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(54) **DEVICE FOR SUPPLEMENTING VOICE AND METHOD FOR CONTROLLING THE SAME**

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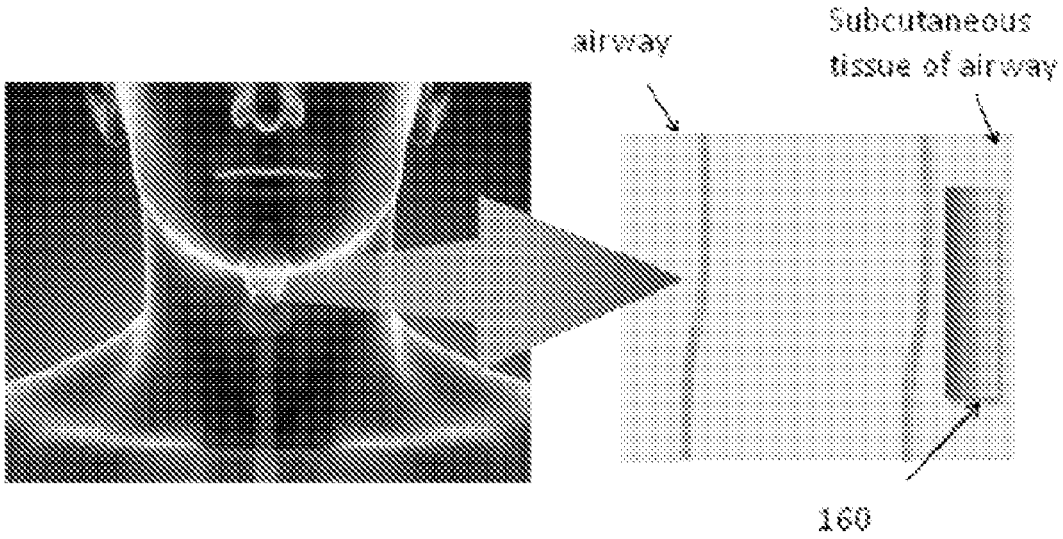
(57) **ABSTRACT**

A device for supplementing a voice includes: a sensing unit sensing a bio-signal corresponding to a first vibration of vocalization and generating a first signal corresponding to the bio-signal; a vibration unit generating a second vibration using the first signal; and a power unit supplying a power to the sensing unit and the vibration unit.



