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PATENTED OCT. 13, 1903.

G. C. POWELL & A. D. SMITH.

APPARATUS FOR THE TREATMENT OF DEFECTIVE HEARING.

APPLICATION FILED MAY 28, 1902.

2 SHEETS—SHEET 1.

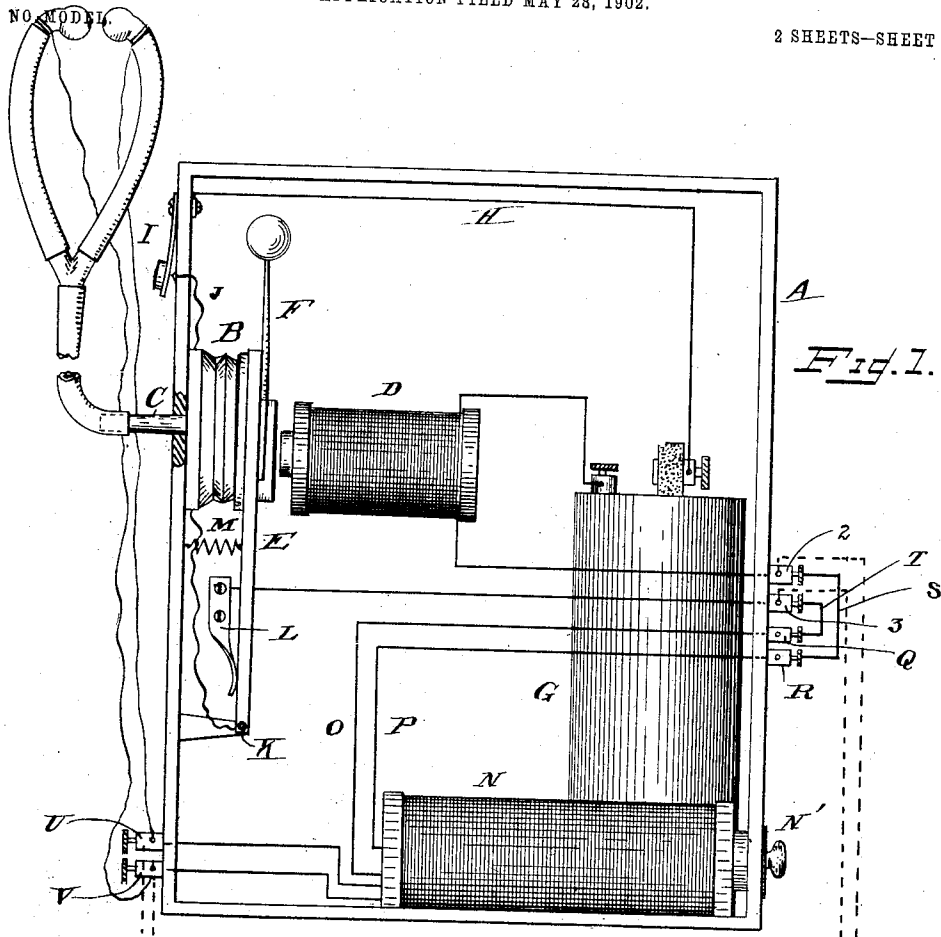
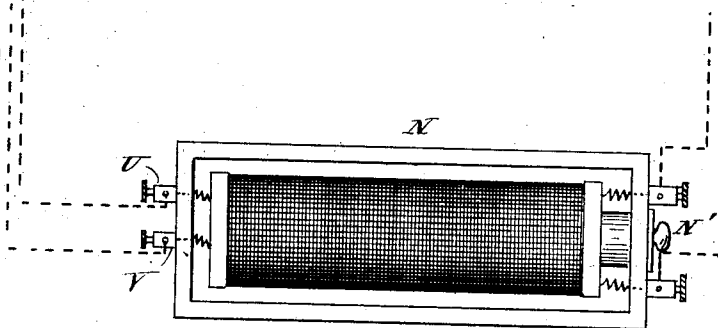


Fig. 3.



WITNESSES

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NO MODEL.

2 SHEETS—SHEET 2.

Fig. 4.

