No. 756,813. PATENTED APR. 12, 1904.

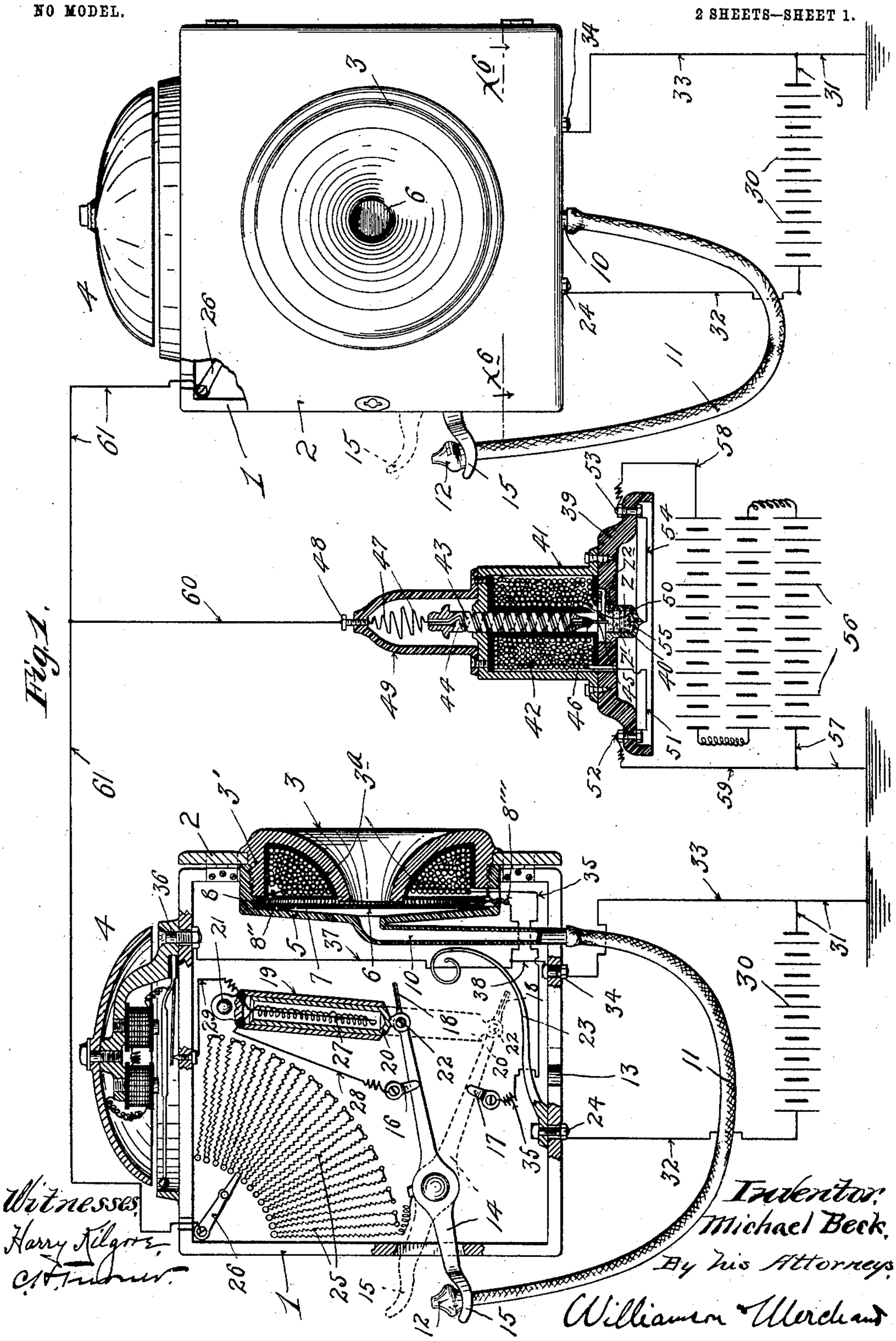
M. BECK.

