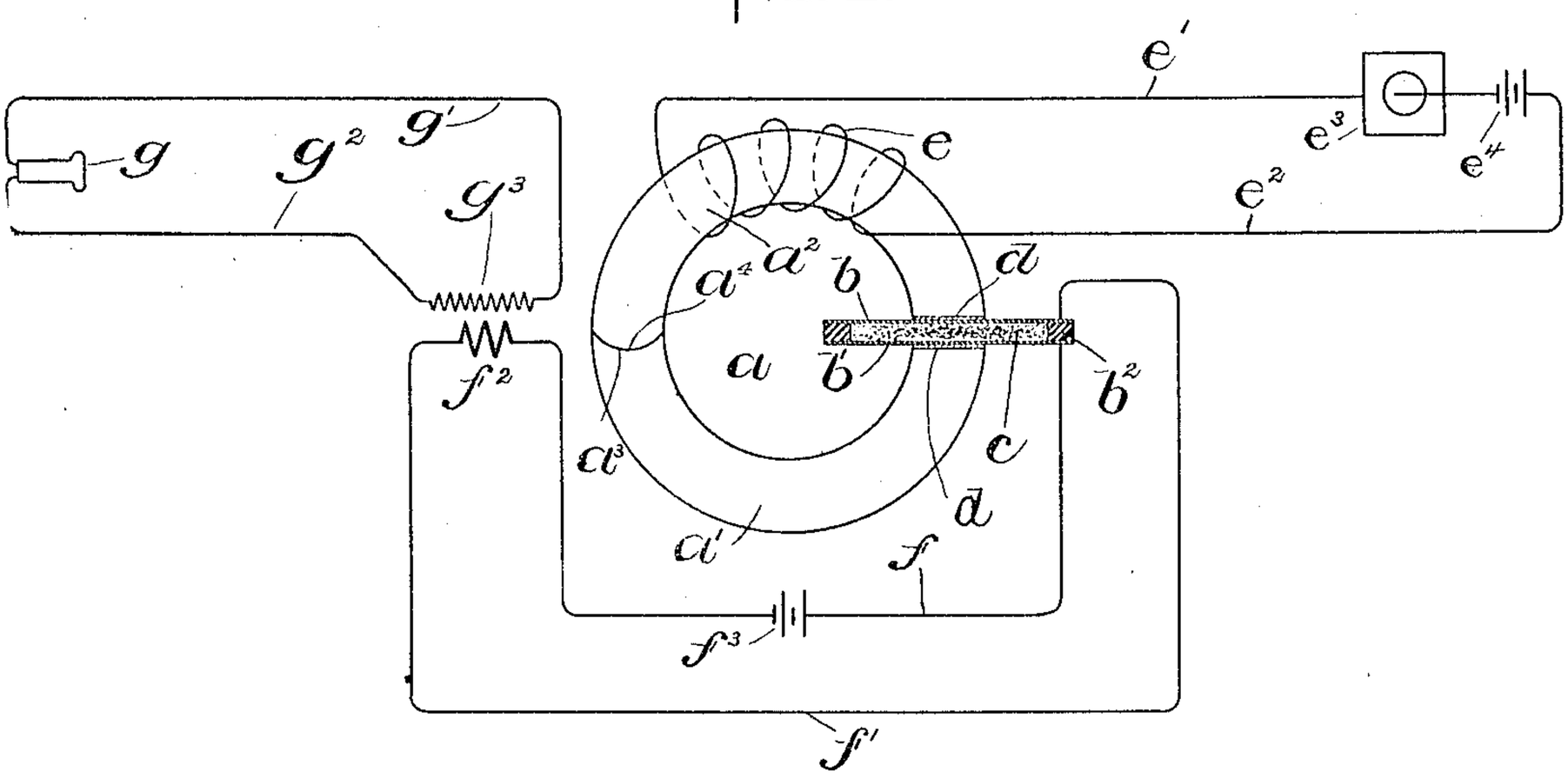


FIG. 2.