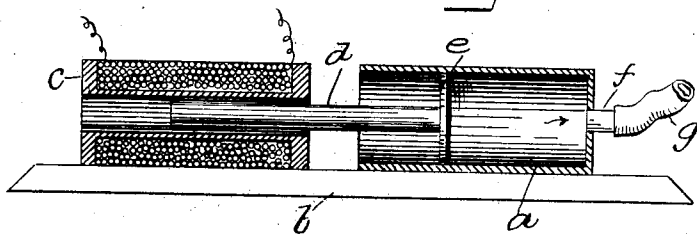
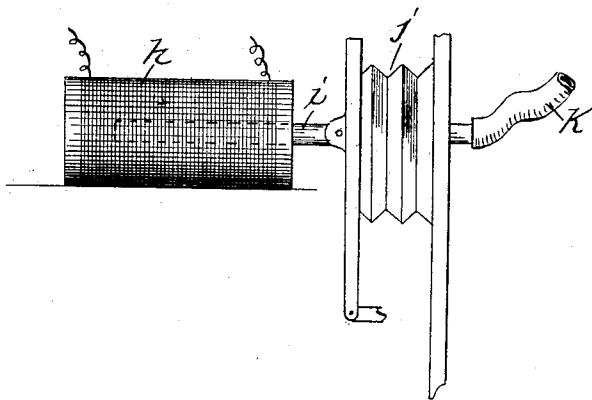


Fig. 5.

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GUY C. POWELL AND ALLEN D. SMITH, OF PEORIA, ILLINOIS.

APPARATUS FOR THE TREATMENT OF DEFECTIVE HEARING.

SPECIFICATION forming part of Letters Patent No. 741,371, dated October 13, 1903.

Application filed May 28, 1902, Serial No. 109,368. (No model.)

To all whom it may concern:

Be it known that we, GUY C. POWELL and ALLEN D. SMITH, citizens of the United States, residing at Peoria, in the county of Peoria and State of Illinois, have invented certain new and useful Improvements in Apparatus for the Treatment of Defective Hearing; and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a new and improved apparatus for the treatment of disease, and more particularly to the stimulation of the auditory structure of the ear.

The object of our invention is to provide a mechanical and electrical device which will vibrate the ear-drum and thus aid in making the same better perform its natural functions when rendered defective from diseases and by means of mild electrical impulses stimulate the various structures of the inner ear.

The first object is to vibrate the ear-drum and osseous structures by pulsations of air by a mechanical device operated by an electromagnet. We are aware that small pumps operated by electric motors as well as other devices of like nature have been employed for the above purpose, but we believe that our apparatus about to be described is new.

The second object—i. e., producing an electrical current through the inner ear, either separate from or in connection with the device for creating air movements or impulses for vibrating the drum of the ear—we also believe to be new, and the same will be pointed out more clearly in the following description and in the accompanying claims.

To the end that the entire arrangement may be fully understood we provide the accompanying drawings, wherein characters of reference correspond with those of the specification.

In said drawings, Figure 1 is a front elevation of the entire apparatus. Fig. 2 is a top view of a separate induction device used in connection with the arrangement shown in Fig. 1 when a portion of the latter figure is not embodied as shown. Fig. 3 is a sectional view of a metallic tip or electrode to be described. Fig. 4 is a view in section of a modi-

fied form of air-impulse device, showing a solenoid connected therewith. Fig. 5 is still another modified form showing a solenoid connected to operate the bellows shown in Fig. 1.

A indicates a box or cabinet of any desired form and finish and provided with a door. (Not shown.) To one side of said cabinet is secured a small bellows B, having a tube C for the exit and entrance of air and which forms the only opening in said bellows. Said tube perforates the side of the cabinet and is secured in the solid body of the bellows in any suitable manner. Adjacent to the bellows is an electromagnet D, having its core in the vicinity of said bellows, substantially as shown. Now interposed between the latter and the magnet is a vibrating armature E, whose lower extremity is pivoted to the bracket F, secured to the box or cabinet. The free portion of the bellows-body is attached permanently to said armature, and the latter carries a suitable weight mounted at the end of a flexible arm F. The construction of this portion of the apparatus is common to all electric call-bells and will therefore be fully understood without further description. It is not meant, however, that the weight above described, which is the clapper in electric-bell construction, is common to that class of devices, although we lay no claim thereto. Attached to the tube C of the bellows is a flexible tube of the desired length having at its outer end a branching ear-tube similar to that used on phonographs and which will require no further description at this time, except, perhaps, to state that the tips therefor are somewhat larger than those used on phonographs, so as to more fully fill the cavity of the ear into which they are inserted. An electric battery G or other desired source of electrical current is located within the cabinet or kept separate therefrom, as best suited to the wants of the user, and this is connected through the magnet and armature as follows: A wire H connects one pole of the battery with a button I, placed outside the cabinet within easy reach of the operator, and the contact-piece of said button is connected by wire J with the armature E at K. A contact-point L is located behind the armature in any desired manner

