(No Model.) 2 Sheets—Sheet 1.

V. M. BERTHOLD.

TELEPHONE.

No. 375,862. Patented Jan. 3, 1888.

Fig. 1

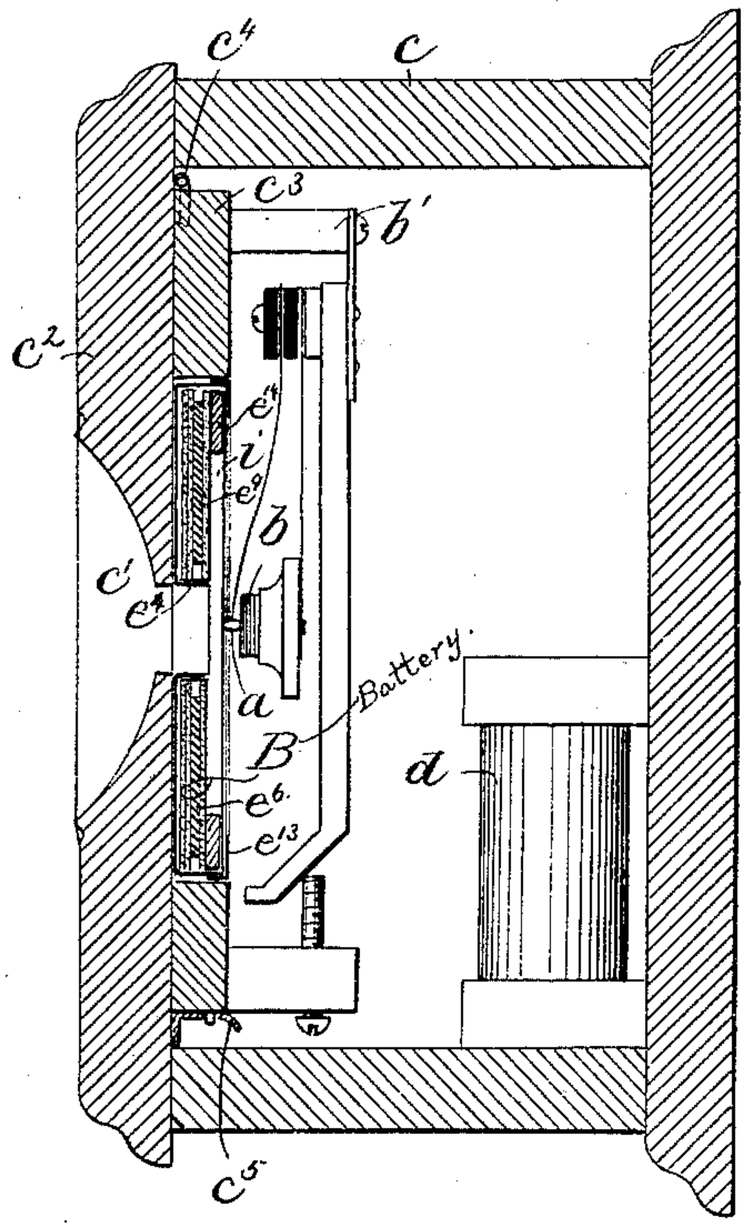


Fig. 2.