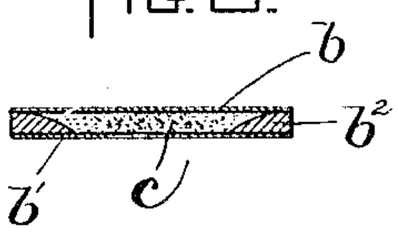
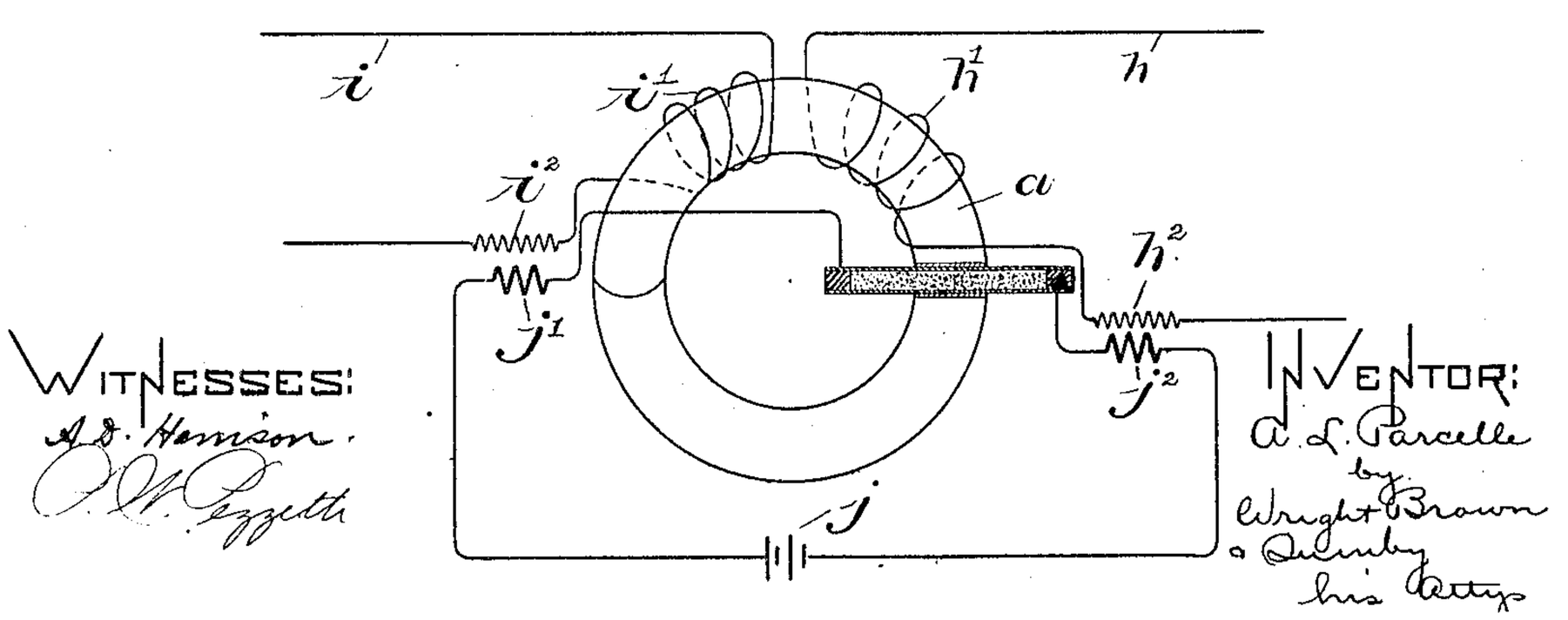


FIG. 3.



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UNITED STATES PATENT OFFICE.

ALBERT L. PARCELLE, OF BOSTON, MASSACHUSETTS.

TELEPHONE RELAY OR REPEATER.

No. 843,296. Specification of Letters Patent. Patented Feb. 5, 1907.

Application filed October 12, 1900. Serial No. 32,871.