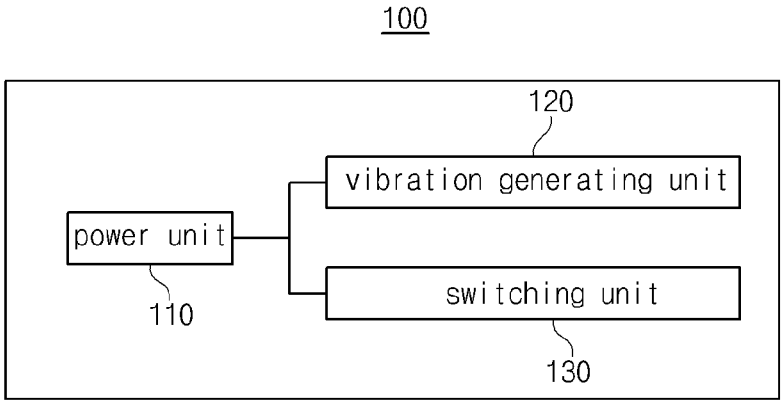

100
120
vibration generating unit
power unit
110
switching unit
130

FIG. 1

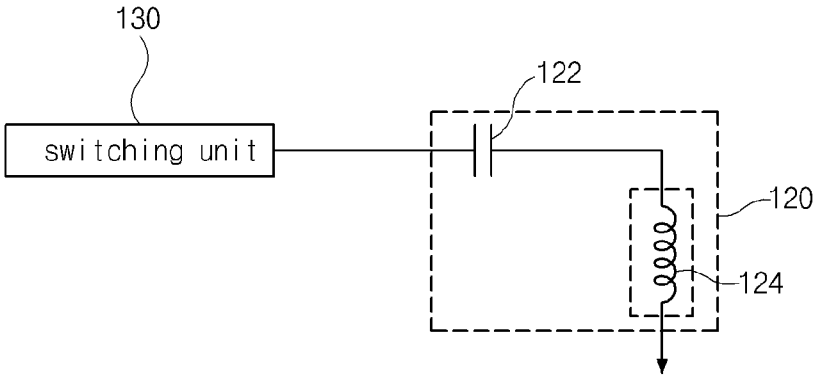

130
switching unit
122
120
124

FIG. 2

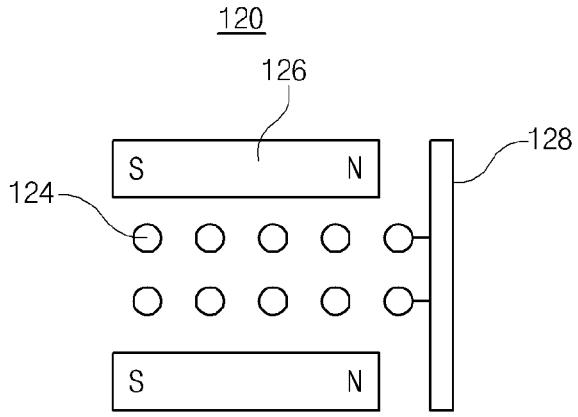


FIG. 3

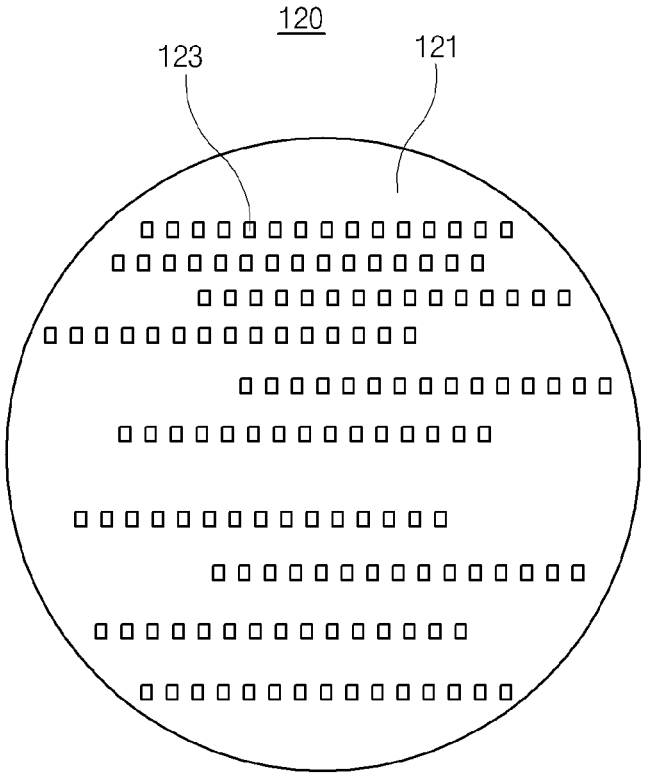


FIG. 4

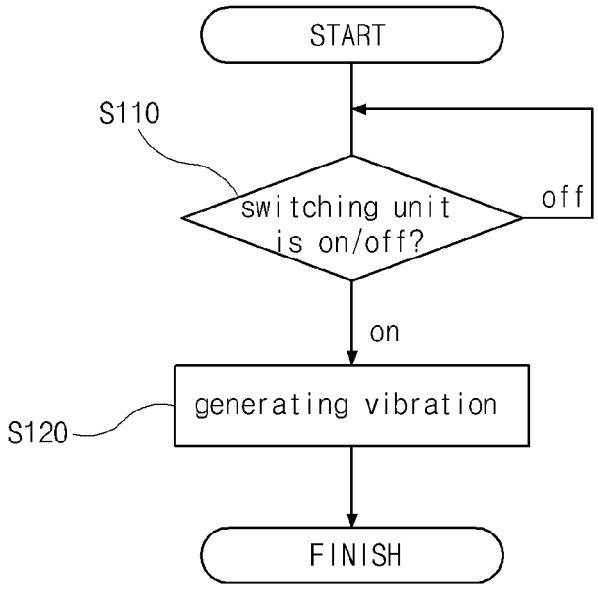

START
S110
switching unit is on/off?
off
on
generating vibration
S120
FINISH

FIG. 5

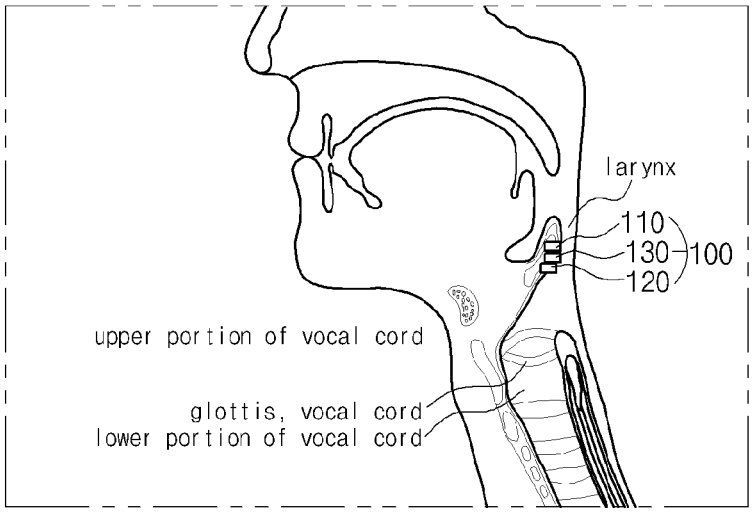

larynx
110
130
120
100
upper portion of vocal cord
glottis, vocal cord
lower portion of vocal cord

FIG. 6

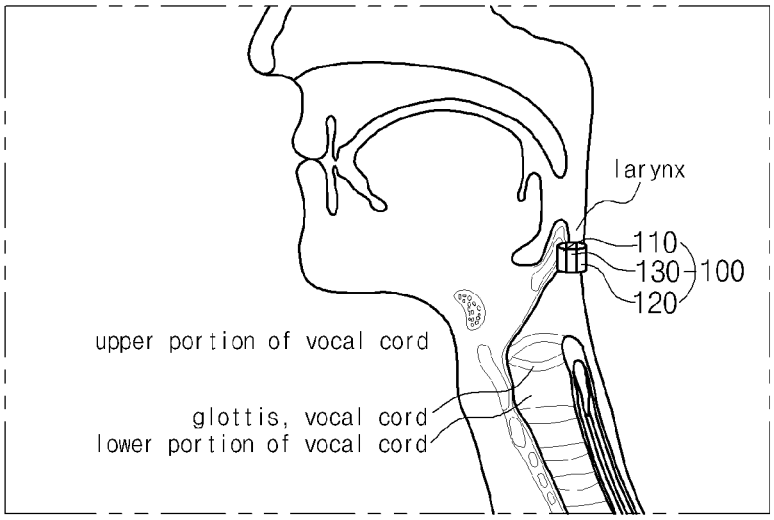

larynx
110
130
120
100
upper portion of vocal cord
glottis, vocal cord
lower portion of vocal cord

FIG. 7

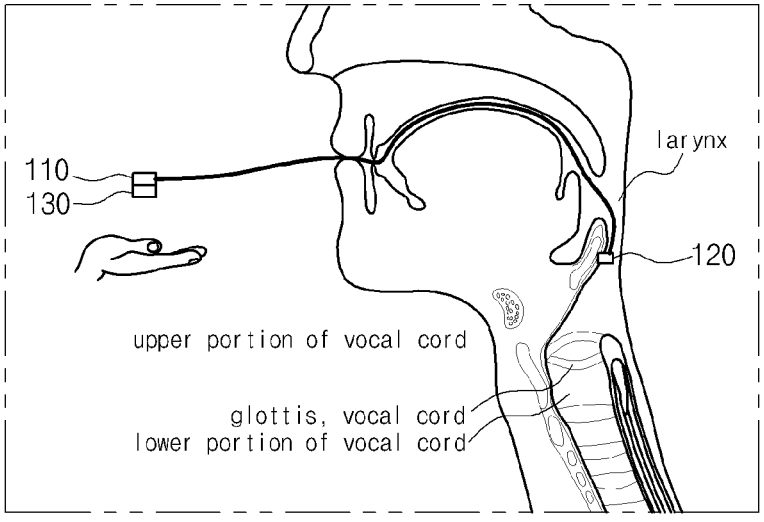

110
130
larynx
120
upper portion of vocal cord
glottis, vocal cord
lower portion of vocal cord