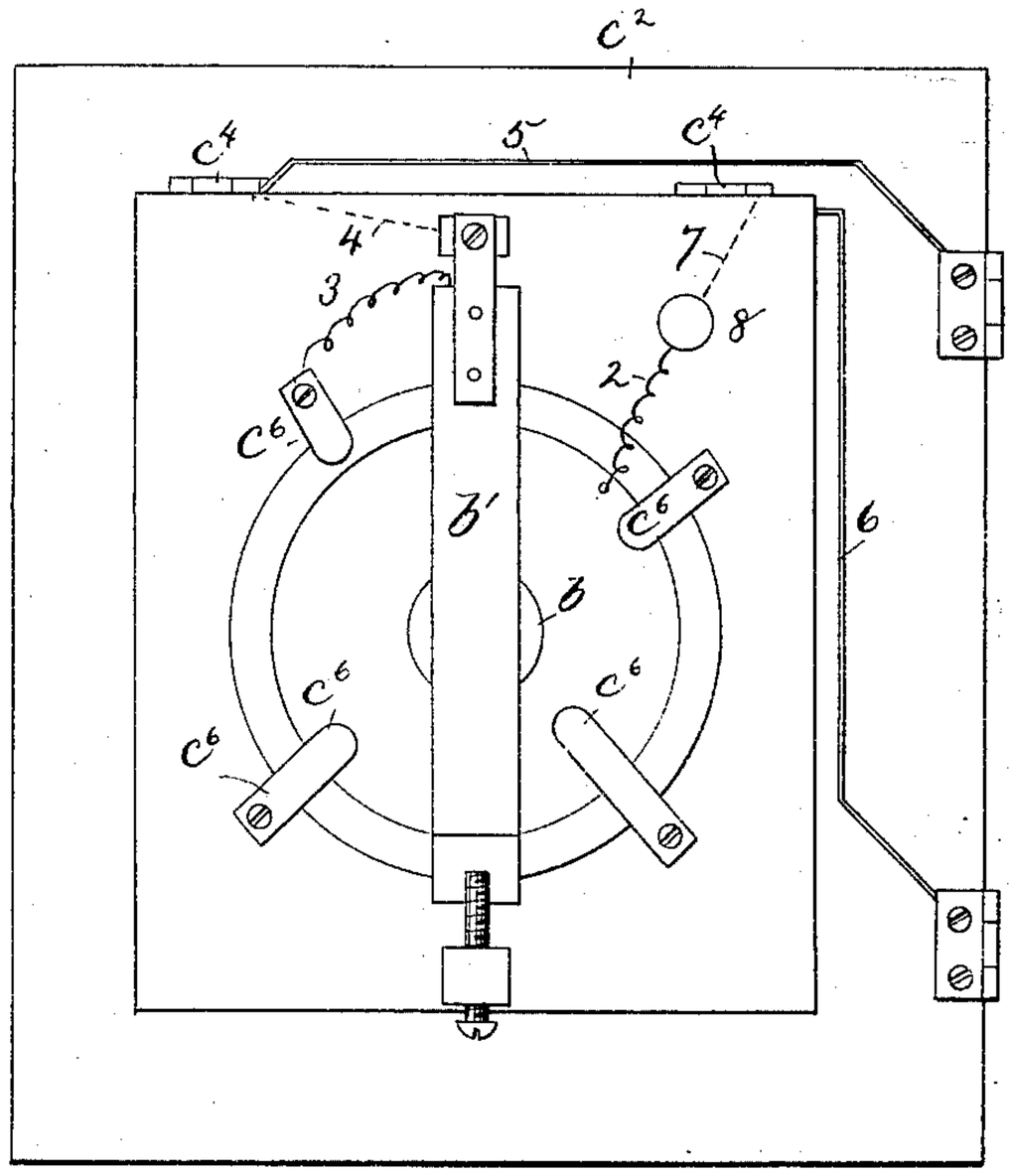


Fig. 3.

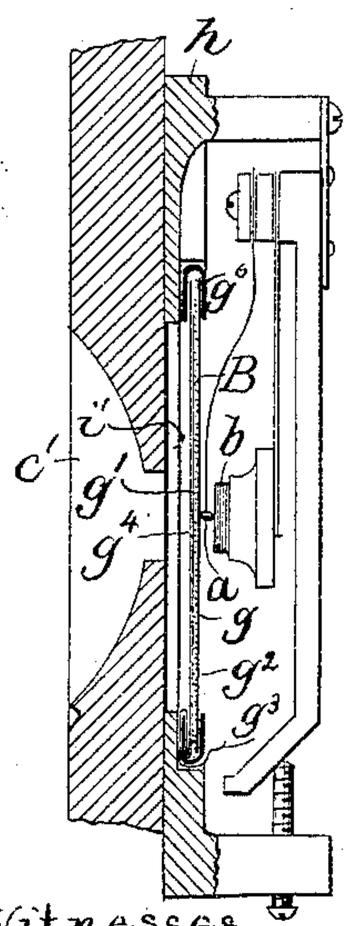
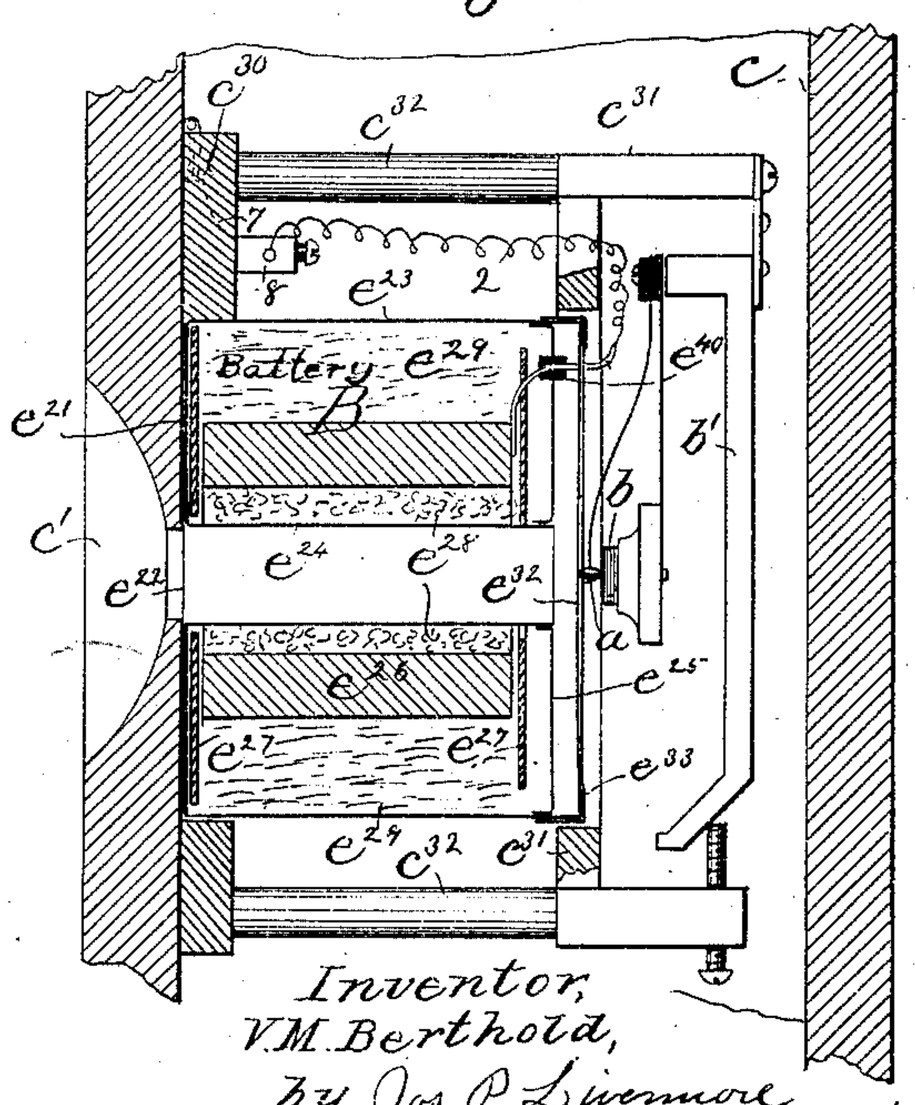


