July 14, 1959 G. M. WRIGHT 2,895,126

NOISELESS DEVICE FOR GENERATING AUDIBLE VOICE FREQUENCIES INCLUDING HARMONICS

Filed Nov. 12, 1957

FIG. 1.

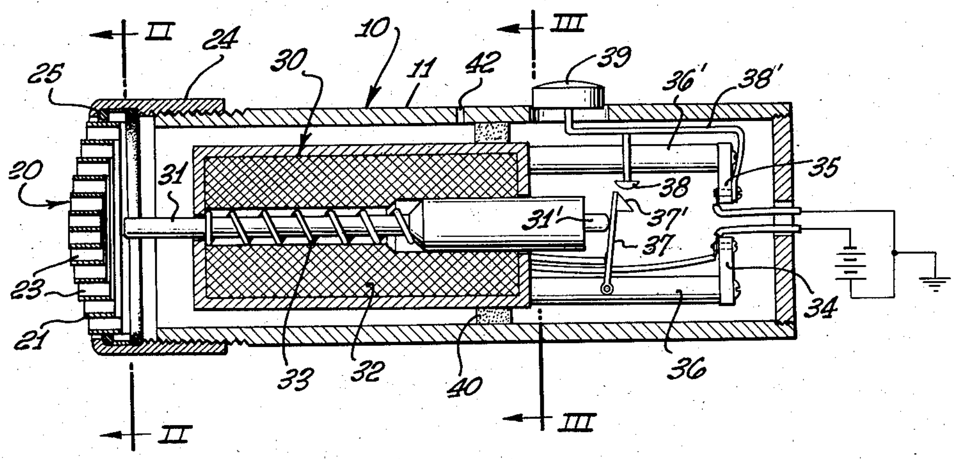


FIG. 2.

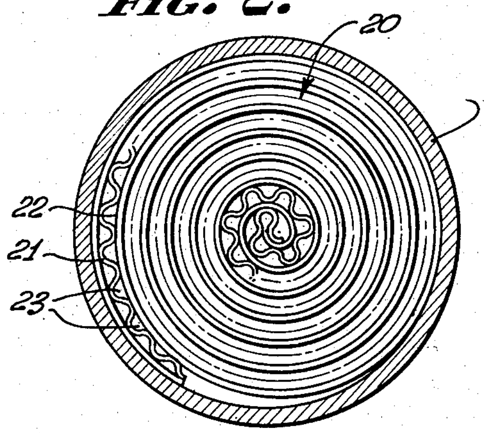


FIG. 3.

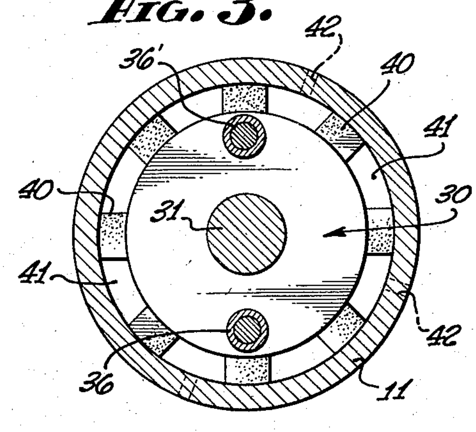


FIG. 4.

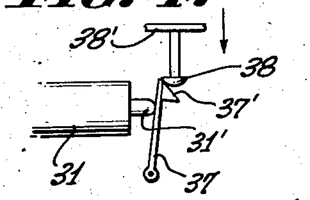


FIG. 6.

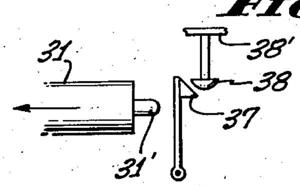
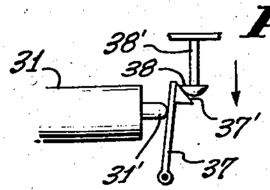


FIG. 5.



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ATTORNEYS.

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NOISELESS DEVICE FOR GENERATING AUDIBLE VOICE FREQUENCIES INCLUDING HARMONICS

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17 Claims. (Cl. 340—392)

This invention relates to a device for generating and varying voice frequencies including harmonics which is particularly well adapted for use by afflicted persons unable to normally produce voice sounds.