LONG DISTANCE TELEPHONE SYSTEM.

APPLICATION FILED NOV. 12, 1900.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



No. 756,813. PATENTED APR. 12, 1904.

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LONG DISTANCE TELEPHONE SYSTEM.

APPLICATION FILED NOV. 12, 1900.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

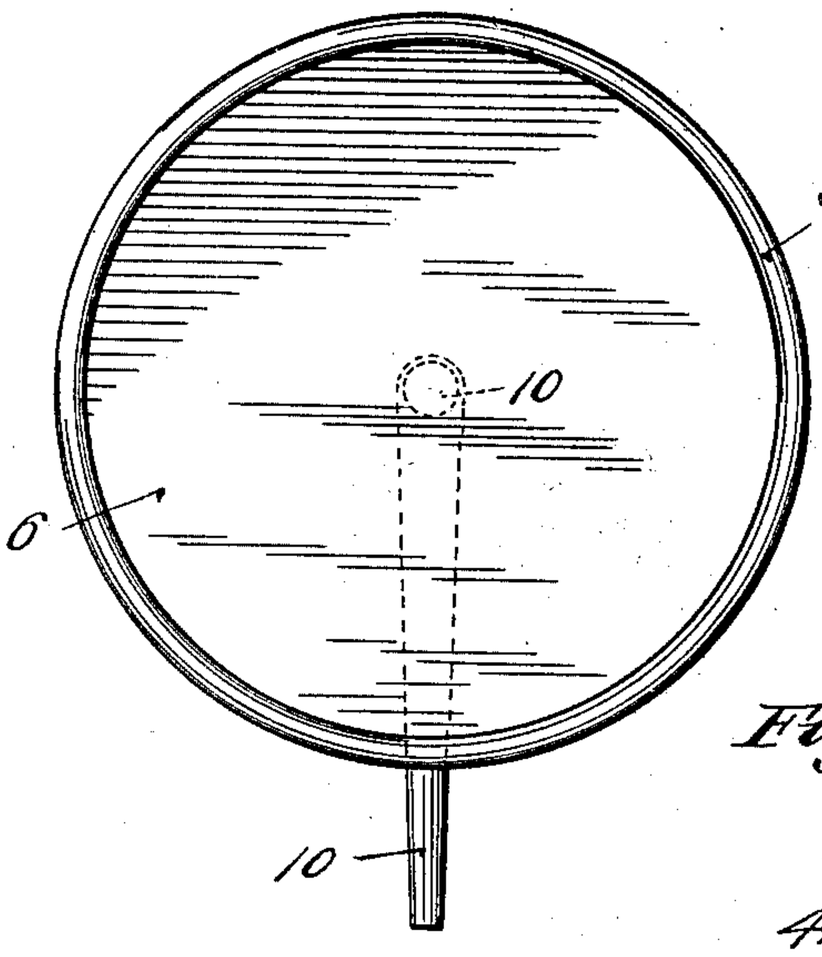


Fig. 3.