Fig. 4.



Witnesses,
Jas. J. Maloney.
E. L. Healey.

Inventor,
V. M. Berthold,
by Jos. P. Livermore Atty.

(No Model.) 2 Sheets—Sheet 2.

V. M. BERTHOLD.

TELEPHONE.

No. 375,862. Patented Jan. 3, 1888.

Fig. 5.

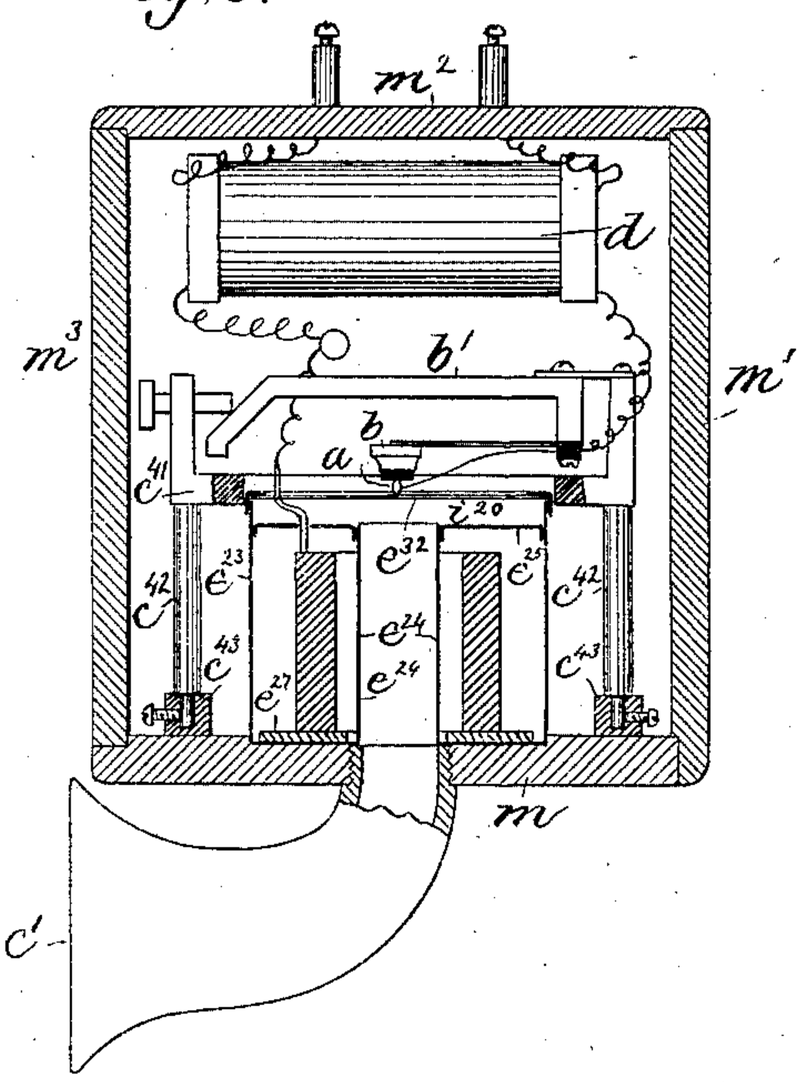


Fig. 6.

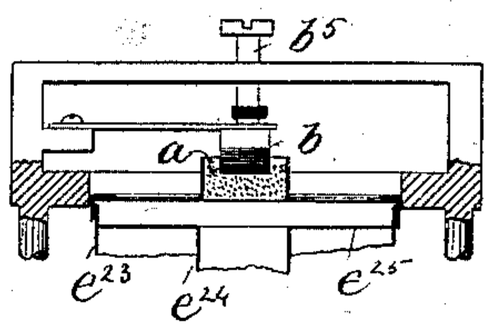


Fig. 7.