There are many afflicted persons who cannot produce voice sounds and speak understandably because their vocal organs, such as the larynx, have been removed or injured in whole or in part; surgery necessitated by carcinoma of the throat or larynx often destroys the power of speech. This invention relates to a small, portable device which generates mechanical frequencies similar to those of the normal speaking voice and imparts such frequency vibrations to the skin of an afflicted person in the region of his throat to produce sound waves within the cavities in which natural sounds would have been normally created, such sound waves being capable of modulation by the tongue and lips into understandable, audible words and sounds. However, when the device of the present invention is not in contact with a sounding board such as the skin of the cheek or throat, no objectionable sound or noise is produced even though the device is generating vibrations. Sound is only produced when the device engages a substantially solid resilient material, like the skin and flesh of a person's throat or other sheet material which acts as a diaphragm to produce sound waves. This advantage eliminates embarrassment which may be caused by an audible and perceptive buzzing of a noise-generating device when the user is not actually speaking. Moreover, in a preferred form of the device, the pitch or tone of the vibrations may be selectively and rapidly varied to permit the user to speak with inflection and not in a monotone.

Generally speaking, the present invention provides a substantially silent device for generating audible voice frequencies including harmonics when in contact with a solid material, the device having an elongated hollow casing adapted to be hand held, a reticulated, virtually rigid contact element mounted on one end of the casing, and electromagnetic striker means positioned within the casing and including a striker having a face of reduced area adapted to strike the contact element at selectively variable frequencies.

An object of the present invention is to provide a device which enables afflicted persons, unable to normally produce voice sounds, to speak audibly.

Another object of this invention is the provision of a device which is substantially silent but capable of generating audible voice frequencies including harmonics when in contact with a solid material.

A further object of the present invention is the provision of a novel contact element for devices adapted to generate audible sound frequencies when the element is placed in contact with a vibration-transmitting solid.

Other objects, uses, advantages and adaptations of the invention will become apparent to those skilled in the art from the following description. For purposes of facilitating understanding, reference will be had to the appended drawing, in which:

Fig. 1 is a longitudinal section of an exemplary embodiment of the invention.

Fig. 2 shows a transverse section of an exemplary embodiment taken along plane II—II of Fig. 1.

Fig. 3 shows a transverse section of the device taken along plane III—III of Fig. 2.

Figs. 4, 5 and 6 are a series of views illustrating the operation of the means for varying the frequency of reciprocation of the electromagnetic striker means.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Fig. 1 a substantially silent device **10** for generating voice frequencies including a casing **11**, a contact element **20** mounted on one end of the casing, and a striker means **30** positioned within the casing and adjacent the contact element **20**.

The elongated casing **11** may be hollow having its ends open and is adapted to be hand held. A recticulated, virtually rigid contact element **20** may be mounted on one end of the casing and is adapted to generate and transmit vibrations of audible frequencies when the element is placed into contact with a vibration-transmitting element. The contact element preferably has a multiplicity of passageways therethrough to permit it to transmit mechanical vibrations without acting as a generator of air waves of such vibrations. To attain this novel and desirable effect, the total area of passageways should exceed the frontal area of the solid material constituting the contact element. Although various constructions may be employed, the contact element **20** illustrated in the drawings may be made of spirally wound corrugated metallic ribbon **21** alternating with a non-corrugated ribbon **22**, adjacent lays being firmly connected as by furnace brazing, soldering etc. to form a virtually rigid, disk-like element which has a convex outer contour adapted to be comfortably placed against the skin of the user. Fig. 2 (equivalent to a plan view) shows that the frontal solid area is less than the total area of air passages such as **23**.

Means may be provided for adjustably positioning the contact element **20** with respect to the striker means **30**. Such means may be a ring **24** having the contact element **20** secured on one end and the other end threadedly and adjustably received on an open end of the casing **11**. A resilient washer or bushing **25** may be provided between the contact element **20** and the ring **24** to prevent any mechanical or artificial sounds from being produced when the contact element is set into vibration.

An electromagnetic striker means **30** may be positioned within the casing and may include a striker **31** having a face of reduced area adapted to strike the contact element **20**. The armature or striker **31** has an effective striking face area of less than 20% and preferably less than 10% of the total plan area of the contact element **20**. The striker means may be a solenoid coil **32** in which the reciprocatable armature or striker **31** is movably positioned, the striker being normally biased out of contact with the contact element **20** by means of the spring **33**.