and may be connected directly with the battery through the magnet D, although we prefer to carry it to binding-posts or other means of connection, so that certain purposes may be accomplished, but which will appear presently. The device thus arranged and connected operates as follows: When the button I is depressed to close the electric circuit, the magnet is at once made to attract the armature E, thus tending to open the bellows. When thus attracted, the contact of the part L and the armature is of course immediately broken and the magnet loses its power, when by the action of a spring M the armature is returned to its first position, thus closing the bellows and forcing the air out. By contact the current is again sent through the circuit and the operation repeated as long as the button I is closed.

It will be readily seen that by the above operation the bellows is continually opened and closed, producing a succession of alternate pressures and retractions of air. If the earpieces be held in the ears, a consequent vibration of the drums will take place as the alternations are produced. Naturally a continued use of such means will gradually bring the ear-drums in normal condition. By adjustment of the armature or its contact-piece L, or both, the former may be made to vibrate at any desired rate, and thus produce air movements of greater or less length, as will be understood. In conjunction with this we desire to use an induction-coil or other electrical device which will accomplish the same function, which, as before stated, will produce a current to be passed through the head for stimulating the inner ear structures. We illustrate at N, Fig. 1, an induction-coil whose primary coil is connected by wires O P with binding-posts Q and R, respectively, on the outside of the cabinet. The secondary coil is connected by wires U V with the tips of the ear-tubes, which in this case are metallic and used as electrodes, and as one is used in each ear the current must pass entirely through the head, the shortest route being through the inner ear structure, which receives the beneficial effects thereof. The usual covering N' for the core of the coil N is provided, whereby any desired strength of current may be had.

As intimated above, we may have the induction-coil or other apparatus removed entirely from the cabinet A and placed in a receptacle of its own, as shown in Fig. 2. When this is the case, the wires therefrom are connected to the binding-posts 2 and 3, Fig. 1, so that it may be thrown into the circuit with the bellows device. In other words, the current will pass through the armature and its contact-point, the magnet, and the induction-coil, so that the air movements and the induced current are both operating upon the ear at the same time. The same is true when using the coil within the cabinet. By providing the posts 2 and 3 and Q and R said

coil N may be brought into the circuit by connecting the posts 2 and R by a wire S and the posts 3 and Q by a wire T. If, however, the coil is to be left out of the circuit, the posts 2 and 3 are merely connected by a wire or suitable switch, (not shown,) and the bellows is in use separate from the said coil. Binding-posts U and V serve to connect the wires from the secondary coil with the electrodes of the ear-tubes when either the coil within the cabinet is used or the detached or removed one shown in Fig. 6.

The wires may be connected to the electrodes, as shown in Fig. 1, or they may be run up through the tube and then connected thereto, either of which methods will be equally satisfactory, or the branching portion of the tube may be made of metal covered with an insulating material for protection and the wires connected to such metal portions in any good way.

If desired, means may be employed whereby the armature can be made to vibrate faster to slower for the purposes explained. A means of regulation of the current flowing through the induction-coil will thus be provided. This will act in the same manner as the ordinary vibrator on an induction-coil and which the armature takes the place of, as will be clearly seen. This, then, gives a more or less number of alternations per minute to the induced current, and when the vibrations are increased the number of air movements are increased likewise, so that actually any desired current and number of vibrations of air may be had at will.

From the foregoing it will be seen that we desire to secure the means of and idea of employing a bellows for furnishing air for the purposes outlined and also to combine therewith the induction apparatus and use both together or one separate from the other.

