Jan. 5, 1932. C. E. LANE 1,840,112

ARTIFICIAL LARYNX

Filed Dec. 17, 1927

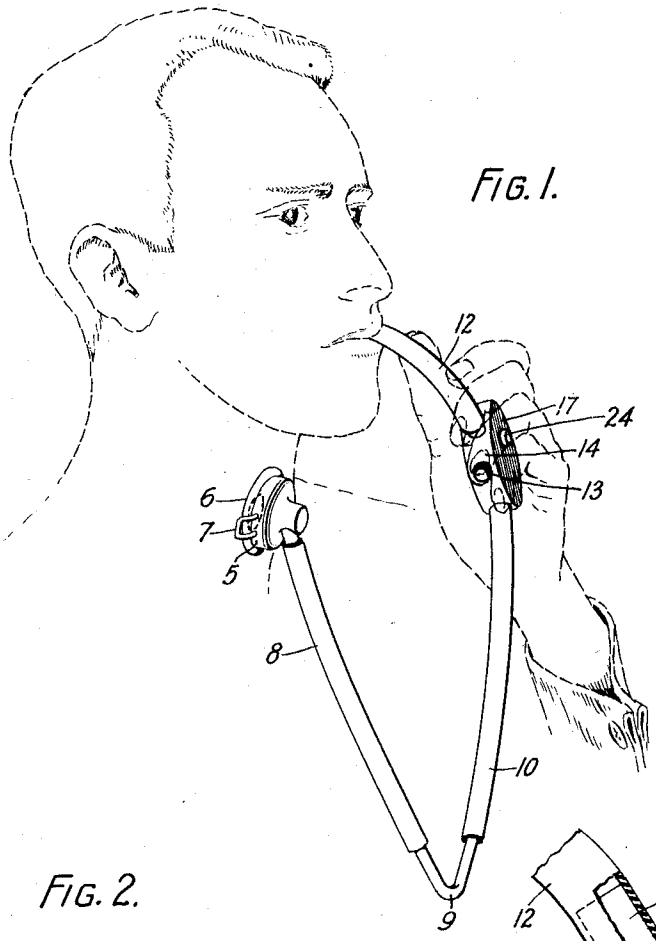
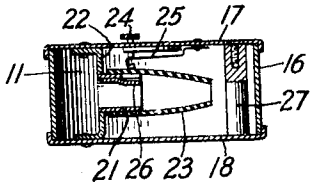


FIG. 1.

FIG. 2.



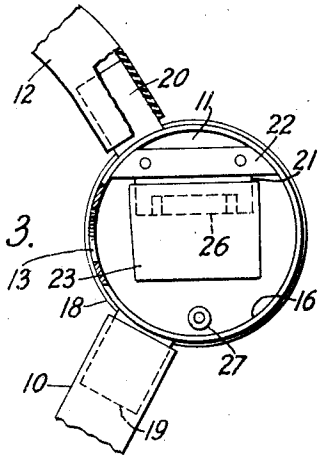


FIG. 3.

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UNITED STATES PATENT OFFICE

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ARTIFICIAL LARYNX

Application filed December 17, 1927. Serial No. 240,686.

This invention relates to an artificial larynx of the type which is intended to restore the power of speech to a person who has the natural larynx removed.

It is well known that human speech is accomplished by two major actions within the throat and head of the human body. First, air from the lungs is forced between the vocal cords which are set into vibration to produce sounds. These sounds are then introduced to the cavities of the throat, mouth and nose and by the alteration of the internal shape of these cavities by the movement of the throat, tongue and lips, articulated sound or speech is produced.

Many persons who are afflicted with cancer of the larynx or other malignant diseases of the throat have found it necessary to undergo a surgical operation in which the larynx is removed. After such an operation the trachea, or air passage tube, from the lungs is terminated in an opening in the base of the neck. This, of course, leaves the patient without the power of breathing through the mouth or nose and requires that this function be performed through the opening in the base of the neck. Likewise, such a person cannot produce sounds in the throat since the vocal cords have been removed and is accordingly without the power of speech. It has been found possible to restore speech to such persons by carrying the air from the opening in the base of the neck to an external, mechanical vibratory member or artificial larynx which may be set into vibration by air expelled from the lungs. The sound which is produced by the vibratory member is transmitted through a tube and introduced into the mouth where the movement of the tongue and lips transforms the sound into articulated speech.

Devices known as artificial larynges embodying the above features are well known. The difficulty with such devices, however, has been that the reproduced speech is not easily understood and is not pleasant to hear. Furthermore, the operation of the vibratory member is affected by moisture from the lungs and throat.

An object of this invention is to enable a person to reproduce speech sounds through an artificial device which is simple and efficient in operation and which can be easily adjusted by the user.

Another object of this invention is to improve the sound producing vibratory member in an artificial larynx.

In accordance with this invention the improved larynx overcomes the above disadvantages in a simple manner and comprises a trachea connection which is applied to the trachea opening in the neck of the user. This connection is joined to a sound chamber through an air passage-way to introduce air from the lungs into the sound chamber which contains a vibratory element in the form of a tubular elastic member rigidly supported at one end of the chamber and having its free end slightly open. After the air passes through the element it is led to the mouth of the user to formulate the sound into articulated speech.

A feature of the invention relates to a regulating means for changing the pitch of the tone produced by the vibratory element. This feature comprises an adjustable member which engages a side of the element whereby the element is pinched to vary the tone produced in the sound chamber.

Other features of the invention will be apparent from the following detailed description and the accompanying drawings in which,

Fig. 1 is a pictorial view showing the application of the improved artificial larynx to a person to reproduce speech,

Fig. 2 is a cross-sectional view of the sound chamber and the improved vibratory element made in accordance with this invention, and

Fig. 3 is a plan view of the sound chamber with one of the end walls removed to show the elastic element.