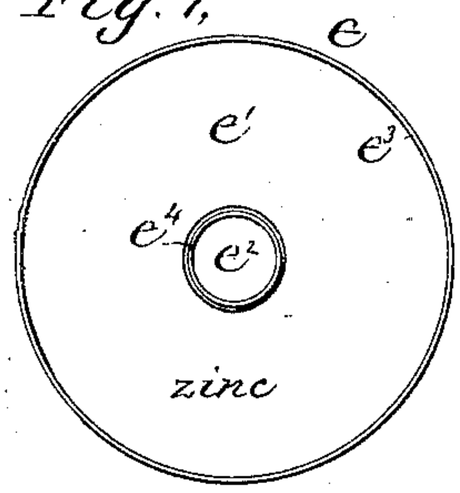


Fig. 8.

Fig. 9.

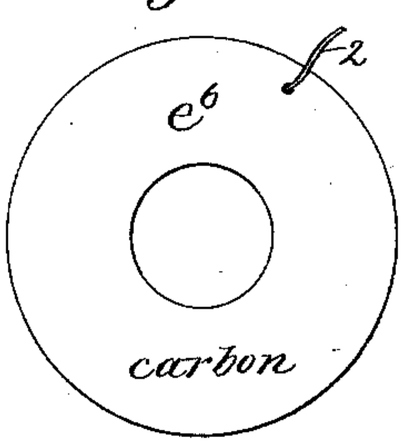


Fig. 10.

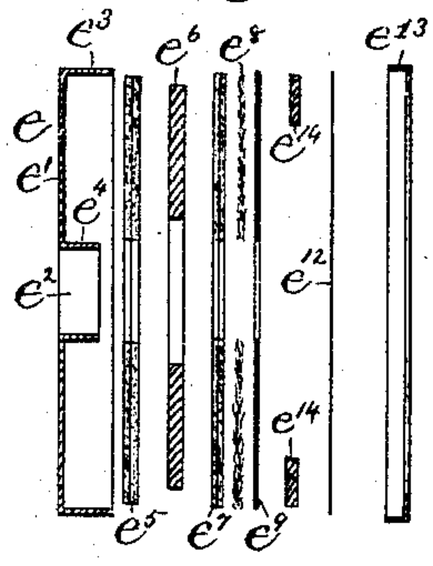


Fig. 11

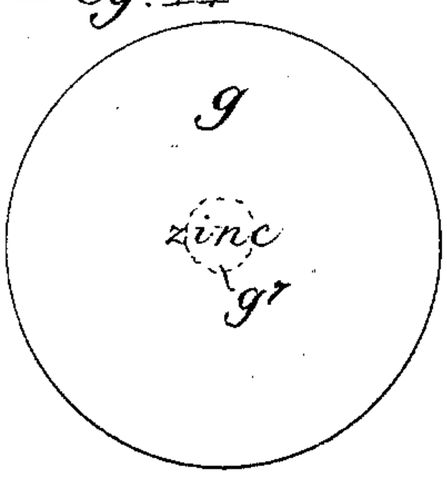


Fig. 12.

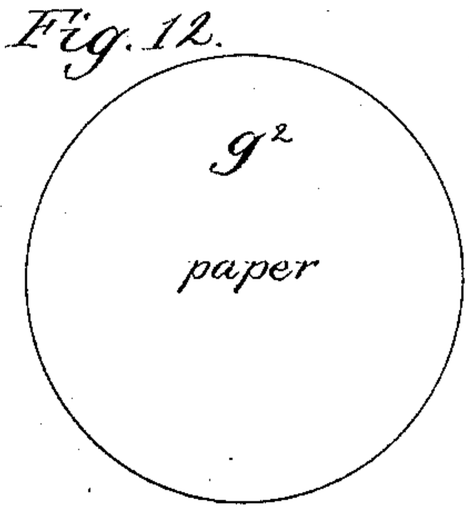


Fig. 13.

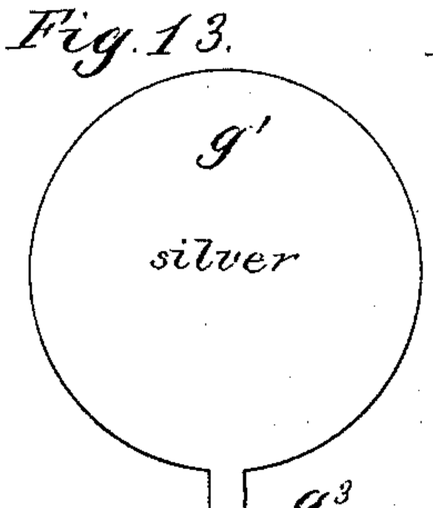


Fig. 14.