To all whom it may concern:

Be it known that I, ALBERT L. PARCELLE, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Telephone Relays or Repeaters, of which the following is a specification.

This invention, which relates to apparatus for transmitting electrical impulses, has for its object the production of a practical telephone relay or repeater by means of which the most minute electrical undulations or waves set in motion by corresponding sound-waves impinging upon the transmitter in one circuit may be duplicated in another circuit without loss.

In carrying out the invention I place in the receiver or intermediate circuit a conductor of variable conductivity, such as granular carbon, and arrange it in the field of a magnet controlled by the transmitter-circuit, so that the current of electricity in the receiver-circuit will take the path of the magnetic lines of force, whereby the variation of conductivity of the variable conductor will be in exact accordance with the variation in the strength of the magnet due to the electrical undulations or impulses in the transmitter-circuit. I likewise secure a microphonic effect by confining the granular material and arranging the magnet in such relation thereto that a compression or expansion of the material takes place, according to the electrical impulses or undulations in the coil which surrounds a part of the magnet.

On the accompanying drawings I have diagrammatically illustrated and in the following specification have described a telephone relay or repeater embodying my invention; but it will be borne in mind that various changes may be made in said relay without departing from the spirit and scope of the invention, that the phraseology which I employ is for the purpose of description and not of limitation, and that I reserve the right to employ all known electrical and mechanical equivalents for the various parts or features of my invention where substantially the same results are accomplished by their employment.

Referring to the said drawings, Figure 1 represents diagrammatically a relay embodying my invention. Fig. 2 represents a form of holder for the granular material. Fig. 3 represents another embodiment of the invention.

On the drawings, a indicates a two-part circular or ring-like magnet, the sections of which are indicated, respectively, at a' a^2 and each of which in the illustrated embodiment of the invention is semicircular in shape. The two sections a' a^2 have abutting ends a^3 a^4, one of which is concave, while the other is convex, whereby one section of the magnet may be oscillated relatively to the other section without disturbing the magnetic reluctance at the ends a^3 a^4, the sockets serving substantially as a pivot for the end a^4. Between the free ends of the sections a' a^2 there is a small gap in which are placed two thin resilient electrically-conducting disks or diaphragms b b', separated by a ring b^2, of material of no or relatively low electrical conductivity. Within the ring is placed a mass of granular material c, whose electrical conductivity is increased by pressure on its surface—such, for instance, as granular carbon.

The section a' of the magnet is formed of steel and is permanently magnetic, being subsequently referred to as the "permanent" magnet, while the section a^2 is of soft iron, (being hereinafter referred to as the "electromagnet,)" and its free end rests upon the disk or diaphragm b, there being interposed between them, however, a thin sheet d of mica. A similar sheet is placed between the disk b' and the end of the section a' of the magnet. On the soft-iron section of the magnet is placed a coil e, which forms a part of the transmitter-circuit, the latter including the lines e' e^2, the transmitter e^3, and the source of electrical energy e^4. The disks or diaphragms b b' and the mass of granular material c are included in an intermediate electrical circuit comprising the lines f f', the primary coil f^2, and the source of electrical energy f^3. The receiving-circuit includes the receiver g, the lines g' g^2, and the secondary coil g^3, the latter being placed in inductive relation to the primary coil f^2.

The magnet a is small, as is consistent with the size of the coil e, and it is arranged upright, as shown in Fig. 1. The magnetic lines of force between the poles of the magnet sections or parts a' a^2 traverse the granular

material between the disks *b b'*, and as the electrical impulses or undulations pass through the coil *e* (due to sound-waves impinging upon the diaphragm of the transmitter) they affect the magnet-section a^2 and strengthen or weaken, as the case may be, said magnetic lines of force, according to the polarity of the circuit, causing what I term "magnetic impulses" similar in form to the electrical impulses. The variations in strength of the magnet or the magnetic impulses affect a like change in the conductivity of the mass of granular material *c*, and electrical impulses or undulations take place in the intermediate circuit *f f'* similar to those in the transmitter-circuit, causing like impulses or undulations in the receiver-circuit.

