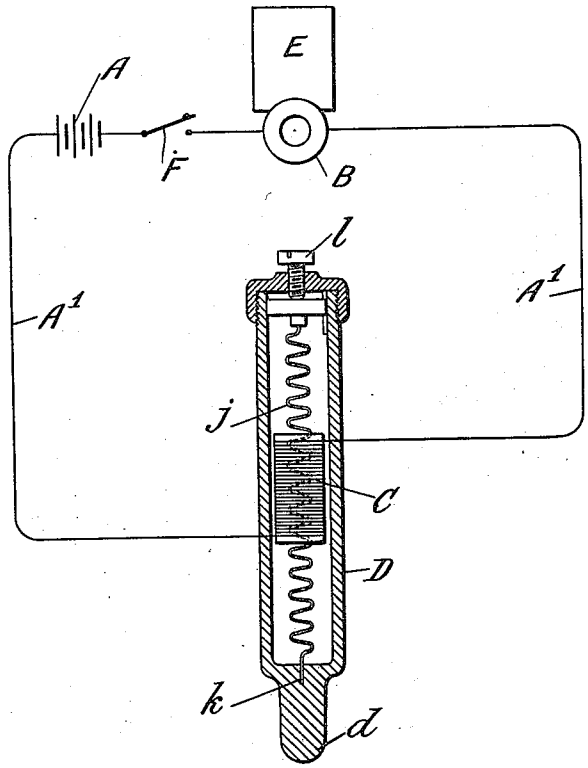
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APPARATUS FOR USE IN THE TREATMENT OF DEAFNESS.

APPLICATION FILED JULY 27, 1911.

1,077,096. Patented Oct. 28, 1913.



WITNESSES

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APPARATUS FOR USE IN THE TREATMENT OF DEAFNESS.

1,077,096. Specification of Letters Patent. Patented Oct. 28, 1913.

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To all whom it may concern:

Be it known that I, AUGUSTUS ROSENBERG, a subject of the King of Great Britain, and resident of 259 High Holborn, London, W. C., England, engineer, have invented Apparatus for Use in the Treatment of Deafness, of which the following is a specification.

My present invention is a division of my application filed July 30, 1909, and serially numbered 510,463, and which was patented March 25, 1913, No. 1,057,279, and has for its object a device for the treatment of deafness and other disorders of the auditory organs by agitating the sound-conducting and sound-perceiving portions of the ear by means of mechanical vibrations having a continuous undulatory character corresponding to that of the sounds (speech, music and the like) to which it is required to train the ear to respond.

By my invention, mechanical vibrations, having the continuous undulatory character required, are generated initially by means of apparatus (of the general type represented by the phonograph) capable of producing such vibrations for any length of time as may be necessary for the purposes of the treatment. The vibrations thus generated are converted into, and transmitted electrically without make-and-break as corresponding continuous undulatory pulsations in the current flowing in an electric circuit; the current-pulsations being due to corresponding continuous undulatory variations of resistance produced in the electrical conductor under the control of what may be termed a sound-controlled current-regulator (such for example as a microphone) which is interposed in the circuit and agitated by direct mechanical contact with the phonograph or equivalent instrument whereby the initial vibrations are mechanically generated. The continuous undulatory pulsations thus set up in the electric current are reproduced as mechanical vibrations by means of an improved form of electrical apparatus (analogous to a telephonic receiver) which is also interposed in the circuit and is further adapted to transmit said vibrations to the inner ear or the osseous structure of the head; the arrangement being such that the reproduced vibrations exhibit not only a character and periodicity identical with those of the original vibrations, but also an amplitude as much greater as is necessary, in order that transmission to the sound-perceiving portions of the ear may be insured.

The apparatus whereby the continuous undulatory mechanical vibrations are initially generated, and the current-regulator whereby said vibrations are converted into corresponding continuous undulatory pulsations in the electric current, are so combined as to constitute together a single instrument of special construction (hereinafter for convenience called the "transmitter"), wherein the movements of a stylus (or equivalent mechanical contact-member) under the influence of a phonographic or like record are communicated directly to the structure of the microphone or equivalent device.

Hence the device of the present invention consists in the combination of a "transmitter" such as that just described; a source of electrical energy in whose circuit the microphonic element constituting the current-regulator of said transmitter is interposed; an electrical device (hereinafter for convenience called the "undulator") also interposed in the circuit and adapted to transform into undulatory mechanical vibrations, the undulatory pulsations set up in the electric current by the action of the current-regulator; and a casing or support for the undulator (hereinafter for convenience called the "vibrator"), adapted to be inserted in the external auditory canal or otherwise applied to the person of the patient in such manner that the mechanical vibrations communicated by the undulator to the vibrator shall be transmitted to the osseous structure of the head.

In the accompanying drawings, the figure is a diagrammatic view of the entire device, the vibrator being shown in section.

