(No Model.)

C. A. RANDALL.

Telephonic Transmitter.

No. 238,434. Patented March 1, 1881.

Fig: 1.

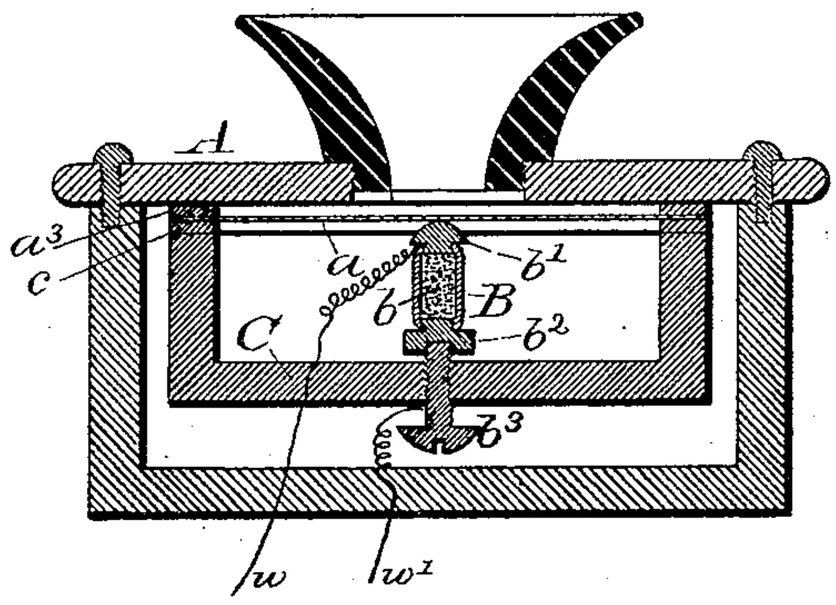

Fig: 2.

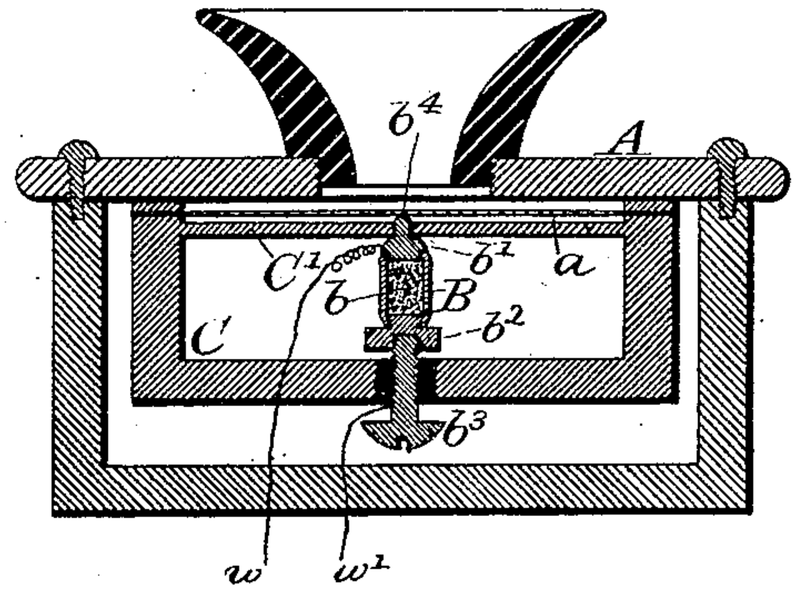

Fig: 3.