FIG. 8

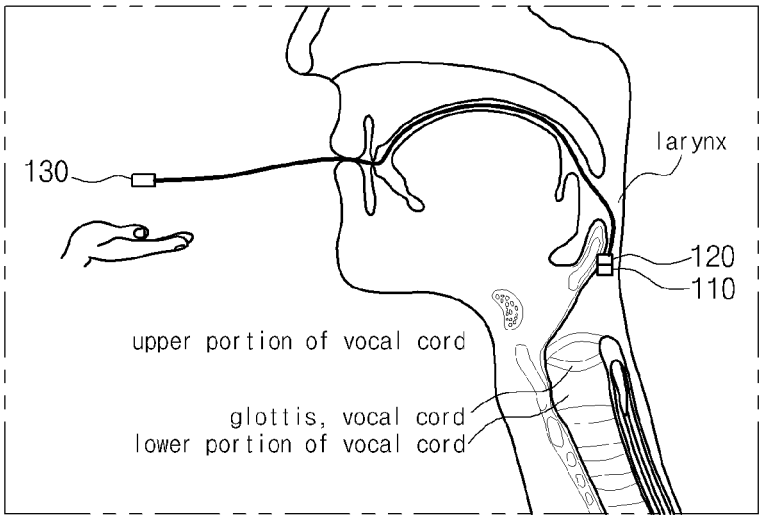

130
larynx
120
110
upper portion of vocal cord
glottis, vocal cord
lower portion of vocal cord

FIG. 9

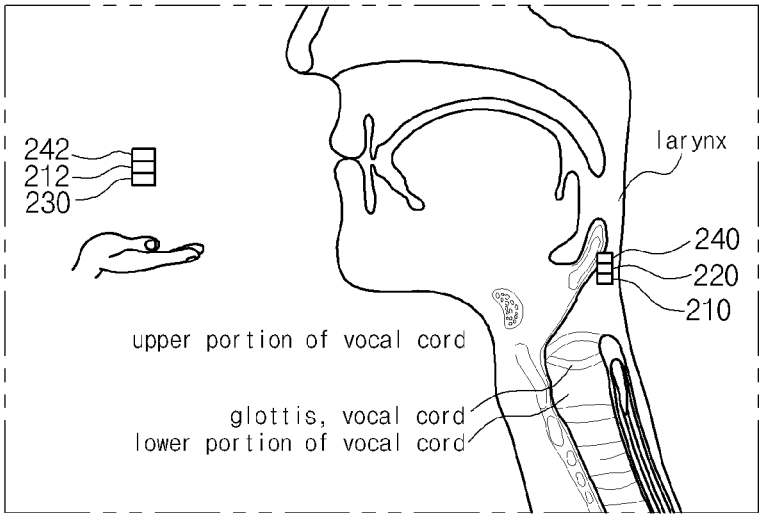

242
212
230
larynx
240
220
210
upper portion of vocal cord
glottis, vocal cord
lower portion of vocal cord