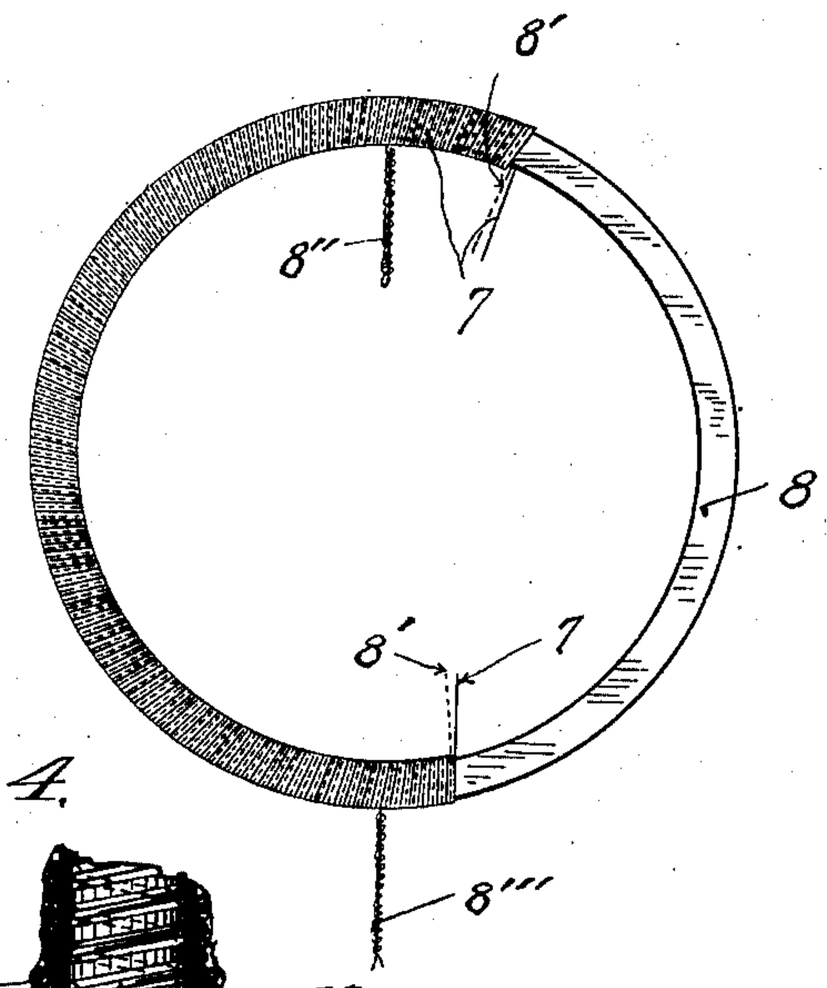


Fig. 4.