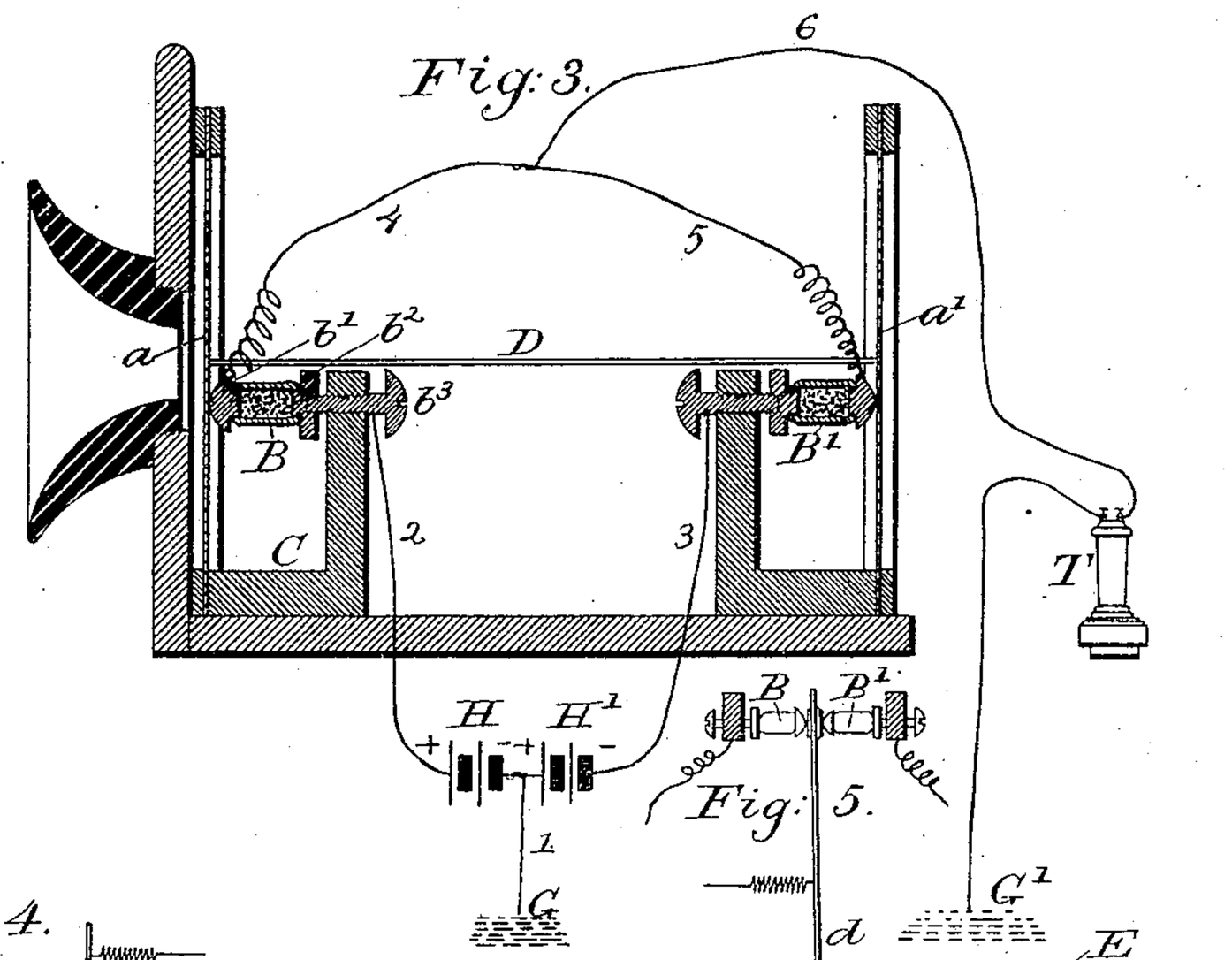

Fig: 4.

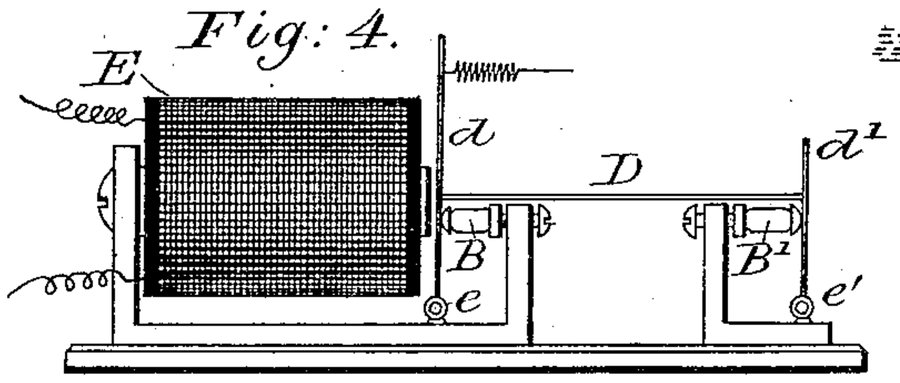

Fig: 5.