Means are provided for energizing the striker means **30** at will, and preferably for varying the frequency at which striker **31** hits contact element **20**. Electrical energy may be supplied from a battery (capable of being carried in a pocket of a user of the device) and a flexible cable or conductor connected to ends of coil **32**. In its simplest embodiment an interrupter switch may be introduced into one of the conductors, but this would only permit the striker to hit contact element at a virtually constant frequency and preclude variation in tone or pitch. In the form of device illustrated, means are provided for varying the frequency. As shown in the drawings, the ends of the conductors from the battery are con-

nected to terminals 34 and 35 on insulated terminal posts 36 and 36'. Terminal 34 may be directly connected to one end of the coil 32 whereas the other end of the coil 32 is connected to a movable, resilient contact arm 37 against which insulated tip 31' of striker 31 is urged by spring 33 when the coil is de-energized (a condition illustrated in Fig. 1). When in such position, an inclined or cam face 37' of contact arm 37 is immediately beneath but out of contact with contact button 38 carried by a resilient actuating arm 38' electrically connected to terminal 35. Actuating arm 38' also carries an actuating push button 39 which extends through a suitable port in the casing. When push button 39 is depressed contact is made between contact button 38 and contact arm 37 thereby completing the circuit and energizing coil 32 to cause striker 31 to move and strike contact element 20. Movement of the armature or striker 31 in a striking direction removes tip 31' from resilient arm 37 and breaks the circuit; return of the striker closes the circuit.

The mode of operation of contact 37 to vary the frequency of reciprocation of the armature or striker 31 will be described by reference to Figs. 4, 5 and 6. As shown in Fig. 4, when contact 38 touches the upper end of the inclined face 37', the circuit is completed and the armature or striker 31 begins to move to the left or is drawn within the coil 32. When the armature 31 moves to the left, the resilient arm 37 also begins to pivot to the left and therefore breaks the circuit, assuming a position similar to that in Fig. 6, even through button 39 is partly depressed. When button 39 is partly depressed, say only an amount sufficient to cause contact button 38 to contact the upper end of resilient arm 37 and its inclined face 37', the striker 31 reciprocates through its longest stroke and at its lowest frequency, thereby generating the vibrations of low frequencies in the contact element 20. By depressing button 39 a greater distance, contact button 38 prevents resilient arm 37 from moving to the right (see Fig. 6) and thereby the stroke of striker 31 is shortened and vibrations of higher frequency are set up in contact element 20. The arrangement thus permits the user to vary the pitch of the tones formed in the cavities of his throat and mouth by varying the position of actuating push button 39. In addition, the position of the contact element 20 can be varied, thereby establishing a further change in pitch range. The user can add color, inflection and emphasis to sounds or words uttered with the sound generated by this device. In practice, the device may be adjusted to generate sounds of frequencies between about 100 and 2000, although a range of 200–700 is adequate.

While it is necessary that percussion takes place between the armature 31 and the contact element 20 in order to produce a vibration rich enough in harmonics to be articulated, the sound of the striking of the armature on the contact element should be at an absolute minimum. A sound-absorbing means may be provided within the casing 11 and is adapted to absorb sound generated by the striking of the armature 31 against the contact element 20 or sound within the casing. As shown in Figs. 1 and 3, the striker means 30 is spaced from and acoustically insulated from the casing 11 by means of strips of suitable sound-absorbing material 40 (such as felt) which form resonating chambers 41 surrounding the striker means. The chambers may be of various sizes and lengths to absorb any length sound waves that are generated within or transmitted into the casing 11. Small holes 42 are provided in the casing 11 at suitable points to dissipate the sound waves sent into the chambers.

It will be noted that contact element 20 is not a diaphragm and does not actually set up audible air waves when the striker 31 hits it. The striking face of striker 31 is also of small area and does not set up air waves of any intensity. The striking face impinges either upon the edges of the ribbons 21, 22, at the center area of contact 20 or against a small solid portion at such center, but any air waves generated by such percussion are distorted and readily pass through openings or reticulations 23, or bounce back into the case and are absorbed by chambers 41. The design of the device is therefore such that when the device 10 is not in contact with the throat of the afflicted person, and the operating button 39 is depressed (thereby setting up vibrations in contact element 20) no audible sound or noise will be produced.

The vibrations produced in the contact element 20 are turned into sound only when the contact element 20 engages the skin of the throat or cheek of the user or some other diaphragm-like object. The vibrations set up by contact element 20 against the skin of the throat of the afflicted person is a mechanical vibration and is turned into sound waves when the vibration reaches the air within the throat. The mass of the armature 31, the mass of the contact element 20 and the resilient values of the spring 33 and of the contact element mounting are designed to mechanically match the impedance of the flesh of the throat achieving the maximum transfer of energy to the air within the throat and causing the minimal disturbance of the air in contact with the skin of the throat and with the device. The skin of the throat in contact with contact element 20 acts as a diaphragm and moves air back into the casing as described above. As the air is trapped within the sound-absorbing chambers 41 as described hereinabove, a certain desirable quality to the voice is produced, thus giving it a fullness. Therefore, the seemingly undesirable noise transmitted back into the casing is used to give depth and roundness to the voice.