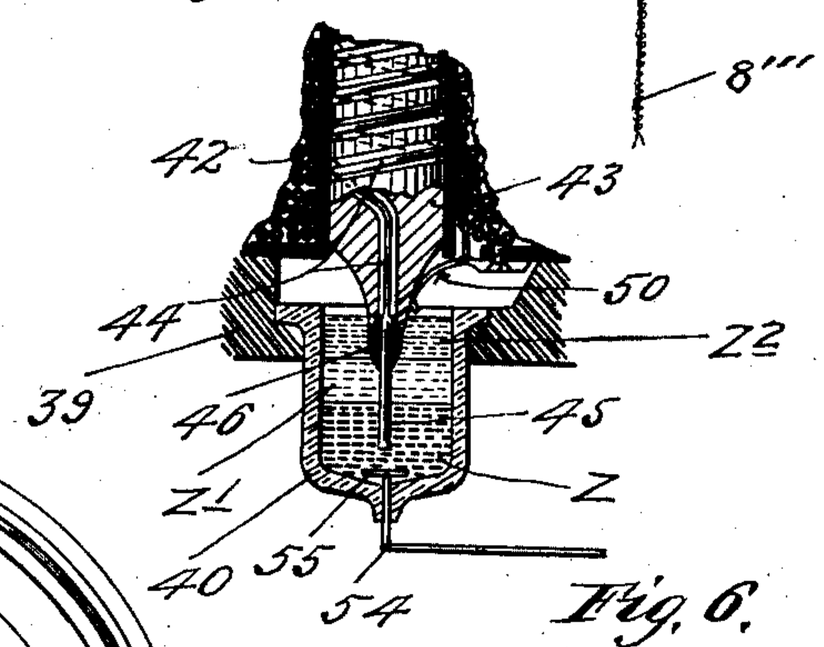
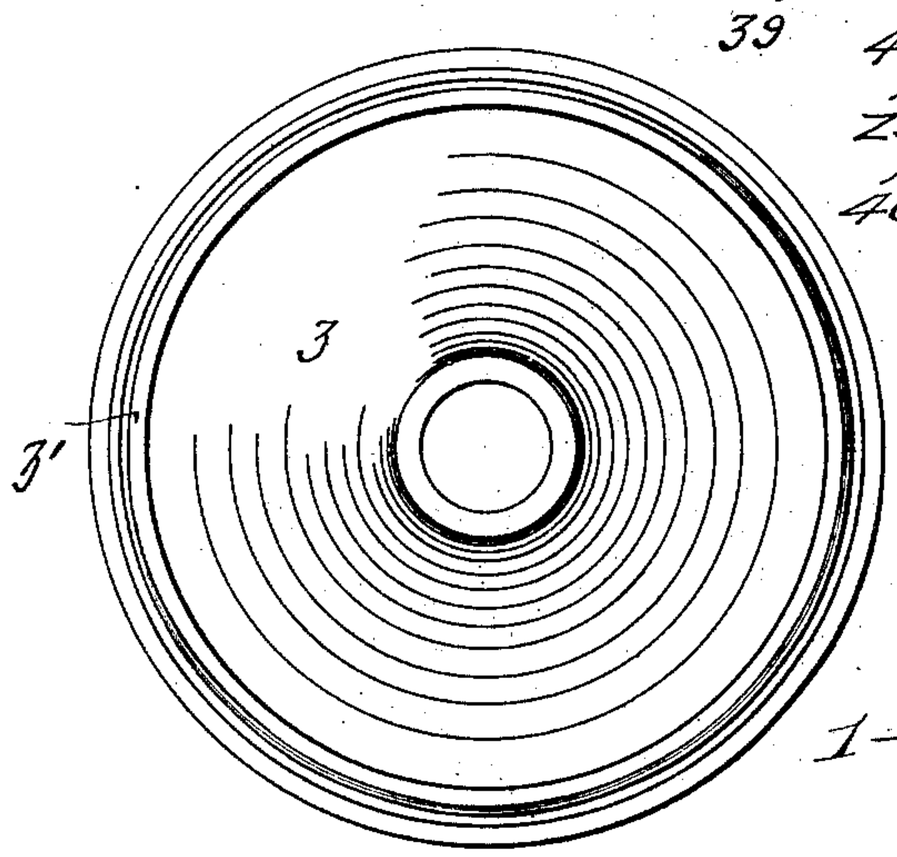
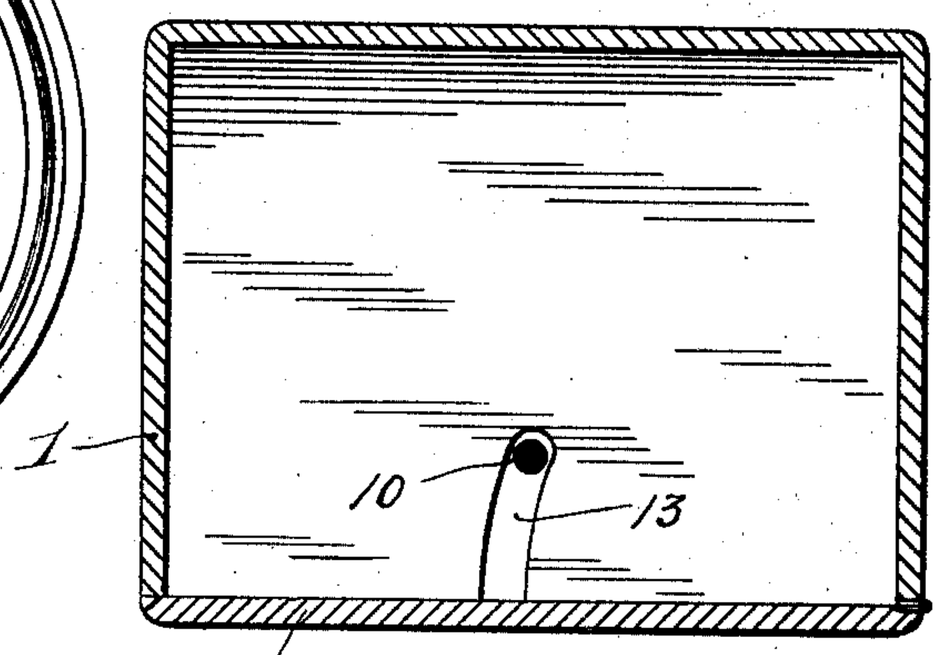


Fig. 6.