Witnesses;

Chas. Co. Terry

Miss F. Lockwood French,

Inventor,

Charles A. Randall,

by his Attorney,

Frank L. Popp.

UNITED STATES PATENT OFFICE.

CHARLES A. RANDALL, OF NEW YORK, N. Y.

TELEPHONIC TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 238,434, dated March 1, 1881.

Application filed November 23, 1880. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. RANDALL, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Telephonic Transmitters, of which the following is a specification.

The object of my invention is to provide an instrument for transforming sound vibrations into corresponding vibrations or undulations in the strength of an electric current, and for increasing the normal power or amplitude of these electrical vibrations or repeating them into another electric circuit. I attain these results by a novel method of constructing a resistance so as to vary in accordance with the vibrations of a diaphragm acted upon by acoustic vibrations, or with the variations of an armature or lever actuated by an electro-magnet.

In the telephonic transmitters heretofore in use, so far as I am aware, specially prepared carbon compressed into comparatively solid blocks or buttons has been used under varying pressure to produce the variation in an electric circuit. Blocks of specially prepared carbon or ordinary gas carbon have also been used, one or more such pieces being supported upon a spring or springs and in contact with each other or with platinum or other electric conductor, all of which, for telephonic purposes, are subject to certain disadvantages either in the limit of the variation of the current or in the imperfect and intermittent contact, the same being interrupted by rapid vibrations and also when the vibrations are increased in amplitude. This invention avoids these defects and enables me to produce a more effective transmitter than those hitherto employed.

In the accompanying drawings, Figure 1 is a vertical transverse section of a telephonic transmitter embodying my improvements. Fig. 2 is a modification of the same. Fig. 3 is a diagram showing the manner of applying my apparatus to the transmissions of undulations of alternate polarity; and Figs. 4 and 5 show different methods of repeating or relaying from one circuit to another by means of my invention.

Referring to Fig. 1, A represents the frame for holding the diaphragm and mouth-piece, both of which are similar in form and construction to corresponding parts of the ordinary telephone. Against the raised outer circle or rim, a^3, a thin plate, disk, or diaphragm, a, is clamped by a second ring, c, or by any other convenient arrangement suitable for the purpose. This plate, disk, or diaphragm is capable of responding to sonorous vibrations traversing the atmosphere, being rigidly supported by its edges while its central portion is left free to vibrate. The diaphragm may be made of any suitable material, such as thin sheet metal, membrane, glass, or, what I consider preferable to any of these, paper coated with silicate of soda.

Against the center of the diaphragm rests, with a given normal pressure, a metal button, b', which is secured at one end of a short tube or chamber, B, of rubber, felt, or other suitable non-conducting elastic or yielding material. To the opposite end of this elastic tube is secured a metallic plate or cap, b^2, having a socket into which fits the end of an adjusting screw, b^3, or the end of the tube may be secured directly to the screw b^3. This screw passes through a nut in the arm C, and is used to regulate the normal pressure of the tube B against the diaphragm, the arm C being rigidly fastened to the frame of the diaphragm.

The tube or chamber B is filled with a mass of some finely-pulverized substance or mixture, b, whose electrical resistance is capable of varying according to the pressure exerted upon it. For example, I make use of pulverized carbon, or carbon and copper, or carbon and silver, &c. Preferably I make use of a mixture of about equal quantities of carbon and silver, as I have obtained therefrom the best results in practice.

If a diaphragm of non-conducting material is used, it will be necessary to make the electric connection directly with the button b'; if otherwise, it may be made either directly to the button or through the diaphragm. The other connection, in either case, will be made with the screw b^3.

Fig. 2 shows another construction of the hereinbefore-described apparatus, in which C′ represents a rigid plate, against which the end plate, b^2, of the variable resistance b rests by means of a shoulder, while a projection, b^4, extends through an aperture in the plate C′ so as to touch the diaphragm a. By this means

the normal compression of the material in the tube B, which is required to produce the best results, may be produced by means of the screw b^3 without exerting any undue pressure upon the diaphragm, or interfering in the least with the freedom of its vibration.