We do not intend to confine ourselves to the particular construction and arrangement shown in the drawings, but various changes may be made without departing from the spirit of our invention. As an instance of what changes we may wish to make the following will be understood: In Fig. 4 we show a cylinder *a*, lying horizontally and mounted on a base *b*. Adjacent to the cylinder is a solenoid *c*, into which a bar-magnet *d* is drawn and from which it is expelled by changing the direction of the movement of the current passed through said solenoid. At one end the magnet has a piston *e*, adapted to move back and forth with the cylinder to set up air impulses through the tubes *f* and *g*, which convey air to the ear. By rapid reversals of the current through the coil the magnet will have a correspondingly rapid travel in both directions. In Fig. 5 a solenoid is represented at *h* and a bar-magnet at *i*, which is pivotally connected to a bellows *j*, to which the ear-tube *k* is attached. The same reversals of direction of current above referred to will operate the magnet and thus set up air move-

ments in the bellows. Evidently the sound produced by any of these devices acts to vibrate the ear-drum in a slight degree by the movement of the air, all of which will be understood.

We are aware of two devices of this nature, one of which employs a diaphragm operated by an electromagnet for producing air impulses and including also a device for producing electric impulses simultaneously therewith, the other having also a device for electric impulses and also an electromagnet by which a vibrating armature is operated to produce sound and not air impulses in the sense that a bellows, diaphragm, or like device produces them. The first of these devices combined its electric-impulse arrangement with its air-impulse device without separate use of either of them, while the other employs an electric-impulse device and the vibrating sounder described, the latter arrangement using the two portions either separately or combined. As differing from either of these our improved apparatus uses the electric-impulse portion separately or the air-impulse portion alone or combines them, so that the electric current and the air can be used on the patient as desired. Evidently sound transmitted to the ear cannot accomplish the same results as that of impulses of confined air which vibrate the ear-drum freely and with certainty. The actual movement of the drum is necessary in order to obtain the desired massaging of that membrane. The separate use, therefore, of a confined-air-impulse device in an apparatus of the nature described we claim as new.

We claim—

1. In a device of the character described, a bellows, metallic ear-tubes connected therewith, a spring-held armature attached to the bellows, an electromagnet for attracting said armature to move the bellows to cause air-suction within the bellows and the tubes, apparatus for passing an electric current through the magnet and armature, the latter arranged to break the circuit when attracted to the magnet, the armature being retracted by its spring, when the circuit is broken, to reverse the air movement in the ear-tubes, in combination with electrical apparatus for creating electric impulses through the ear-tubes, the same adapted to be cut into circuit with the magnet and armature, both the circuit for operating the bellows and the circuit for the ear-tubes capable of separation one from the other so that one may be used separate from the other or the two combined.

2. In a device for producing vibrations of air within the ear for the purposes set forth, a bellows, a support therefor, a spring-held armature attached to such bellows, an electromagnet for attracting said armature, an

apparatus for producing an electric current, the same having connection through the magnet and armature, said armature by its attraction to the magnet forming a suction of air into the bellows and by such movement breaking the circuit and by its spring forcing the air out of the bellows and an air-conductor for the ears attached to the bellows through which the air is alternately drawn and expelled by said bellows.

3. In a device of the character described, a bellows, an ear-tube connected thereto and constituting the only outlet and inlet for the bellows, an electrically-operated armature attached to the bellows by which said bellows is rapidly moved to set up air impulses in the air-tube, in combination with a device for producing electric impulses consisting of an induction apparatus connected into the circuit of the electrically-driven armature to produce electric impulses either separately from or in conjunction with the air movements.

4. In a device of the character described, the bellows B, the air-tube C connected thereto, the armature E for operating the bellows, the electromagnet D for driving the armature, the battery G and its connections through the armature and magnet arranged substantially as set forth and described.

5. In a device of the character described, the bellows B, the air-tube C connected thereto, the armature E for operating the bellows, the electromagnet D for driving the armature, the battery G and its connections through the armature and magnet in combination with the induction-coil N and its connections through the magnet and armature circuit all arranged substantially as described and shown.

6. A device of the character described comprising a bellows, an electrically-vibrated armature, an electromagnet adjacent to and driving said armature, a source of electrical current for operating said armature by means of the magnet, in combination with an induction-coil the armature for operating the bellows forming the vibrator for said coil and the coil being in the circuit with the armature and magnet, ear-tubes connecting the bellows with the ears, metallic tips for the said tubes and electrical connection between the said tips and the secondary coil of the induction apparatus all for the purposes set forth and described.

In testimony whereof we affix our signatures in presence of two witnesses.

GUY C. POWELL.
ALLEN D. SMITH.

Witnesses:

E. J. ABERSOL,
MAE DAVIS.