Fig. 5.





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C. A. Turner.

Inventor,
Michael Beck,
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No. 756,813. Patented April 12, 1904.

UNITED STATES PATENT OFFICE.

MICHAEL BECK, OF MINNEAPOLIS, MINNESOTA.

LONG-DISTANCE TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 756,813, dated April 12, 1904.

Application filed November 12, 1900. Serial No. 36,201. (No model.)

To all whom it may concern:

Be it known that I, MICHAEL BECK, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Long-Distance Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to telephone systems, and has for its object to improve the same, whereby audible sounds may be transmitted to greater distances than has hitherto been possible.

To the ends above indicated the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Figure 1 is a view, partly in diagram, partly in section, and partly in elevation, illustrating a telephone system designed and arranged in accordance with my invention. Fig. 2 is a detail view looking at the face of the diaphragm and showing the diaphragm-holder. Fig. 3 is a plan view showing the so-called "differential contact-coil," some parts of the same being removed. Fig. 4 is a detail, on an enlarged scale, corresponding in the line of its section to Fig. 1 and showing a portion of the instrument at the intermediate or half-way station. Fig. 5 is an inside face view of the mouthpiece of one of the instruments; and Fig. 6 is a horizontal section on the line x^6 x^6 of Fig. 1, some parts being removed.

We will first describe one of the terminal instruments, which operates both as a receiver and as a transmitter. It may be here stated that in this system these terminal instruments are provided at each end of the line and that at an intermediate station approximately midway between the terminal instruments there is provided an intermediate instrument from which the message-conveying current, in whole or in part, flows to and from the said terminal instruments.

The numeral 1 indicates the box or case of the terminal instrument, the same, as shown, having a hinged front board or lid 2, in which the mouthpiece 3 is located, which mouthpiece is of novel construction, as will presently appear.

The numeral 4 indicates the call-bell, which, as shown, is secured on top of the box 1.

The so-called "mouthpiece" 3 has from the exterior much the appearance of the mouthpiece of an ordinary telephone; but in this system it is preferably made of soft iron and is provided with an inwardly-projected marginal flange 3′, so that the said mouthpiece affords a magnet-core having concentric pole-pieces. The coöperating magnet-coil 3^a is wound in the annular space formed at the inner side of the said mouthpiece or core 3.

A disk-like head or diaphragm-holder 5 is screwed onto the flange or pole-piece 3′ of the mouthpiece 3, and this holder serves to loosely retain the soft-iron diaphragm 6 in operative position just inward of the poles of the said mouthpiece or core. Seated loosely between the peripheral portion of the diaphragm 6 and the annular pole formed by the flange 3′ of the core 3 is a flattened coil 7, formed by winding fine uninsulated wire on a ring 8, of mica or other suitable insulating material. To separate the turns of the coil and to prevent short-circuiting, an insulating thread or coil 8′, preferably of silk, is wound parallel with and between the said coil 8. Preferably the coil 8 is wound in two sections, the sections being provided with terminals 8″ and 8‴ at diametrically opposite points, as best shown in Fig. 3. The terminals 8″ (see Fig. 1) are connected to the coil 3^a, above noted.

The cap or holder 5 is provided with a depending stem 10, to the lower end of which a flexible tube 11, provided at its free end with an earpiece 12, is attached. The box 1 is shown as provided with a segmental slot 13, in which the lower end of the tubular stem 10 works when the front plate 2 is swung open or closed.