When the plate C′ is of metal, the electrical connection with b' may be made through it by insulating it from the adjusting-screw b^3 in any suitable manner.

The operation of the transmitter is as follows: When placed in connection with a battery, a current of electricity passes continuously through the button to the variable resistance B, the adjusting-screw b^3, and then to the other pole of the battery. The strength of this current will be varied according to the variations in the resistance in b, due to the variations in the pressure exerted by the diaphragm a, these variations being caused by vibrations of the said diaphragm in response to sound waves or vibrations traversing the atmosphere.

These electrical vibrations or undulations may be reconverted into acoustic vibrations at any point in the circuit by means of an ordinary telephonic receiver of any suitable or well-known character.

Fig. 3 represents my invention, as applied in connection with a system of circuits similar to the so-called "Wheatstone bridge." In this arrangement two transmitters, similar to the one described in connection with Fig. 1, are secured to each other in the manner and position illustrated in the figure. The diaphragm a is also connected with the secondary diaphragm a' by a connecting-rod, D, secured to corresponding points on each diaphragm, in such a manner that the vibrations of a will be transmitted to and reproduced by a'. These diaphragms are preferably of the form and material already described. Thus a vibration of diaphragm a, causing decreased resistance in B, will be transferred, by the rod D, to a', causing increased resistance in B′, and vice versa.

Assuming now that the battery connections are made as indicated in Fig. 3, the transmitter being at rest, the resistance of B and B′ will be equal, and the effect of the divided currents will be to neutralize or balance each other, producing no effect upon the receiving instrument T.

If, now, the diaphragm a be made to vibrate, the respective resistances of B and B′ will vary accordingly, but inversely to each other, so that alternate positive and negative currents will pass over the line 6, in correspondence with the vibrations of a. This alternating current may be made to act upon an ordinary telephone-receiver, as indicated in the drawings, or in place of the telephone may be inserted an instrument similar to the one described in connection with Figs. 4 and 5, and used as a repeater or relay.

Fig. 4 shows an application of the invention to an electro-magnet, in connection with which it may be used as a relay, a repeater, or by introducing it into a local circuit, as a transmitter.

E represents an electro-magnet, and d and d' levers or armatures pivoted at e and e', and connected together by a rod, D, similar to the method employed in Fig. 3, or the same device that is shown in Fig. 3 may be employed. A greater effect can be produced by this arrangement, both as regards the power and extent of changes in the electric current, since a vibration of greater amplitude can be had with the lever d than with a diaphragm, thus producing a greater variation in the electrical current.

Fig. 4 represents another combination of the variable resistance and an electro-magnet.

In this instance one connection may be made with the lever, and the corresponding one with the end of the resistance, as indicated in the diagram, the other arrangement remaining essentially as shown and described, in connection with Fig. 3.

I do not claim herein the combination of a diaphragm capable of responding to acoustic vibrations, an elastic compressible tube inclosing a mass of conducting material in a pulverized or finely-divided state, a movable and a fixed adjustable plate inclosing the respective open ends of said tube, and a rigid or unyielding support against which the movable plate bears when the tube is compressed by the adjustment of the fixed plate, whereby the diaphragm is relieved from undue pressure, as I intend to embrace it in a subsequent application.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of a diaphragm capable of responding to sonorous vibrations, two variable resistances or rheostats synchronously acted upon by the variations of said diaphragm, so that the resistance of one rheostat increases as that of the other decreases, and vice versa, an electric circuit divided into two parallel branches, in each of which one of said resistances or rheostats is placed, and two batteries having equal strength but opposite polarities, one in each of said branches.

2. The combination, substantially as hereinbefore set forth, of an electro-magnet, a movable or vibrating diaphragm or armature, two variable resistances or rheostats synchronously acted upon by the vibrations of said armature, so that the resistance of one rheostat increases as that of the other decreases, and vice versa, and an electric circuit divided into two parallel branches, in each of which one of said resistances or rheostats is placed.

In testimony whereof I have hereunto subscribed my name this 15th day of November, A. D. 1880.

CHARLES A. RANDALL.

Witnesses:
WM. C. WITTER,
MILLER C. EARL.