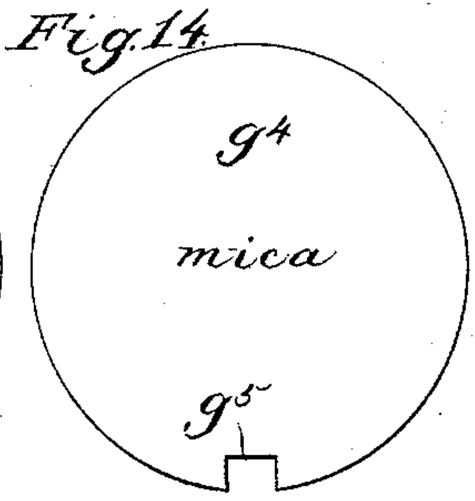
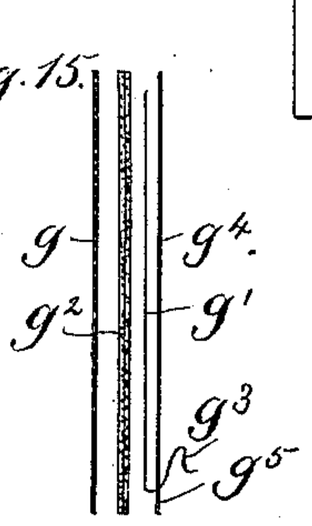


Fig. 15.



Witnesses,
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A. L. Healy.

Inventor,
V. M. Berthold
by Jos. P. Livermore
Att'y.

UNITED STATES PATENT OFFICE.

V. MAXIMILIAN BERTHOLD, OF CAMBRIDGE, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 375,862, dated January 3, 1888.

Application filed April 2, 1887. Serial No. 233,380. (No model.)

To all whom it may concern:

Be it known that I, V. MAXIMILIAN BERTHOLD, of Cambridge, county of Middlesex, State of Massachusetts, have invented an Improvement in Telephones, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to telephones of the class commonly known as "transmitters" or "battery-telephones," in which the electric impulses are produced by varying the resistance of a battery-current in accordance with the sound-waves that commonly act on a diaphragm or vibrator, which in turn acts on electrodes in the battery-circuit to vary the resistance in said circuit at the contact-point of said electrodes.

The present invention refers especially to the construction of the battery and its arrangement with relation to the other elements of the apparatus, some of the objects of the invention being to produce a more compact and portable instrument than those heretofore made and to reduce the cost of the apparatus and facilitate the exchange of batteries or the replacing of an exhausted battery by a fresh one.

A small portable battery-telephone or transmitter such as produced by this invention is of great value for out-of-door work or for a field-telephone—for instance, for military purposes, or where the telephone has to be carried about from place to place. Attempts have been made to use the hand magneto-telephone for such purposes, but the results are unsatisfactory, and a battery-telephone capable of producing a considerable current is much desired for such uses.

The instrument forming the subject of this invention is also of great value for private installations—as, for example, for communication in large hotels or other large buildings and on vessels. The battery is so constructed and arranged as to render it difficult for a subscriber of a telephone exchange to tamper with or injure it.

The invention may be embodied in a telephone having the general construction of the well-known Blake transmitter, so far as relates to the microphone contact or electrodes that vary the resistance of the battery-current, or any other suitable microphone may be used; but, instead of using a separate battery outside the case that contains the microphone-contact and induction coil, the said battery is, in accordance with this invention, introduced into the said case and made constructively a part of the telephone itself, the said battery or a portion thereof forming a portion of the sound-chamber, and in some cases constituting the vibrator that acts on the electrodes or microphone-contact.

My invention is, however, not limited to any one special type of battery, and I have shown several kinds—as, for example, a dry, a moist, and a liquid battery, each of which will operate effectively, and each of which has some special advantage for some of the purposes to which the telephone may be put.

The invention consists partly in a telephone having a galvanic battery located between the mouth-piece or sound-opening and the microphone-contact and partly in various details of construction of the battery and of the box or case in which it is used, in combination with the microphone-contact, by which ready access may be had to the battery without disturbing the adjustment of the microphone, and a battery may be readily removed and replaced by a new one when required.

Figure 1 is a sectional view of a battery-telephone or microphone-transmitter embodying this invention and containing a moist battery; Fig. 2, an elevation of the parts connected with the door or front of the telephone box or case as seen when looking toward the inside of the box-door; Fig. 3, a sectional detail showing the main parts of a telephone embodying this invention having a dry battery; Fig. 4, a sectional view of a telephone embodying this invention having a liquid battery; Figs. 5 and 6, sectional views showing a modified arrangement which may be desirable with a liquid battery; and Figs. 7 to 15, inclusive, details showing the construction of the different kinds of batteries.

The telephone comprises the usual electrodes or microphone-contact, *a b*, which may be of the same construction as in the well-known Blake transmitter, or may be of any other suitable or usual construction—as, for exam-

ple, the one shown in Fig. 6, in which the electrode *a* is composed of a mass of finely-divided conducting material—for instance, powdered carbon. The said electrodes are preferably contained in a box or case, *c*, (shown in Fig. 1,) substantially of the same construction as commonly employed for the Blake transmitter, said box having a mouth-piece or sound-opening, *c'*, and containing an induction-coil, *d*, the primary coil of which is connected with the electrodes *a b*, while the secondary coil is connected with the line over which the communication is to be transmitted.

Instead of having the battery B, the current of which is controlled by the resistance at the electrodes *a b* in a separate case, and having no constructive relation with the mouth-piece and microphone-contact, as has been heretofore usually practiced, the said battery is in accordance with this invention constructed to be contained within the transmitter box or case *c* and to enter into constructive relation with the other parts of the telephone, being, as herein shown, interposed between the mouth-piece *c'*, at which the sound-waves enter, and the microphone-contacts *a b*.