A represents a source of electric energy which is interposed in a circuit A^1; a switch F being placed in the circuit for the purpose of opening or closing the same when desired. The sound-controlled current-regulator B, which is agitated by direct mechanical contact with the phonograph or equivalent instrument E, is interposed in the same circuit, wherein is also interposed the undulator which is contained in the vibrator D as hereafter described.

According to the present invention, the action of the undulator is dependent upon

the variations occurring in the length of a magnetizable element in consequence of variations in the strength of the current flowing in a coil of insulated wire surrounding said element; these variations in the length of the magnetizable element being utilized for the purpose of transmitting, to the vibrator D, pulsations having the requisite intensity. It is, of course, assumed that the undulations produced in the current through the medium of the sound-controlled current-regulator B possess the necessary amplitude.

The magnetizable element is constituted by a length of stiff wire *j* inclosed in and traversing the length of a tubular casing D constituting the vibrator, the wire *j* being encircled by a coil C of insulated wire whose opposite ends are connected to the respective members of the electric circuit A^1. When current is passed through the coil C, the length of the wire *j* undergoes variation, the actual change of length being dependent upon the strength of the current which, at any given moment, is passing through the coil. Hence, molecular movements are set up which are communicated to the casing D as a series of mechanical vibrations corresponding to the variations in the strength of the current passing in the circuit. The wire *j* is fixed at one end *k* to the casing D, and at the opposite end bears against an adjustable abutment constituted by a set-screw *l* passing through the closed end of the casing. By turning the screw *l* in one direction or the other, the compression to which the wire *j* is subjected may be increased or diminished so as to correspondingly vary the force of the vibrations transmitted to the casing D. The wire *j* is preferably bent spirally or in zig-zag fashion so as, by presenting a greater effective length, to be capable of affording more powerful vibrations than would be produced if the wire were straight.

The casing D is provided, at the end opposite to the screw *l*, with a cylindrical plug *d* having a length and diameter adapted for insertion in the external auditory canal in such manner as to insure the communication of the vibrations from the casing D to the middle and inner ear (or other parts involved in the disorder) as directly as is practicable. The plug *d* should have a smooth surface and a rounded end as indicated, so as to avoid injury to the surfaces with which it is brought into contact.

Referring now to the transmitter, it is to be observed that the reason why it is necessary that the so-called sound-controlled current-regulator B should be agitated not by sound-waves transmitted aerially, but by direct mechanical contact with the phonograph or equivalent device E, is that the pulsations in the electric current, and consequently also the mechanical vibrations which are produced in the portion D of the apparatus applied to the person of the patient and which are transmitted by osseous conduction to the sound-perceiving portion of the ear, must have an amplitude as great as is practically attainable. Hence the vibratory diaphragm of a microphone constituting the current-regulator may, for example, be provided with a stylus which rests upon the record-cylinder or equivalent part of a phonograph or like instrument, so that, on the record-cylinder being rotated, the microphone will be agitated to an extent as great as would the ordinary sound-diaphragm of the phonograph.

It is to be clearly understood that while it is necessary that the device herein called the "undulator" should be capable of translating into undulatory mechanical vibrations undulatory pulsations produced in the electric current by the current-regulator, I do not intend to convey that, for the purpose of training the disordered ear, I employ exclusively vibrations which are undulatory in the restricted sense of being phonetic (*i. e.* of a character corresponding to the sounds of human speech), since I may and do employ vibrations of any character (musical or other) suited to the particular nature of the disorder and the progressive stages of recovery, and corresponding to any sounds (excepting, of course, mere "noise") to which it may be required to train the ear to respond. Hence the phonograms or records used in connection with the phonograph or similar instrument may advantageously represent not merely human speech (in the form, for example, of recitations or conversations), but also musical performances of all kinds, orchestral and other, as well as songs; in fact the greater the diversity (as regards both character and pitch) of the sounds represented, the better.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A device for enabling the communication to the ear of electrically-produced undulatory mechanical vibrations, consisting in the combination of a tubular casing, a length of wire fixed within and traversing said casing longitudinally, a coil of insulated wire wound about said fixed wire and forming part of the electric circuit, and a plug integral with the casing and adapted for insertion in the external auditory canal.

2. A device for enabling the communication to the ear of electrically-produced undulatory mechanical vibrations, consisting in the combination of a tubular casing, a length of bent wire fixed within and traversing said casing longitudinally, a coil of insulated wire wound about said fixed bent wire and forming part of the electric circuit,

and a plug integral with the casing and adapted for insertion in the external auditory canal.

3. A device for enabling the communication to the ear of electrically-produced undulatory mechanical vibrations, consisting in the combination of a tubular casing, a length of bent wire fixed within and traversing said casing longitudinally, a coil of insulated wire wound about said fixed bent wire and forming part of the electric circuit, means for adjusting the tension of the fixed bent wire, and a plug integral with the casing and adapted for insertion in the external auditory canal.

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Witnesses:
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