FIG. 10

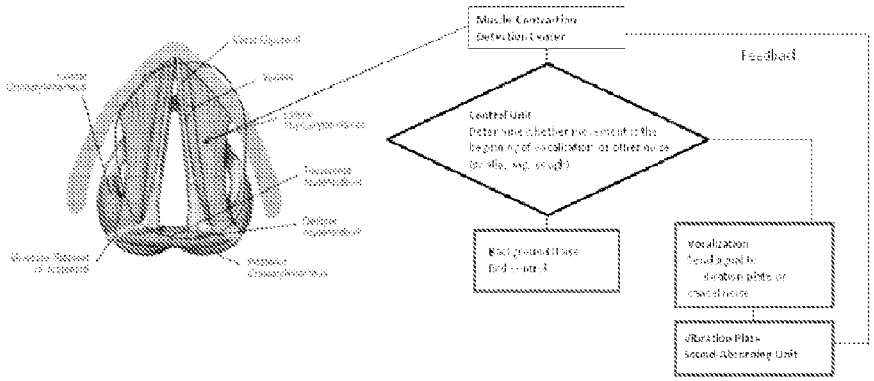


FIG. 11A

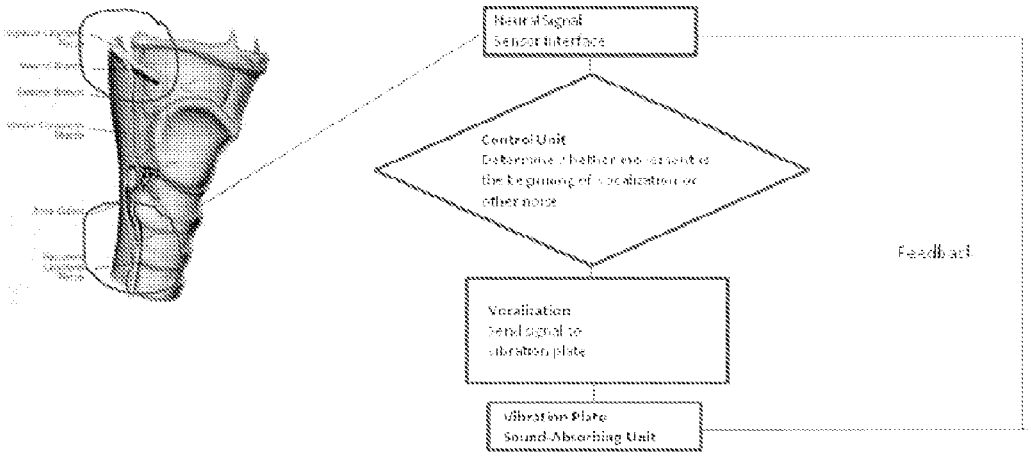


FIG. 11B

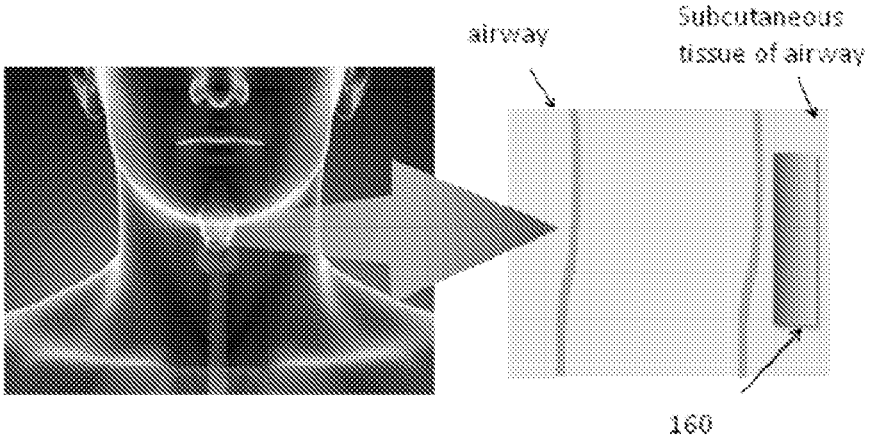


Fig. 12A

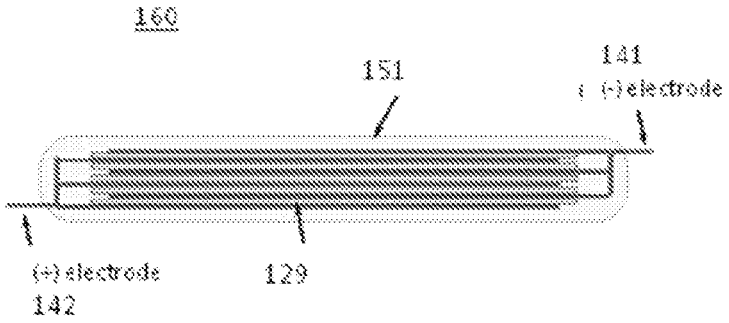


Fig. 12B

Fig. 13A

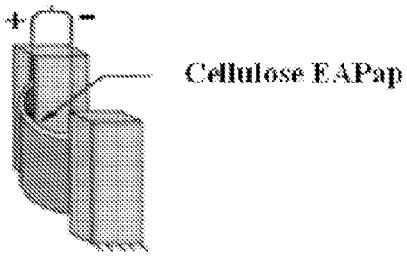


Fig. 13B

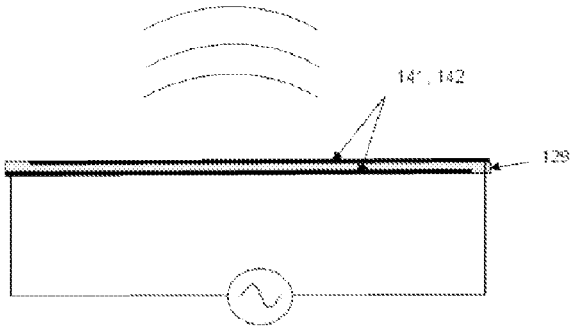


Fig. 13C

DEVICE FOR SUPPLEMENTING VOICE AND METHOD FOR CONTROLLING THE SAME

[0001] This application claims the benefit of Korean Patent Application No. 10-2012-0003868, filed on Jan. 12, 2012, No. 10-2012-0022979, filed on Mar. 6, 2012 and No. 10-2012-0039843, filed on Apr. 17, 2012, which are hereby incorporated by reference in their entirety.

BACKGROUND

[0002] 1. Field

[0003] The present disclosure relates to a device for supplementing a voice, and for example, to a device for supplementing a voice that generates a vibration for sound by attachment to or contact with a body and a method for controlling the device.

[0004] 2. Description of Related Art

[0005] A sound of human beings is expressed through a voice. The voice generated by vocal organs is classified into: a pronunciation or a speech sound for communication of linguistic transinformation; and a non-linguistic vocalization irrelevant to communication. While a sound of animals without a vowel is differently felt by a listener according to his own thought, a voice of human beings with a vowel constitutes various discriminable sounds. As a result, human beings communicate with one another by the voice.

[0006] The voice of human beings is an essential element for communication, and various vocal organs of a nervous system and a respiratory system relate to generation of the voice. Among the nervous system, a central nervous system and a peripheral nervous system relate to generation of the voice. A cranium or a nucleus of a brain cell which is necessary for generation of language is disposed in a brain stem of the central nervous system. A cerebellum of the central nervous system has a function of tuning a control of muscle for operation, and a cerebral hemisphere of the central nervous system performs a dominant role in language function. There are the fifth brain nerve relating to movement of a chin, the seventh brain nerve relating to movement of lips, the tenth brain nerve relating to movement of a pharynx and a larynx, the eleventh brain nerve relating to movement of a pharynx and the twelfth brain nerve relating to movement of a tongue in a cranial nerve relating to generation of the speech sound. A nersus laryngeus superior and a recurrent laryngeal nerve of the peripheral nervous system which are separated from a vagus nerve directly relate to movement of the larynx.

[0007] The speech sound is generated by an intimate interaction among a lower respiratory system, a larynx and a vocal track. Specifically, the larynx in a neck of human beings which relates to a voice is disposed between second and third cervical vertebrae (C2, C3) when one is a baby and moves to be disposed between third and sixth cervical vertebrae (C3, C6) when one is an adult. The larynx has functions of swallowing, cough, occlusion, respiration and vocalization. Specifically, the larynx includes a vocal cord as a source of a voice. The vocal cord has a wrinkled double-layered shape crossing an inner space of the larynx. A flow of an expired air vibrates the vocal cord and a control of the expired air efficiently supplies a sound energy during vocalization. When the vocal cord is properly strained and closed, the expired air vibrates the vocal cord, and a glottis that is a gap between the vocal cord and an arytenoid of the larynx opens and closes with a specific period to cut and connect the expired air. The discontinuous flow of the expired air functions as the source of the voice. When the air expired to exterior by respiration passes though the glottis, the air vibrates the vocal cord. Although the sound generated in the larynx is a consonant, a vowel is generated by means of a palate, a tongue, teeth and lips.

[0008] A voice disability may be defined as a problem such that a pitch, a loudness, a quality and a flexibility of a voice are not proper to a gender, a physique, a social environment and a geographical position. The innate or acquired voice disability may be cured by a surgery of expanding or reducing the vocal cord of the larynx. However, the voice disability is not completely cured and an effect of the surgery is not accurate. Various methods for determining the voice disability, for example an investigation of voice symptom, an investigation of voice usage pattern, an acoustic test and aerodynamic test, have been developed, and whether the voice disability exists or not is determined by the various methods to a certain extent.

[0009] The voice disability having various types is classified into a functional voice disability and an organic voice disability. Most of voice disabilities may result from a disability of the vocal cord, and the disability of the vocal cord may be caused by generation of a tumefaction, a tearing or an abnormal substance due to an external environmental factors.

[0010] For the purpose of overcoming the voice disability, an artificial vocal cord has been suggested. In a method of using the artificial vocal cord, an artificial connecting tube is inserted between a respiratory tract and an esophagus so that the air of the respiratory tract can be induced to the esophagus and can vibrate an esophageal sphincter instead of the vocal cord. When the esophageal sphincter vibrates, a flow of the air remaining in the respiratory tract is cut so that vocalization can be performed. However, the voice by the artificial vocal cord has a poor quality to have a mere conversation. Accordingly, a number of troubles in a social life are still not surmounted.

[0011] Besides the vocal disability, people suffer from a vocal disorder such that vocalization is not controlled due to an uncontrollable voice. For example, a voice may be too loud, too quiet or too hoarse. Although the surgery of the larynx or the vocal cord is performed to overcome the vocal disability or the vocal disorder, the curing method is not a perfect solution because the surgery is sometimes impossible.