Batteries of various construction may be used in carrying out this invention, which batteries form a whole or a part of the sound-chamber and vibrator that is set in operation by the sound-waves, and in turn operates upon the microphone-contact *a b* to vary the resistance to the current of the said battery B.

The form of battery represented in Fig. 1 and in detail in Figs. 7 to 10, inclusive, is well adapted for use in a telephone of this kind, as it gives out no perceptible gases or disagreeable odors, and, in order to guard against any corrosion of the metallic parts of the microphone proper, such parts are coated with shellac or varnish. This battery may be of the same nature as the well-known Niaudét battery, which is fully described in the "Traité Elementaire de la Pile Electrique," by Ch. Niaudét, published in Paris, 1885. This battery comprises a box, *e*, made of zinc, one side of which is composed of a plate, *e'*, (see Fig. 7,) of about the size of the usual microphone-diaphragm, having a central opening, e^2, and having around its outer edge a rim or flange, e^3, and around the edge of the opening e^2 a second flange, e^4, which does not project quite so far from the face of the plate as does the flange e^3. (See Fig. 10.) Within this box are placed several pieces or disks, e^5, (see Fig. 8,) of porous material—such, for example, as blotting-paper or felt—having central openings tightly fitting over the flange or tube e^4 at the middle of the box. The tube or flange e^4 is insulated in any suitable manner, as by wrapping around it paper saturated with paraffine or oil. The porous material, e^5, is saturated in a solution of common salt (chloride of sodium) and placed in contact with the inner face of the disk *e'*. On these disks e^5, of porous material, is placed an annular carbon disk, e^6, Fig. 9, which is pressed tightly against the saturated disks e^5, but is insulated from the zinc flanges e^3 e^4, and upon the other side of the carbon disk is laid another disk, e^7, of porous material, and upon that a mass, e^8, Fig. 10, of mica chips or shavings, which are made into paste by pouring over them a solution of calcium chloride, which is quickly absorbed. On this layer of mica shavings is placed an annular disk, e^9, of oiled silk, which prevents access of air to the various disks in the box. These various disks are shown separate from one another in Fig. 10, in proper relation to one another to enter the box *c*, and when all are pressed into the box the surface of the disk e^9, of oiled silk, is about flush with the edge of the flange e^4, as shown in Fig. 1, and the battery proper is then complete, the box itself constituting one element of the battery and the carbon disk e^6 constituting the other element, and having connected with it in any suitable manner a wire or conductor, 2, which passes out through the oiled silk without making electrical contact with the zinc box. A diaphragm or plate, e^{12}, of any suitable material—such, for example, as mica—of the same diameter as the plate *e'*, but having no central opening, is then fastened in any suitable manner on the edge of the flange e^3, that forms the cylindrical side of the box, and is held in place by an annular ring or collar, e^{13}, which is preferably also made of zinc and fitted tightly over the flange e^3. The diaphragm e^{12} is thus supported at a short distance from the disk of oiled silk, so as to form a sound-chamber, *i*, (see Fig. 1,) of about the same dimensions as commonly used in the Blake transmitter. One or more pieces of rubber may be placed between the diaphragm e^{12} and oiled silk, as shown at e^{14}, to insure that the diaphragm shall be properly separated from the oiled-silk disk e^9 to maintain the sound-chamber in proper condition, which sound-chamber communicates through the opening e^2 in the zinc plate and the tube formed by the flange e^4 around said opening with the mouth-piece *c'*, at which the sound-waves enter, the said sound-waves thus passing wholly through the battery and entering between one side of the battery and the diaphragm supported at a short distance therefrom, and the said diaphragm operating upon the electrodes *a b* in substantially the usual manner.

The elements of the battery may be treated in any suitable way to produce greater efficiency—as, for example, by coating the inner surface of the zinc box with a mixture of tallow, paraffine, and mercury, and by treating the carbon with a sugar solution and heating in a smoky flame, and by varnishing the outside of the box, excepting the cover e^{13}.

In order to facilitate the introduction of the battery to its working position, the usual door or cover, c^2, of the telephone-case *c*, which is hinged to open in the usual manner, (see Fig. 2,) is provided at its inside with a plate, c^3, which may be of wood and about the thickness of the battery B, constructed as described, and the said plate c^3 is preferably connected at its

upper end, by hinges c^4, with the door c^2, and provided at its lower end with a suitable fastening, (shown as a spring-catch, c^5,) to retain it fastened down against the inner face of the door c^2. The said plate c^3 has a circular opening of proper size to receive the battery B within it, and by merely unfastening the catch c^5 and turning the plate c^3 up on its hinges the battery may be inserted in or removed from the opening in the said plate from the side opposite the electrodes *a b*, which thus do not need to be disturbed by the act of taking out or putting in a battery.