Normally the free end of the tube 11 is supported by a switch-lever 14, provided at its outer end with prongs 15, which serve to engage the said earpiece 12. The inner section

of the switch-lever 12 works between and is adapted to engage either of a pair of contact-pieces 16 17, suitably secured within the box 1. At its extreme inner end the lever 14 is provided with a spring-finger 18, the upper surface of which is preferably covered with insulating material for a purpose which will hereinafter appear.

The numerals 19 and 20 indicate a pair of closely-telescoping tubes or cylinders provided with closed outer ends and constituting an expansible bulb. The tube 19 is pivoted to the box 1, as shown at 21, and at its lower end the tube 20 is pivoted to the lever 14, as shown at 22.

The numeral 23 indicates a contact-piece which is preferably in the form of a leaf-spring having a coiled end located in such position that it will be engaged by the finger 18 of the lever 14 when the said lever is moved past the same. This contact-piece 23 is shown as secured to the bottom of the box 1 by means of a contact-bolt 24. Within the box 1 there is also a resistance-coil or rheostat 25, which is connected with the switch-lever 14 and with which coöperates a pivoted contact-lever 26.

The numeral 27 indicates a heating-coil, which is located within the telescoping tubes 19 and 20. This coil is connected with the contact-piece 16 by a wire 28 and with the bell-actuating mechanism by a wire 29.

The numeral 30 indicates a local battery at the terminal instrument, which battery is grounded by a wire 31 and is connected by wires 32 and 33, respectively, with the contact-bolt 24, heretofore noted, and with another contact-bolt 34, shown as secured to the bottom of the box 1. The contact 17, already noted, is connected by a wire 35 with the coil 3^a. The contact-bolt 36 of the bell 4 is connected by a wire 37 with the terminals $8'''$ of the coil 8. As shown, the contact-bolt 34, just noted, is connected by a short wire 38 with the said wire 37.

The above-described construction is the same in both terminal instruments.

The instrument at the intermediate or central station will now be described.

The numeral 39 indicates a base of insulating material which may be supported in any suitable manner and is provided at its center with a cup 40, also of insulating material. This cup 40 contains mercury, (indicated at z,) water above the mercury, (indicated at z',) and oil above the water, (indicated at z^2.)

41 indicates a cylindrical case supported by the base 39 and containing a spool-like magnet 42, through which a soft-iron plunger 43 works much after the manner of a needle in a solenoid. The plunger 43 is provided with a spiral channel, in which is wound a coil of wire 44, the lower end of which is connected to a depending contact-finger 45, secured at the apex of the conical lower end of said plunger, as best shown in Fig. 4. The coil 44 is formed of insulated wire, and the finger 45 is shown as insulated from the plunger 43 by a bushing 46. The upper end of the coil 44 is connected to the lower end of a spring 47, the upper end of which spring is shown as secured to a contact-screw 48, supported by a dome-like section 49, applied to the top of the housing 41. One terminal of the coil 42 is connected to a spring-contact 50, which normally engages the contact-finger 45, as shown in Fig. 1, but is adapted to engage with the lower end of the plunger 43, as shown in Fig. 4. The other terminal of said coil 42 is connected by wire 51 to a binding-bolt 52 on the base 39. Another binding-bolt 53 on the base 39 is connected by a short wire 54 with a metallic head 55, which is submerged in the mercury z, contained within the cup 40.

The numeral 56 indicates a battery or source of electrical energy of high electromotive force. This battery 56 is grounded by a wire 57 and is connected with the binding-bolt 53 by a wire 58. A wire 59 connects the grounded wire 57 with the binding-bolt 52, already noted. A main wire 60 leads from the contacts 48 and is provided with branch wires 61, which lead one to each of the contact-levers 26 of the two terminal instruments.