SUMMARY

[0012] Accordingly, the present disclosure is directed to a device for supplementing a voice and a method for controlling the device that substantially obviate one or more of the problems due to limitations and disadvantages of the related art.

[0013] An advantage of the present disclosure is to provide a device for supplementing a voice where vocalization of excellent quality is obtained by generating a vibration at or near a vocal cord.

[0014] Another advantage of the present disclosure is to provide a device for supplementing a voice where vocalization of excellent quality is obtained by generating an amplified vibration or an attenuated vibration from an original vibration.

[0015] Another advantage of the present disclosure is to provide a device for supplementing a voice where vocalization of excellent quality is obtained by generating a frequency modulated vibration for an original vibration.

[0016] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. These and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0017] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a device for supplementing a voice includes: a switching unit outputting a signal; a vibration generating unit generating a vibration according to the signal; and a power unit supplying a power to the switching unit and the vibration generating unit.

[0018] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0020] In the drawings:

[0021] FIG. **1** is a block diagram showing a device for supplementing a voice according to a first embodiment of the present invention;

[0022] FIG. **2** is a view showing an exemplary electric circuit for a vibration generating unit of a device for supplementing a voice according to a first embodiment of the present invention;

[0023] FIG. **3** is a view showing a vibration generating unit of a device for supplementing a voice according to a first embodiment of the present invention;

[0024] FIG. **4** is a plan view showing a vibration generating unit of a device for supplementing a voice according to another embodiment of the present invention;

[0025] FIG. **5** is a flow chart illustrating a method of controlling a device for supplementing a voice according to a first embodiment of the present invention;

[0026] FIGS. **6** to **9** are views showing installation states of a device for supplementing a voice according to a first embodiment of the present invention;

[0027] FIG. **10** is a view showing installation state of a device for supplementing a voice according to a second embodiment of the present invention;

[0028] FIG. **11**A is a diagram illustrating an example of a method of detecting original vibration;

[0029] FIG. **11**B is a diagram illustrating another example of a method of detecting original vibration;

[0030] FIG. **12**A is a diagram illustrating a method of implanting a device for supplementing voice according to another example;

[0031] FIG. **12**B is a diagram illustrating a film speaker according to another example.

[0032] FIG. **13**A is a photograph of a film speaker according to another example;

[0033] FIG. **13**B is a diagram illustrating concept of a film speaker according to another example; and

[0034] FIG. **13**C is a schematic diagram illustrating a film speaker according to another example.

DETAILED DESCRIPTION

[0035] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, similar reference numbers will be used to refer to the same or similar parts.

[0036] A glottis between vocal cords of a larynx is periodically opened and closed and a discontinuous flow of an expired air vibrates the vocal cords to generate a voice. A loudness of the voice corresponds to an amount of the discontinuous flow of the expired air and a pitch of the voice corresponds to a frequency of the vibration. A number of the vibration of the vocal cords per second is defined as an individual fundamental frequency. Since a force of a muscle narrowing the vocal cords, a thickness of the vocal cords and a size and a shape of the glottis are different according to individuals, the flow of an expired air through the vocal cords is also different according to individuals. For example, since women or children have a narrow glottis, the flow of an expired air is fast and the vibration has a relatively high frequency. As a result, women or children have a relatively high frequency and a relatively high pitch as compared with men.

[0037] Although human beings have various voices due to the vibration of the vocal cords, one may have an innate or acquired voice disability such that the vocal cords never vibrate or do not vibrate appropriately. The device according to the present disclosure may provide a fundamental vibration, an amplified vibration, an attenuated vibration or a frequency modulated vibration for the voice.

[0038] In illustration, an original vibration by a vocal cord may be referred to as a first vibration and an electric signal corresponding to the first vibration may be referred to as a first signal. In addition, a vibration which is obtained using the original vibration may be referred to as a second vibration and an electric signal corresponding to the second vibration may be referred to as a second signal.

[0039] FIG. **1** is a block diagram showing a device for supplementing a voice according to a first embodiment of the present invention.

[0040] In FIG. **1**, a device **100** for supplementing a voice includes a power unit **110**, a vibration generating unit **120** and a switching unit **130**. The power unit **110** supplies a power to the vibration generating unit **120** and the switching unit **130**. For example, the power unit **110** may include a rechargeable battery. In addition, the battery may be formed of a material having biocompatibility based on the point that the device **1000** may be installed in a body such as a vocal cord. In other examples, the power unit **110**, the vibration generating unit **120**, the switching unit **130**, or any combination thereof, may be coated with or encapsulated in a biocompatible material.

[0041] The device **100** may further include a first signal detecting unit that detects original vibration and convert the original vibration into a first signal.

[0042] Referring to FIG. **11**A, in an example of a method of detecting the original vibration. The original vibration of the vocal cord may be detected from the movement of vocal cord muscles. Various muscles determine the change in the shape of the vocal fold. For instance, thyroarytenoid is a broad, thin muscle that lies parallel with and lateral to the vocal fold, and functions in fine tonal control of the vocal cords. The contraction of the muscle may be detected and converted to a first signal. Further, a control unit that includes a processing unit may be employed to determine whether a movement of the

muscle corresponds to the beginning of vocalization or to movements unrelated to vocalization, such as swallowing or coughing. If the control unit determines that the movement is not the beginning of vocalization, the signal may be removed or suppressed. If the control unit determines that the movement corresponds to vocalization, the obtained signal can be send to the vibration plate.

[0043] Thyroarytenoid muscle is just one example of muscle which may be monitored to detect the original vibration. Various other muscles related to vocalization may be monitored to detect the original vibration. In addition, signals obtained from a plurality of muscles may be combined to obtain the first signal.

[0044] As illustrated in FIG. **11**B, in another example, the original vibration may be detected from monitoring the firing of action potential along various nerves. For instance, the electrical signal along a peripheral nerve bundle, such as the vagus nerve fiber, laryngeal nerve, and various neuromuscular junction can be detected and converted to the first signal. The original vibration may also be detected from central nervous system, or from the movement of muscles or neuromuscular junctions that are not directly related to the movement of the vocal folds.

[0045] The electrical signals along a pheripheral nerve may be detected by a peripheral nerve interface. For instance, a cuff type neural electrode may be used to surround a nerve bundle. This is a type of extraneural electrode. The signal that travels along a nerve may be also intensified by applying pressure to the nerve bundle. In other examples, an intraneural electrode that penetrates into a nerve bundle may be used to detect the signal. Examples of intraneural electrodes include insertion type electrodes and regenerative type electrodes. An insertion type electrode includes a needle-type electrode, a ribbon-type electrode, and a needle array type electrode. A regenerative type electrode includes a sieve-type electrode, a regenerative tube type electrode, a regenerative cuff type electrode.