Referring to Fig. 1 the artificial larynx comprises a metallic covering member or trachea connection 5 which fits over the trachea opening in the base of the neck. This connection is provided with a soft rubber ring 6 which is at the point of contact with the flesh of the user of the device. The trachea connection 5 may be supported in

this position by a band (not shown) strapped around the neck and attached to the slotted flange 7 or the connection 5 may be held in position by the user. A flexible rubber tube 8 fits over a tubular extension of the trachea connection 5 and is connected to one side of a bent tube 9, preferably of hard rubber or metal. Fitted over the other side of the bent tube 9 is a flexible rubber tube 10 which is connected to one side of the sound chamber 11. Attached to the opposite side of the sound chamber 11 is a flexible rubber tube 12 which serves as the mouthpiece of the device. The free end of the tube 12 may be introduced into the mouth of the user of the device to form a continuous artificial passage-way between the trachea opening and the mouth of the user. An opening 13 is provided in the sound chamber 11 for the purpose of permitting air to be drawn into the lungs and to permit air to be expelled from the lungs without passing through the vibratory member. In Fig. 1, this opening is shown closed by a finger 14 of the user of the device. With the opening 13 thus closed the air expelled from the lungs passes through the vibratory member in the sound chamber and into the mouth.

The improved form of sound chamber made in accordance with this invention is shown in Fig. 2 and comprises a casing or chamber 11 having a cylindrical wall 16 and two flat end walls 17 and 18 closing the cylindrical wall of the chamber. The casing is preferably made of sheet metal or other light material but may also be made of molded insulating material. An oval-shaped tubular supporting member 21, preferably of metal and having a flange 22, is attached to the inner wall of the casing with the tubular member 21 projecting toward the larger portion of the chamber. A vibratory member or element 23 consisting of a hollow, flat, soft rubber tube has one end tightly stretched over the supporting member 21 and the other end free and unsupported. The stretching of the hollow element over the supporting member causes the free end to be partially opened. An adjusting screw 24 extends through the wall 17 of the casing and engages a spring or member 25 which has one end attached to the wall 17 and the other end engaging the element 23 adjacent the tubular supporting member. A short strip 26 of rigid material is attached to the inner surface of the supporting member 21 and extends to the edge of the supporting member. This member has a portion cut away intermediate the strip 26 and the elastic element 23 as shown more clearly in Fig. 3. In this figure the relation of the tubular passage-ways to the vibratory element is shown in which a short tubular extension 19 projects from the cylindrical wall 16 to which one end of the rubber tube 10 is attached to inject air into the sound chamber 11. A similar tubular extension 20 projects from the opposite side of the cylindrical wall and is joined to one end of the rubber tube 12 whereby air injected into the chamber 11 may pass through the tube 12 when the opening 13, shown in Fig. 1, is closed. Adjustment of screw 24 causes the spring member 25 to pinch the vibratory element 23 and thereby increase or decrease the tension in the element. This increase or decrease in tension results in the production of a lower or higher pitched tone by the vibratory element 23. The end walls 17 and 18 are attached to the casing by screws which fit into the flange 22 and the post 27.

The operation of this improved artificial larynx will now be explained. With the device arranged as shown in Fig. 1 the user of the device places his finger over the opening 13 in the sound chamber when he wishes to talk. Air is then forced from the lungs through the trachea connection 5, tube 8, connection 9, tube 10 and then to the sound chamber 11. The vibratory element 23 within the sound chamber is set into vibration by the air passing through it and a tone is produced. This tone is carried from the sound chamber by the mouthpiece 12 into the mouth of the user. By moving the lips and tongue the user will modulate the tone produced by the vibratory element and speech will be produced. By varying the adjustment of screw 24, the pitch of the tone produced by the vibratory element may be changed at the will of the user of the device. The use of a hollow elastic vibratory element unsupported at one end, and mounting the vibratory element so that air enters the unsupported end, causes vibrations of low frequency to be obtained. These vibrations produce sound waves which when modulated by the mouth or lips, result in speech closely resembling that of the normal person. The improved sound chamber is of simple construction and the vibratory element needs no adjustment or replacement due to moisture condition.

What is claimed is:

1. In an artificial larynx, a trachea connection, a sound chamber, means for conveying air from said connection to said chamber, and a tubular vibratory member having one end supported in said chamber and the other end having a continuous edge free to vibrate, said member being so arranged in said chamber that air from said connection enters the free end.

2. In an artificial larynx, a trachea connection, a sound chamber, means for conveying air from said connection to said chamber, apertured supporting means in said chamber, a tubular vibratory member having one end attached to said supporting means and the other end free to vibrate, said member being so supported in said chamber that air from said connection enters the free end to produce tones, and adjustable means engaging said

member for changing the character of the tones produced.

3. In combination, a sound chamber having inlet and outlet openings, a tubular support within said chamber adjacent said outlet opening, a hollow vibratory member engaging said tubular support and open at its free end toward said inlet opening, means for conveying air to said chamber attached to said inlet opening, and means for conveying sound attached to said outlet opening.

4. In combination, a sound chamber having inlet and outlet openings, a tubular support within said chamber adjacent said outlet opening, a hollow vibratory member engaging said tubular support and open at its free end toward said inlet opening, means for conveying air to said chamber attached to said inlet opening, means for conveying sound attached to said outlet opening, and adjustable means engaging said vibratory member to change the rate of vibration thereof.

In witness whereof, I hereunto subscribe my name this 15th day of December, A. D. 1927.

CLARENCE E. LANE.