The plate c^3 may have one or more spring-arms, c^6, (see Fig. 2,) that engage the inner part of the battery and hold it against the inner face of the door c^2 when the plate c^3 is turned down and fastened in its normal position. One or more of said spring-arms may bear against the diaphragm to act as a damper in the usual manner. One of the said spring-arms c^6 makes electric contact with the box which forms the zinc element of the battery, and said spring is connected, by a wire, 3, with the electrode *a* of the microphone-contact, from which the current will pass by conduction to the electrode *b* and metallic frame-work *b'*, that supports it, from which the circuit is continued by a suitable conductor, 4, to one of the hinges c^4 of the plate c^3, and thence by a conductor, 5, to one of the hinges of the door c^2, connected in the usual manner with one terminal of the primary coil of the induction-coil *d*, the other terminal of which is connected with the other hinge of the cover c^2, from which the circuit is continued by wire 6 to the other hinge of the plate c^3, which is connected, by wire 7, with the binding-post 8, which receives the wire 2, that passes to the carbon element e^6 of the battery, and thus completes the circuit of the battery through the microphone-contact and induction-coil by merely placing the battery in position and connecting the wire 2 with the binding-post 8.

A battery of this kind produces a suitable current for telephonic transmission, and will retain its activity for a considerable time, and, being very small, compact, inexpensive, and easily placed in operative connection with the other parts of the telephone, its use greatly facilitates the proper maintenance of the apparatus, as an operator can easily take a large number of such batteries and substitute them for the exhausted batteries.

The entire apparatus can thus be made in a very compact form, well adapted for use in a portable instrument whenever required, because the entire essential parts, including the battery, may be placed in smaller compass than the usual Blake transmitter, without its accompanying battery, which, as commonly used, is considerably larger than the transmitter itself.

For a portable instrument the smaller battery (represented in Fig. 3 and in detail in Figs. 12 to 15) may be found more convenient. This battery may be composed of a disk of zinc, *g*, nearly the size of the usual diaphragm, and a plate of silver, *g'*, separated by one or more sheets, g^2, of porous material—such, for example, as blotting-paper saturated with ammonium chloride or sulphate of zinc and placed in contact with the said zinc disk. The plate or sheet, *g'*, of silver is preferably of a little smaller diameter than the zinc disk. It has a projecting strip or tongue, g^3, at one side, preferably about one inch long. Upon one side of this silver plate is laid a paste of silver chloride, or the chloride may be melted upon the plate. The silver disk thus prepared is then pressed firmly upon the saturated porous material, g^2. (See Fig. 15.) The opposite side of the silver plate is preferably strengthened by a disk, g^4, which may be of mica and of the same size as the zinc plate *g*, and is provided with a notch, g^5, which is placed opposite the tongue g^3 of the silver plate, which is folded down in said notch onto the face of the mica plate. The zinc, silver, and mica plates, with the saturated porous material between them, are then fastened together by a rubber band, g^6, stretched over the edge, as best shown in Fig. 3, and the silver stem g^3 is then folded over the rubber band and constitutes one of the poles of the battery. This battery is then placed in the iron seat *h* (see Fig. 3) used in the Blake transmitter in place of the usual iron diaphragm, so that the mica plate lies at the front opposite the mouth-piece c^2 and the zinc plate opposite the electrode *a*, the said zinc plate being provided with insulating material—such, for example, as a small piece of mica, g^7—to prevent making electrical contact with the said electrode *a*. The silver tongue g^3 thus makes automatic contact with the iron frame, which carries the current to the electrode *b* in the usual manner, from which the circuit is continued to the electrode *a*, connected through one hinge of the box with one terminal of the primary induction-coil, the other terminal of which is connected with the other hinge of the box, from which the circuit is completed by a conductor fastened to the zinc plate *g* of the battery. In this connection between the hinge and zinc plate a binding-post may be used connected with the hinge of the box and adapted to receive the wire soldered to the zinc plate, so that the connection may be readily made when the battery is inserted in its place in the frame. This battery may be inserted or removed in exactly the same manner as the usual diaphragm in the Blake transmitter, and in this construction the entire battery forms one side of the sound-chamber *i'*, which is included between it and the inner face of the box-door c^2, and the entire battery also forms the diaphragm or vibrator that is set in motion by the sound-waves, and acts on the electrodes *a b* to vary the resistance, thereby controlling the current generated within it.

A battery of this construction is of high power in proportion to its size and of considerable permanence in action. It is very light

and durable and may be used for a variety of purposes.

In case it is desirable to use a large liquid battery, giving greater volume of current, I adopt the constructions represented in Figs. 4, 5, and 6.

In the construction represented in Fig. 4, the inclosing case or receptacle of the battery constitutes one element thereof, and is constructed very much like that represented in Fig. 1, having an end plate, e^{21}, with a central opening, e^{22}, and a cylindrical flange or tube, e^{23}, around the outer edge of the said plate, and a tube, e^{24}, around the edge of the said opening, but much longer than the flanges e^3 e^4 of the battery represented in Fig. 1. The tube e^{24} is shorter than the outer cylinder, e^{23}, and the space between the said tube and cylinder is closed by a second disk, e^{25}, which may be soldered upon said tube and cylinder, so as to form a tight annular or cylindrical reservoir of considerable capacity. The said reservoir contains an annular carbon element, e^{26}, which is prevented from coming in contact with the reservoir by disks e^{27}, of insulating material—such, for instance, as paper or oiled silk. The space between the inner surface of the carbon e^{26} and the tube e^{24} is filled with loose asbestus saturated with a solution of chloride of lime, as represented at e^{28}, and the space around the carbon and within the cylinder e^{23} is filled with mica shavings saturated with a solution of common salt, (chloride of sodium,) as indicated at e^{29}. The diaphragm e^{32} is then fastened upon the end of the cylinder e^{23}, being held in place by a ring, e^{33}, that fits over the said cylinder e^{23}.