[0046] Suitable material for the electrode includes metallic electrode materials such as Pt, Au, Ir, Pd, and other corrosion resistant noble metals, stainless steel or other alloy metals, and metallic and polymer composite materials. Other suitable materials include conductors and semiconductor ceramic materials, such as Si, ITO; composites of nano-ceramic materials; graphite and carbon-based materials such as graphite, carbon fiber, carbon nanotube, grapheme; carbon and polymer composites; conductive polymers such as PEDOT, PPY, PANI, polythiophene of synthesized conjugated polymers, melanin natural conjugated polymers, conductive hydrogel conductive hydrogels, and conductive elastomers. However, suitable electrode materials are not limited to this list.

[0047] The possibility of nerve interface inflammation may be reduced by various methods, including: using biocompatible material to form the electrode; coating the electrode with biocompatible material; coating the electrode with extracellular matrix; and localized delivery of anti-inflammatory drug to the location of the interface.

[0048] The switching unit **130** may turned on the vibration generating unit **120** according to a user's selection. When the switching unit **130** is turned on, the switching unit **130** may output a second signal to the vibration generating unit **120**. In addition, the vibration generating unit **120** may generate a second vibration corresponding to the second signal.

[0049] When the vocal cord is removed by ventriculocordectomy, the switching unit **130** generates the second signal according to a user's selection and the vibration generating unit **120** generates the second vibration according to the second signal. As a result, vocalization can be obtained even when the vocal cord is removed by ventriculocordectomy.

[0050] In addition, the switching unit **130** may include a determining unit for setting up an intensity of the second vibration of the vibration generating unit **120** so that the switching unit **130** can control the intensity of the second vibration. For example, the second signal of the switching unit **130** may include information regarding the intensity of the second vibration of the vibration generating unit **120**.

[0051] FIG. **2** is a view showing an exemplary electric circuit for a vibration generating unit of a device for supplementing a voice according to a first embodiment of the present invention.

[0052] In FIG. **2**, a device for supplementing a voice includes a switching unit **130** that outputs a second signal and a vibration generating unit **120** that generates a second vibration according to the second signal.

[0053] The switching unit **130** generates the second signal when the switching unit **130** is turned on according to a user's selection. The vibration generating unit **120** may include a capacitor **122** and a coil **124**. The capacitor **122** for matching an impedance of the coil **124** may be connected to the coil **124** in series, and the coil **124** may generate the second vibration using an electromagnetic induction. The coil **124** may be referred to as a voice coil or an inductor.

[0054] FIG. **3** is a view showing a vibration generating unit of a device for supplementing a voice according to a first embodiment of the present invention.

[0055] In FIG. **3**, a vibration generating unit **120** includes a coil **124**, a magnet **126** and a vibration plate **128**. The vibration generating unit **120** generates the second vibration similarly to a speaker. For example, the magnet **126** of a ring shape may have a gap at a center thereof and the coil **124** wound around a bobbin is disposed in the gap. The vibration plate **128** may be attached to the coil **124** through the bobbin to improve efficiency by enlarging a vibration area.

[0056] Since a magnetic field is generated by the magnet **126**, a Lorentz force is generated by the magnetic field and the coil **124** where a current corresponding to the second signal flows. The magnitude of the Lorentz force is proportional to the intensity of the magnetic field, the intensity of the current and the length of the coil **124**, and the direction of the Lorentz force is normal to a plane constituted by the direction of the magnetic field and the direction of the current.

[0057] Since an attractive force or a repulsive force is generated between the magnet **126** and the coil **124** according to the direction of the magnetic field by the magnet **126** and the direction of the current flowing through the coil **124**, the coil **124** moves back and forth. The vibration plate **128** attached to the coil **124** vibrates by the reciprocating motion of the coil **124**, and the air adjacent to the vibration plate **128** vibrates to generate the second vibration. As a result, the vibration generating unit **120** generates the second vibration corresponding to the second signal having the same amplitude, the amplified amplitude, the attenuated amplitude or the modified frequency as compared with the first signal. The vibration plate **128** may, for example, be made of a piezoelectric paper.

[0058] The vibration generating unit may generate the second vibration using a piezoelectric phenomenon in another embodiment. The piezoelectric element has a mechanical strain when an electric field is applied and a plate vibrates by the mechanical strain.

[0059] For example, the device for supplementing voice may be inserted in to the airway in the vicinity of the esophageal sphincter and utilize piezoelectric effect to control the vibration of the vibration generating unit or to supplement the sound-making function of vocal cord. Because the device performs the vibration that is usually carried out by the vocal cord, the sound quality can be excellent in comparison to a device in which the esophageal sphincter performs the vibration while air is artificially forced into the esophagus. Further, in examples where abnormal sounds are eliminated by analyzing the original vibration, background notice and noise unrelated to speech-making can be eliminated or suppressed, further improving the sound quality.

[0060] FIG. **4** is a plan view showing a vibration generating unit of a device for supplementing a voice according to another embodiment of the present invention.

[0061] In FIG. **4**, a vibration generating unit **120** includes a vibration plate **121** and a piezoelectric ceramic **123**. The piezoelectric ceramic **123** may be formed on the vibration plate **121** by a coating method or a deposition method. When the second signal from the switching unit **130** is applied to the piezoelectric ceramic **123**, the piezoelectric ceramic **123** vibrates the vibration plate **121** using the piezoelectric phenomenon. For example, the piezoelectric ceramic **123** may include one of an alloy of $PbZrO_3$ and $PbTiO_3$ (PZT), $PbTiO_3$, $BaTiO_3$, $NH_4H_2PO_4$ (monoammonium phosphate) and $C_2H_4(NH_2)_2C_4H_4O_6$ (EDT: ethylenediamine tartrate).

[0062] The vibration generating unit **120** may be coated with a biocompatible coating or encapsulated in a biocompatible housing such as a film, allowing the vibration generating unit **120** to remain in a patient's body without eliciting adverse immune response.