Inasmuch as the free end of the magnet-section a^2 rests upon the disk *b*, the passage of electrical undulations or waves through the coil *e* in one direction causes the said section to be magnetized and to approach the permanent magnet, whereby the granular carbon is compressed between the end thereof and the adjacent pole of the magnet-section *a'*, with the consequent increase in conductivity of the said material and the passage of similar waves or undulations in the intermediate circuit. If the electrical waves or impulses traverse the coil in the other direction, the free end of the magnetic section a^2 will be oppositely polarized and move away from the pole of the section *a'*, thereby permitting the disks *b b'* to spring apart by their inherent resiliency, whereby the resistance of the granular material is increased.

From this description it will be seen that the intensity of the intermediate circuit (which includes the battery f^3) is regulated or varied by the impulses, undulations, or waves coming over the transmitter-circuit and that by reason of the primary and secondary coils f^2 g^3 electrical waves or impulses similar to those in the intermediate circuit are set up in the receiver-circuit.

It is evident that since the path of the current in the intermediate circuit is the same as the path for the magnetic lines of force through the air-gap between the poles of the magnet the conductivity of the granular material is effected both by the variation in the density of the said material and by the magnetic impulses, (or the variation in the magnetic force of the magnet.) The granular material may or may not be magnetic; but in any case its variation in conductivity is greatly accentuated or increased by the magnetic impulses.

It is also evident that the parts which I have described may be formed and arranged in a number of ways. For instance, in Fig. 2 the ring within which the granular material is confined (which ring, it will be remembered, is placed between the disks *b b'*) is formed of compressed carbon or plumbago or other material of low electrical conductivity. It has its inner edges beveled or rounded, so that the upper disk or diaphragm rests only upon a narrow ledge at its outer edge, and hence more surface is brought into contact between the disk and ring as the disk is pressed down farther and farther.

In Fig. 3 I have shown a relay in which a transmitter and receiver are placed in the two main circuits. In this instance each of the main circuits (indicated as a whole by *h* or *i*) has a coil *h'* or *i'*, placed on the magnet-section a^2. The intermediate circuit (indicated as a whole by *j*) has two primary induction-coils *j' j²* placed in inductive relation to the secondary coils h^2 i^2 of the main circuits *h* and *i*. The electrical impulses in each one of the circuits will be reproduced in the other circuit through the medium of the intermediate circuit *j*.

Although in describing the circuit which includes the conductor of variable conductivity I have termed it for the sake of clearness the "intermediate circuit," yet unless otherwise specified I employ the term "receiver-circuit" in the claims to mean that circuit to which it is desired to transmit the electrical impulses.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. A relay or repeater comprising a receiver-circuit having a confined mass of granular material of variable conductivity, a two-part magnet one section of which is permanent and the other of which is electrically magnetized, said sections having their poles oppositely disposed and movable one toward the other, said granular material being placed between said poles and being compressible thereby, and a transmitter-circuit connected with said electrically-magnetized section of said magnet.

2. A relay or repeater comprising a receiver-circuit having a confined mass of granular material of variable conductivity, a ring-like magnet formed in two sections with their poles separated to receive the mass of granular material between them, one of said sections being permanently magnetic, and a transmitter-circuit having a coil about the other of said sections.

3. A relay or repeater having a transmitter-circuit, a two-part ring-like magnet, one section of which is permanently magnetic and the other of which is soft iron, a transmitter-circuit having a coil about said soft-iron section, a diaphragm in operative rela-

tion to a pole of the soft-iron-magnet section, a confined mass of granular material of variable conductivity placed between the diaphragm and the pole of the permanent-magnet section, and a receiver-circuit connected to the diaphragm and to the mass of granular material.

In testimony whereof I have affixed my signature in presence of two witnesses.

ALBERT L. PARCELLE.

Witnesses:
MARCUS B. MAY,
C. C. STECHER.