The operation is as follows: A person at the one terminal instrument wishing to call a person at the other terminal instrument simply takes down the free end of the flexible tube 11, having the earpiece 12, from the prongs 15 of the switch-lever 14. The switch-lever 14, under the action of gravity, acting on its inner end and on the inner tube or cylinder 20, will be caused to fall into its dotted-line position and into contact with the contact-lug 17; but this falling movement will be retarded by the air, which, as it cools, slowly contracts. Under the downward movement of the switch-lever 14 the metal side of the spring-finger 18 engages the coiled end of the contact-spring 23, thereby closing the following circuit: from the local battery 30, through wire 32, bolt 24, spring-contact 23, switch-lever 14, rheostat 25, contact-lever 26, wires 61 60, binding-screw 48, spring 47, coil 44, contact-finger 45, spring-contact 50, solenoid 42, wire 51, bolt 52, wires 59 and 57, and thence through the ground and through the wire 31 back to the battery 30. The closing of the said circuit energizes the solenoid 42, and thereby draws downward the plunger 43, carrying its contact-finger 45 into the mercury z of the cup 40. When the contact-finger 45 enters the mercury z, it is moved out of contact with the contact-spring 50, and the circuit through the solenoid 42 is broken; but a double circuit is then closed from the powerful battery 56 at the center station, which circuits extend from the said battery to both of the terminal instruments, as hereinafter specified. This double circuit being closed, the current flows directly through the insulated coil 44,

and the soft-iron plunger 43 is then converted into a magnet, which keeps the said plunger drawn downward as long as the said circuit is closed. It will be noted that the said core or plunger 43 is flanged at its upper end, so as to form an expanded pole-piece therefor, which coöperates with the magnetic top of the metal housing 41, which latter serves as an armature. Hence it is that the core 43 when magnetized will be drawn downward and held in its lowered position.

Let us now assume that the person wishing to send out the call removes the free end of the tube 11 from the terminal instrument shown at the right in Fig. 1 and that the parts of the terminal instrument shown at the left are left to their normal positions, as shown by full lines. The current which flows from the central battery 56 to the left-hand terminal instrument will take the following course, to wit: through wire 58, bolt 53, wire 54, mercury *z*, contact-finger 45, coil 44, spring 47, screw 48, wires 60 and 61, contact-lever 26, rheostat 25, switch-lever 14, contact 16, wire 28, coil 27, wire 29, through the actuating mechanism of the bell 3, through bolt 36, wires 37 38, bolt 34, wires 33 31, and through the ground and the wire 57 back to said battery 56. Thus the bell is sounded, and it will continue to ring until the coil 27, becoming heated, heats the air contained in the telescoping tubes 19 and 20, whereupon the expansion of the air forces downward the piston-tube 20 and carries the switch-lever 14 out of contact with the contact-piece 16, thereby breaking the bell-circuit. If some person at this instrument does not immediately remove the free end of the tube 11 from the outer end of the switch-lever 14, the said lever will, as the air within the tubes 19 and 20 cools and contracts, be moved back into its normal position, again closing the bell-circuit and causing the bell to be again rung. This action will be repeated, either until the call is answered or until the speaking-tube 11 of the calling instrument (which we have assumed is the right-hand instrument) is again suspended by its switch-lever 14.

When the two persons at the terminal instrument are ready to communicate, both of the switch-levers 14 stand in the positions indicated by dotted lines in Fig. 1, and in this case the circuit from the central or intermediate station will be changed from that above indicated, so that the bell will be cut out of the main circuit, and the closed circuit, traced from the switch-lever 14 to the ground, will be as follows: from the contact-piece 17, through the wire 35, thence through coil 3^a of the mouthpiece or core 3, thence through the variable-resistance coil 8, thence through a portion of wire 37, through wire 38 and bolt 34, and thence through wire 33 and a portion of wire 31 to the ground.