[0063] FIG. **12**B illustrates another embodiment of a device for supplementing voice and method for controlling the same. In this example, a vibration generating unit includes a plurality of piezoelectric layers **129**, a first electrode **141**, a second electrode **142** and an encapsulator **151**. The plurality of piezoelectric layers **129** may include a piezoelectric polymer, referred to as a piezoelectric paper. The first and second electrodes **141**, **142** may be laminated on the plurality of piezoelectric layers **139** and may be formed on opposite sides, respectively, of each piezoelectric layer **129**. In addition, the encapsulator **151** surrounds the plurality of piezoelectric layers **129**, the first electrode **141** and the second electrode **142** so that the vibration generating unit can be implanted in a vocal cord or a tissue adjacent to a vocal cord as illustrated in FIG. **12**A.

[0064] When the plurality of piezoelectric layers are implanted in the vocal cord or the tissue adjacent to the vocal cord, the bending strain may be rapidly reduced to generate an unwanted vibration. For the purpose of preventing the unwanted vibration, the encapsulator is formed to wrap the plurality of piezoelectric layers. As a result, an electric shortage is prevented and the predetermined vibration is effectively generated in the skin tissue. The encapsulator may be formed of a biocompatible polymer harmless to human beings. For example, the encapsulator may be formed of a synthetic polymer or a natural polymer such as such as polyethylene glycol (PEG), 3-aminopropyltriethoxysilane (APTES), silicon rubber and cellulose.

[0065] In another embodiment, a film speaker may be used for a vibration generating unit **120**. The film speaker may include a piezoelectric film and electrodes.

[0066] For example, the piezoelectric film may have a piezoelectric direct effect such that a mechanical energy is converted into an electric energy and a piezoelectric converse effect such that an electric energy is converted into a mechanical energy. The piezoelectric direct effect may be a function of generating a voltage. When an external stress or a vibration displacement is applied to the piezoelectric film having the piezoelectric direct effect, the piezoelectric film may output an electric signal. The piezoelectric film having the piezoelectric direct effect may be applied to a piezoelectric device for ignition or various sensors. In addition, the piezoelectric converse effect may be a function of generating a displacement. When an external voltage is applied to the piezoelectric film having the piezoelectric converse effect, the piezoelectric film may outputs a mechanical displacement. The piezoelectric film having the piezoelectric converse effect may be applied to an actuator or an acoustic system. As a result, when an AC voltage is applied to the piezoelectric film having the piezoelectric direct effect and the piezoelectric converse effect, the piezoelectric film may output a sound energy corresponding to a frequency of the AC voltage to generate a sound.

[0067] An example of the film speaker is illustrated in FIG. **13**B. For instance, the film speaker may include, as a vibration generating unit, a layer of piezoelectric paper **129** or a piezoelectric polymer laminated or coated with a first electrode **141** and a second electrode **142**, as illustrated in FIG. **12**C. For instance, a cellulose Electro-active paper (EAPap) may be used in the vibration generating unit of a film speaker. Electrodes **141**, **142** may be a sheet of a conductive material. For example, the vibration generating unit of the film speaker illustrated in FIG. **13**A is a cellulose Electro-active paper (EAPap) coated with electrodes comprising a gold film. The piezoelectric paper may be rolled or placed in layers to produce a compact device.

[0068] FIG. **5** is a flow chart illustrating a method of controlling a device for supplementing a voice according to a first embodiment of the present invention.

[0069] At step S**110**, it is judged whether the switching unit **1310** is turned on or turned off. When the switching unit **1310** is turned off, the process returns to the start step. When the switching unit **1310** is turned on, the switching unit **1310** generates the second signal and sends the second signal to the vibration generating unit **1230**.

[0070] At step S**120**, the vibration generating unit **1230** generates the second vibration according to the second signal.

[0071] FIGS. **6** to **9** are views showing installation states of a device for supplementing a voice according to a first embodiment of the present invention, and FIG. **10** is a view showing installation state of a device for supplementing a voice according to a second embodiment of the present invention. Although a normal vocal cord is shown in FIGS. **6** to **10**, the device for supplementing a voice may be applied to a partially disabled vocal cord or a wholly disabled vocal cord.

[0072] In FIG. **6**, the power unit **110**, the vibration generating unit **120** and the switching unit **130** of the device **100** for supplementing a voice may be installed at an upper portion of the larynx.

[0073] In FIG. **7**, the power unit **110**, the vibration generating unit **120** and the switching unit **130** of the device **100** for supplementing a voice may be wrapped by an encapsulator, and the encapsulated power unit **110**, vibration generating unit **120** and switching unit **130** may be installed at an upper portion of the larynx.

[0074] In FIG. **8**, the vibration generating unit **120** may be installed at an upper portion of the larynx, and the power unit **110** and the switching unit **130** may be installed at an outer portion of the body. The vibration generating unit **120** inside the body may be wiredly communicated with the power unit **110** and the switching unit **130** outside the body. For instance, the power unit **110** and the switching unit **130** may be located outside of the body and connected to the vibration generating unit **120** via the oral cavity, or via a hole that penetrates through the epidermis in the neck region.

[0075] In FIG. **9**, the power unit **110** and the vibration generating unit **120** may be installed at an upper portion of the larynx, and the switching unit **130** may be installed at an outer portion of the body. The power unit **110** and the vibration generating unit **120** inside the body may be wiredly communicated with the switching unit **130** outside the body.

[0076] In FIG. **10**, the first power unit **210**, the vibration generating unit **220** and the first control unit **240** may be installed at an upper portion of the larynx, and the second power unit **212**, the switching unit **230** and the second control unit **242** may be installed at an outer portion of the body. The first power unit **210**, the vibration generating unit **220** and the first control unit **240** inside the body may wirelessly communicate with the second power unit **212**, the switching unit **230** and the second control unit **242** outside the body. Since the vibration generating unit **220** inside the body is wirelessly communicated with the switching unit **230** outside the body, the first power unit **210** for power supply and the first control unit **240** for wireless communication may be installed inside the body, and the second power unit for power supply and the second control unit for wireless communication may be installed outside the body. Thus, it is possible to avoid maintaining a hole through the epidermis of a patient or having a wire connection that pass through the oral cavity.

[0077] Although the vibration generating unit **120** and **220** is installed exemplarily at the upper portion of the larynx in FIGS. **6** to **10**, the vibration generating unit **120** and **220** may be installed at one of a cervical portion, a vocal cord and a subcutaneous tissue adjacent to the vocal cord.