The battery is held in the transmitter-case between the mouth-piece c' and electrodes a b by a hinged plate, c^{30}, connected with the door c^2 of the box by hinges in substantially the same manner as the plate c^3, described in connection with Fig. 1; but, owing to the greater length of the battery, the diaphragm end is supported in a second frame, c^{31}, which also supports the electrodes a b and their adjusting devices, and is connected with the plate c^{30} by posts c^{32}. The connecting-wire e^{30} from the carbon element e^{26} passes through an insulating-plug, e^{40}, in the cover e^{25} of the battery-receptacle and the connections with the electrodes a b, and the induction-coil may be made as described in connection with Fig. 2.

The battery just described is practically a liquid battery, although the liquid is partially filled with the absorbent material around the carbon cylinder.

In some cases it may be desirable to use a battery of similar construction to that last described, but with the cylinder in a vertical instead of horizontal position. In such cases the construction represented in Figs. 5 and 6 may be adopted, the battery being substantially the same as described in connection with Fig. 4. In this construction the bottom m and rear part, m', of the inclosing-case are fastened together permanently, and the top m^2 and front m^3 of the case are also fastened together permanently, but detachable from the bottom and rear. The sides of the box may be connected either with the stationary part m m' or the removable part m^2 m^3, as may be desired. The battery sets on the bottom m, which is provided with a mouth-piece, c', that curves upward to enter the tube e^{24} of the battery, so that the sound passes through the battery to the sound-chamber i^{20}, formed between the cover e^{25} and diaphragm e^{32} at the upper end of the battery, which is held in the frame c^{41}, that supports the electrodes a b, and is connected with posts c^{42}, that are fastened in sockets c^{43} on the base n of the box, being held in said sockets by suitable clamping devices, (shown as set-screws,) so that said posts may be readily unfastened and the frame with the electrodes lifted off from the base, so that the battery may be removed. In this construction a liquid battery may be used without absorbent material in the liquid, if desired, and, instead of zinc and carbon for the elements, iron and zinc may be used, the box being composed of iron in the same shape as the box or cylindrical receptacle described, and the zinc being in the same shape and location as the carbon. With these elements hydrate of potash and copper oxide may be used in the exciting and depolarizing liquids.

The construction represented in Fig. 6 is substantially like that represented in Fig. 5, but shows the invention embodied in a transmitter having powdered carbon for one of the electrodes, a, the said carbon being contained in a cylindrical receptacle on the diaphragm. An adjusting-screw, b^5, is used to sustain the weight of the electrode b.

I have not attempted to mention or describe particularly all the types of battery or forms of microphone-contact that might be used in carrying out my invention, as it is obvious that a very great variety might be used, many of which will be readily suggested to those familiar with such apparatus; but the forms illustrated and described show practical means for embodying my invention, which consists, generally, in making a battery of small size, so that it can be placed in a transmitter-box without materially enlarging the same, and in locating the battery between the mouth-piece or sound-opening and the microphone-contact, and using as a vibrator or sound-collector a diaphragm connected with and forming, constructively, a part of the battery, and more specifically in providing the battery with a tubular passage, through which the sound-waves pass, and in various devices for holding the battery and making the electrical connections therefrom.

I claim—

1. The combination of the microphone or variable-resistance electrodes of a battery-telephone with a battery located between the said electrodes and the mouth-piece or sound-opening of the instrument, and having connected with it a sound-collecting plate or diaphragm

that actuates the said electrodes, substantially as described.

2. A galvanic battery having a passage through it for sound-waves and a vibrator or sound-collector, combined with electrodes connected with the poles of said battery and operated by said vibrator, substantially as described.

3. A battery for a telephone-transmitter, comprising a case or box constituting one element of the said battery, and a co-operating element inclosed in the said case or box, and a vibrator or diaphragm connected with the said case or box and forming therewith a sound-chamber, substantially as described.

4. A battery for a telephone-transmitter, comprising a plate having a central opening and rims or flanges surrounding said plate and opening, the said parts forming one element of the battery and containing the other element and exciting material for the battery, the said central opening and flange surrounding it constituting a passage for the sound-waves, substantially as described.

5. The combination of a galvanic battery having a vibrator or diaphragm connected with it, and an inclosing-case for said battery and the co-operating electrodes and induction-coil, and a movable plate or frame within said case supporting the said electrodes and holding the battery in proper position with relation thereto, by means of which frame the battery may be changed without disturbing the adjustment of the electrodes, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

V. M. BERTHOLD.

Witnesses:
JOS. P. LIVERMORE,
JAS. J. MALONEY.