The rheostats of the two different instruments are adjusted so as to balance the resistance in each circuit. The current of the battery 56 when the circuit therefrom is closed through the wire 60 tends to produce a constant flow, which as long as the resistance in the circuits to the two different instruments are equal will be divided therethrough. When, however, a person talks into the mouthpiece 3 of one of the instruments, the diaphragm 6 is vibrated, so as to throw a variable pressure on the variable resistance-coil 8, thereby varying the contacting engagement between said diaphragm and coil, and thereby short-circuiting to a greater or less extent the variable shunt afforded by the diaphragm between the terminals of the coil. These variations vary, from normal, the resistance of the circuit to that instrument. As is evident from what has been stated, when the resistance in the one circuit is increased from normal the current which will flow therefrom to the battery 56 will be decreased and the current which will flow through the circuit to the corresponding distant instrument will be correspondingly increased, since the total flow from said battery 56 tends to remain constant.

At the receiving instrument the message may be heard by placing the ear to the so-called "mouthpiece;" but for the sake of convenience the ear-tube is provided. This ear-tube receives the sound-wave from the same diaphragm which is used to talk against, or in the vicinity of, when the said instrument is used as a transmitter.

When the two persons are through speaking, they will of course hang the free ends of the speaking-tubes 11 back on the respective prongs 15 of the switch-levers 14, and the said levers will then be slowly restored to normal positions under the action of gravity resisted by the escape of air from within and between the telescoping tubes 19 and 20. Whenever the circuits to both terminal instruments are for an instant broken at the same time, the spring 47 at the central or intermediate station is permitted to raise the plunger or core 43 again into its normal position, inasmuch as the coil 44 is at such time demagnetized. Under the upward movement of the inner end of the lever 14 the insulated upper surface of the spring-finger 18 engages the coiled free end of a contact-spring 23, so that the circuit is not closed by such contact.

Sparking between the mercury *z* and the contact-finger 45 is prevented, inasmuch as the circuit is gradually broken. Under the upward movement of the said finger after it leaves the mercury the water *z'* greatly increases the resistance, and as it is drawn above the water the resistance is increased above that which would be afforded by the atmosphere by the body of oil z^2.

It will of course be understood that this system is capable of many modifications within the scope of my invention.

Many of the features of construction and many of the combinations thereof set forth and described may be incorporated into a magneto-transmitter.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. In a telephone system, the combination with a pair of terminal instruments adapted to receive and transmit vocal sounds, of an intermediate instrument involving a source of electrical energy having circuit connections with the said three instruments, sources of electrical energy at the terminal instruments electrically connected therewith, and switch devices whereby the sources of electrical energy at the terminal instruments throw into action the source of electrical energy at the intermediate station, the arrangement being such that when the resistance is increased in the circuit of the one terminal instrument, the resistance in the circuit of the other terminal instrument will be decreased, and vice versa.

2. In a telephone instrument, the combination with a bell or call device and a transmitter and a receiver having a common diaphragm, of circuit connections from said bell and diaphragm to the main line, comprising a switch-lever movable to cut in and out said bell and diaphragm, in reverse order, an expansible bulb connected to said switch-lever, and a heating-coil within said bulb constituting a part of the electrical connections to said bell.

3. In a telephone system, the combination with terminal instruments involving each a bell, and a transmitter and a receiver having a common diaphragm, a local battery, circuit connections between said bell, diaphragm and battery, and a switch-lever for making and breaking said circuit connections, of an intermediate station comprising a local battery or source of energy with circuit connections to both terminal instruments, a movable contact-piece by means of which said latter circuits connection is normally broken, and a magnet operating on said contact-piece to close said circuits, which magnet is in circuit with said terminal instruments and is controlled by the switch-levers thereof.

4. In a telephone system, two telephone instruments and circuit connections therefor, each instrument involving a bell or call device, a switch, a transmitter and a receiver, said transmitter and receiver having a common diaphragm, and an automatic device actuated from the main line and operative, when thrown into action by a movement of the switch at the calling-station, to cut out the bell-circuit at the receiving-station, substantially as described.

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

MICHAEL BECK.

Witnesses:
HARRY KILGORE,
FRANK D. MERCHANT.