[0078] For example, the device **100** may be a hanging type device where the vibration generating unit **120** and **220** is hung on a cervical portion. In addition, the device **100** may have an attaching type where the vibration generating unit **120** and **220** is attached to the vocal cord or the tissue adjacent to the vocal cord using a biocompatible medical adhesive such as a cyanoacrylate adhesive of liquefied monomer (methyl/ethyl/n-butyl group), a fibrin glue using tissue conglutination, a gelatin glue (e.g., cross-linked gelatin-resorcinol-formaldehyde (GRF)) and polyurethane adhesive. Further, as an implanting type device, after the vocal cord or the subcutaneous tissue adjacent to the vocal cord is cut out, the vibration generating unit **120** and **220** may be implanted and may be covered with the subcutaneous tissue. When the vibration generating unit **120** and **220** is implanted in the vocal cord, the vibration generating unit **120** and **220** may be implanted without damage such that the vibration generating unit **120** and **220** are surrounded by a biocompatible material.

[0079] The power unit **110** may be installed at the outer portion or the inner portion of the body. For example, the power unit **110** may include a transplatable battery such as a nano battery, a biofuel cell that attains electricity during an oxidation process of glucose using enzyme and a biocompatible fuel cell that uses a biopolymer film of nucleic acid/amino acid/protein. The power unit **110** may be recharged by one of an electromagnetic induction method, a human body communication method, an electromagnetic resonance method, an electromagnetic wave method, an ultrasonic method and a solar heat method.

[0080] Similarly to a wireless recharger, for example, a recharging pad may be disposed adjacent to the power unit **1100** and the magnetic field generated by the first coil of the recharging pad may induce the current in the second coil of the power unit **1100**. In addition, the power unit **1100** at the outer portion or the inner portion of the cervical portion may be recharged by the current of the second coil.

[0081] Moreover, the power unit **110** may be recharged by a human body communication (HBC) method using the body as a medium for communication. For example, when a voltage is applied to an external electrode, a surface electric field of a body separated from the external electrode by an insulator may be changed and the power unit **110** may be recharged.

[0082] The device **100** and **200** may have a mouth type where the power unit **110** and **210** and the vibration generating unit **120** and **220** are inserted through the mouth as a tube shape and the vibration is generated in the mouth. In another embodiment, the device may have a neck type where the vibration generating unit **120** and **220** contacts the neck and artificially vibrates the sphincter.

[0083] In a device for supplementing a voice according to the present disclosure, since a second vibration that corresponds to or modified from a first vibration of an original voice is directly provided adjacent to a vocal cord from a bio-signal such as a pulse signal of a nerve, an electromyographic signal, a sound signal and a brain signal, an excellent vocalization can be obtained. In addition, since a first vibration of an original voice that is too loud, too quiet or too hoarse is reduced using a third vibration, a quality of vocalization is improved.

[0084] It will be apparent to those skilled in the art that various modifications and variations can be made in the present disclosure without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[0085] The units described herein may be implemented using hardware components and software components. Examples of hardware components include microphones, amplifiers, band-pass filters, and processing devices. A processing device may be implemented using one or more general-purpose or special purpose computers, such as, for example, a processor, a controller and an arithmetic logic unit, a digital signal processor, a microcomputer, a field programmable array, a programmable logic unit, a microprocessor or any other device capable of responding to and executing instructions in a defined manner. The processing device may run an operating system (OS) and one or more software applications that run on the OS. The processing device also may access, store, manipulate, process, and create data in response to execution of the software. For purpose of simplicity, the description of a processing device is used as singular; however, one skilled in the art will appreciated that a processing device may include multiple processing elements and multiple types of processing elements.

[0086] The software may include a computer program, a piece of code, an instruction, or some combination thereof, for independently or collectively instructing or configuring the processing device to operate as desired. Software and data

may be embodied permanently or temporarily in any type of machine, component, physical or virtual equipment, computer storage medium or device, or in a propagated signal wave capable of providing instructions or data to or being interpreted by the processing device. The software also may be distributed over network coupled computer systems so that the software is stored and executed in a distributed fashion. In particular, the software and data may be stored by one or more non-transitory computer readable recording mediums. Examples of the non-transitory computer readable recording medium include read-only memory (ROM), random-access memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices. Also, functional programs, codes, and code segments for accomplishing the examples disclosed herein can be easily construed by programmers skilled in the art to which the examples pertain based on and using the flow diagrams and block diagrams of the figures and their corresponding descriptions as provided herein.

What is claimed is:

1. A device for supplementing a voice, comprising:

a switching unit outputting a signal;

a vibration generating unit generating a vibration according to the signal; and

a power unit supplying a power to the switching unit and the vibration generating unit.

2. The device according to claim **1**, wherein the vibration generating unit generates the vibration using one of an electromagnetic induction between a magnet and a coil and a piezoelectric phenomenon.

3. The device according to claim **1**, wherein the power unit includes a battery.

4. The device according to claim **3**, wherein the power unit is recharged by one of an electromagnetic induction method, a human body communication method, an electromagnetic resonance method, an electromagnetic wave method, an ultrasonic method and a solar heat method.

5. The device according to claim **1**, wherein the power unit, the vibration generating unit and the switching unit are installed at one of an upper portion of a larynx, a cervical portion, a vocal cord and a subcutaneous tissue adjacent to the vocal cord.

6. The device according to claim **1**, wherein the power unit, the vibration generating unit and the switching unit wrapped by a capsule are installed at one of an upper portion of a larynx, a cervical portion, a vocal cord and a subcutaneous tissue adjacent to the vocal cord.

7. The device according to claim **1**, wherein the vibration generating unit is installed at one of an upper portion of a larynx, a cervical portion, a vocal cord and a subcutaneous tissue adjacent to the vocal cord, and the power unit and the switching unit are installed at an outer portion of a body, and wherein the vibration generating unit is wiredly communicated with the power unit and the switching unit.

8. The device according to claim **1**, wherein the power unit and the vibration generating unit are installed at one of an upper portion of a larynx, a cervical portion, a vocal cord and a subcutaneous tissue adjacent to the vocal cord, and the switching unit is installed at an outer portion of a body, and wherein the power unit and the vibration generating unit are wiredly communicated with the switching unit.

9. The device according to claim **1**, further comprising first and second control units for wireless communication,

wherein the power unit includes a first power unit for supplying a power to the first control unit and the vibration generating unit and a second power unit for supplying the power to the second control unit and the switching unit.

10. The device according to claim **9**, wherein the first power unit, the vibration generating unit and the first control unit are installed at one of an upper portion of a larynx, a cervical portion, a vocal cord and a subcutaneous tissue adjacent to the vocal cord, and the second power unit, the switching unit and the second control unit are installed at an outer portion of a body, and wherein the first power unit, the vibration generating unit and the first control unit are wirelessly communicated with the second power unit, the switching unit and the second control unit.

11. The device according to claim **1**, wherein the device has one of a hanging type on a cervical portion, an attaching type to a vocal cord and an implant type in a tissue.

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