A substantially silent device is therefore provided for generating voice frequencies, including harmonics, while in contact with a solid material. It should be understood that the casing 11 is of such a size that it will readily fit into the pocket of the user. Any type of power source can be provided for operating the device, such as flashlight batteries or a hand-wound spring motor. With this device, a person who cannot produce voice sounds because of loss of his vocal organs can now speak and communiate with others. In addition, the voice produced by the present device will not produce an artificial or mechanical sound, but will enable the user to speak in a normal tone having depth and quality.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. A substantially silent device for generating voice frequencies including harmonics when in contact with a solid material, comprising: an elongated, hollow casing adapted to be hand held; a reticulated, virtually rigid element adjustably mounted on one end of said casing, said element having a frontal solid area which is smaller than the area of reticulations therethrough; electromagnetic striker means positioned within said casing and including a striker having a face of reduced area adapted to strike the element at a frequency of between about 100 and 2000 vibrations per second; and sound-absorbing means within said casing adapted to absorb the sound of blows delivered by the striker upon the element without absorbing vibrations setup in the element.

2. In the construction as stated in claim 1, the provision of means for varying the rate of energization of said striker means including a circuit broken by movement of the striker into striking relation with said element.

3. A construction as stated in claim 1, wherein said element comprises: spirally wound, corrugated metallic ribbon with adjacent lays firmly connected to form a disc-like structure.

4. A construction as stated in claim 1, wherein said striker has an effective striking face area of less than 20% of the plan area of said element.

5. A device as stated in claim 1 wherein the electromagnetic striker means comprises a solenoid coil and said striker comprises an armature of said coil; a source of energy and a circuit operably connecting said source to said coil; and an interrupter switch in said circuit and a manually operable push button to close said circuit.

6. A device as stated in claim 5 wherein the interrupter switch includes a resilient arm biased into circuit opening position; a contact button movable by said push button into contact with said arm; a spring biasing the striker into retracted position, said striker and biasing spring being adapted to move the resilient arm into position beneath the contact button when the striker is retracted, and cooperative means on said arm and contact button to vary the stroke of the striker in accordance with movement of the push button and contact button.

7. In the construction as stated in claim 1, the provision of means for adjustably positioning said element with respect to said striker means.

8. A substantially silent device for generating voice frequencies when in contact with a solid material, comprising: an elongated hollow casing adapted to be hand held; a reticulated, virtually rigid element mounted on one end of said casing; a solenoid coil within said casing and a reciprocatable armature in said coil, normally biased out of contact with said element but movable to strike the element.

9. In the construction as stated in claim 8, the provision of means for varying the length of stroke and frequnecy of reciprocation of said armature.

10. A construction as stated in claim 8, wherein said element comprises: spirally wound, corrugated metallic ribbon with adjacent lays firmly connected to form a disc-like structure.

11. In the construction as stated in claim 8, wherein said armature has an effective striking face area of less than 20% of the plan area of the element.

12. In the construction as stated in claim 8, the provision of sound-absorbing means within said casing adapted to absorb the sound of blows by the armature upon the element.

13. In the construction as stated in claim 8, the provision of means for adjustably positioning said element with respect to said armature.

14. A substantially silent device for generating audible voice frequencies when in contact with a solid, elastic material, comprising: a hollow casing adapted to be hand-held; a virtually rigid element mounted on one end of the casing, said element being provided with a multiplicity of through passageways, the total area of such passageway being greater than the total frontal area of solid portion of such element; electromagnetic striker means within the casing, including a reciprocatable striker adapted to strike the element at a frequency of between about 100 and 2,000 times per second; manually actuatable means for energizing said striker means; and sound-absorbing means within the casing adapted to absorb the sound of blows delivered by the striker upon the element.

15. An element for devices adapted to generate audible frequencies when said element is placed into contact with a vibration-transmitting solid, comprising: a rigid disc-like structure having a multiplicity of passageways therethrough, the frontal solid area of the structure being less than the area of passageways, said structure being substantially non-flexible and comprising spirally wound corrugated metallic ribbon with adjacent lays firmly connected.

16. A substantially silent device for generating audible voice frequencies when in contact with a solid, elastic material, comprising: a hollow casing adapted to be hand-held; a virtually rigid element mounted on one end of the casing, said element being provided with a multiplicity of through passageways, the total area of such passageways being greater than the total frontal area of solid portion of such element; electromagnetic striker means within the casing, including a reciprocatable striker adapted to strike the element at a frequency of between about 100 and 2,000 times per second; and manually actuatable means for energizing said striker means.

17. In the construction as stated in claim 16, the provision of means for varying the length of stroke and frequency of reciprocation of said striker.

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