

[54] **APPARATUS AND METHOD FOR SONIC CLEANING OF HUMAN TEETH**
 [75] Inventor: **Frank Massa**, Cohasset, Mass.
 [73] Assignee: **Massa Division, Dynamics Corporation of America**, Hingham, Mass.

[22] Filed: **June 28, 1972**

[21] Appl. No.: **267,007**

[52] U.S. Cl. **134/1**, 128/24 A, 128/62 A, 310/8.1, 310/8.2, 310/9.1, 340/8, 340/10
 [51] Int. Cl. **B08b 7/02**, B01j 1/12
 [58] Field of Search 134/1; 32/50; 128/62 A, 128/24 A, 66; 310/8.1, 8.2, 8.9, 9.1; 340/10, 8

[56] **References Cited**
UNITED STATES PATENTS

3,380,446 4/1968 Martin 128/24 A

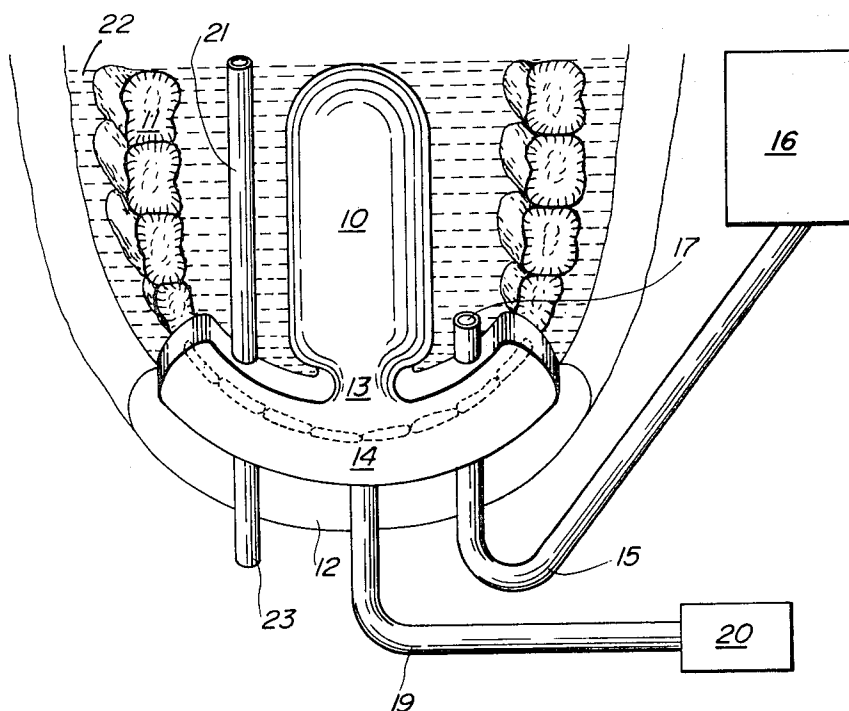
2,640,165 5/1953 Howatt 128/24 A
 3,547,110 12/1970 Balamuth 128/24 A
 3,760,799 9/1973 Crowson 128/24
 3,566,869 3/1968 Crowson 128/66
 2,565,159 8/1951 Williams 340/10 X
 2,829,361 4/1958 Crandell et al. 340/10

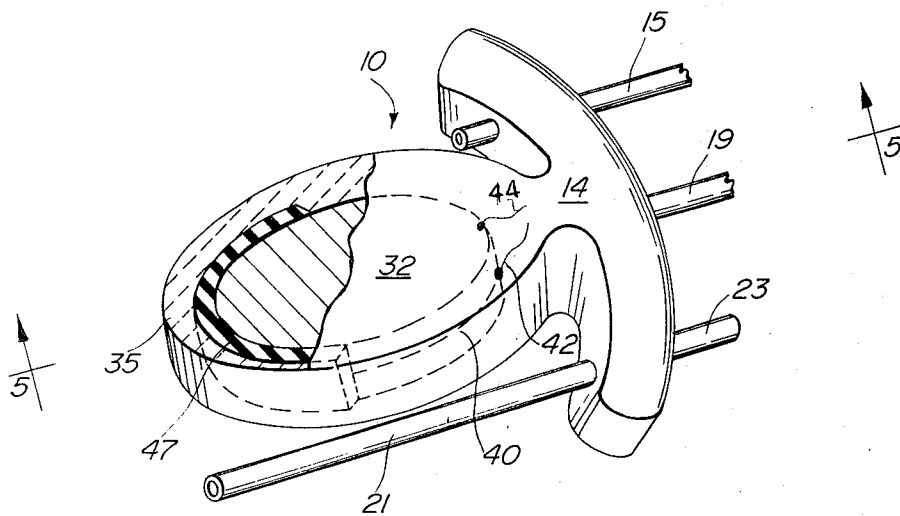
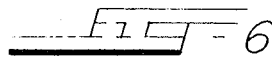
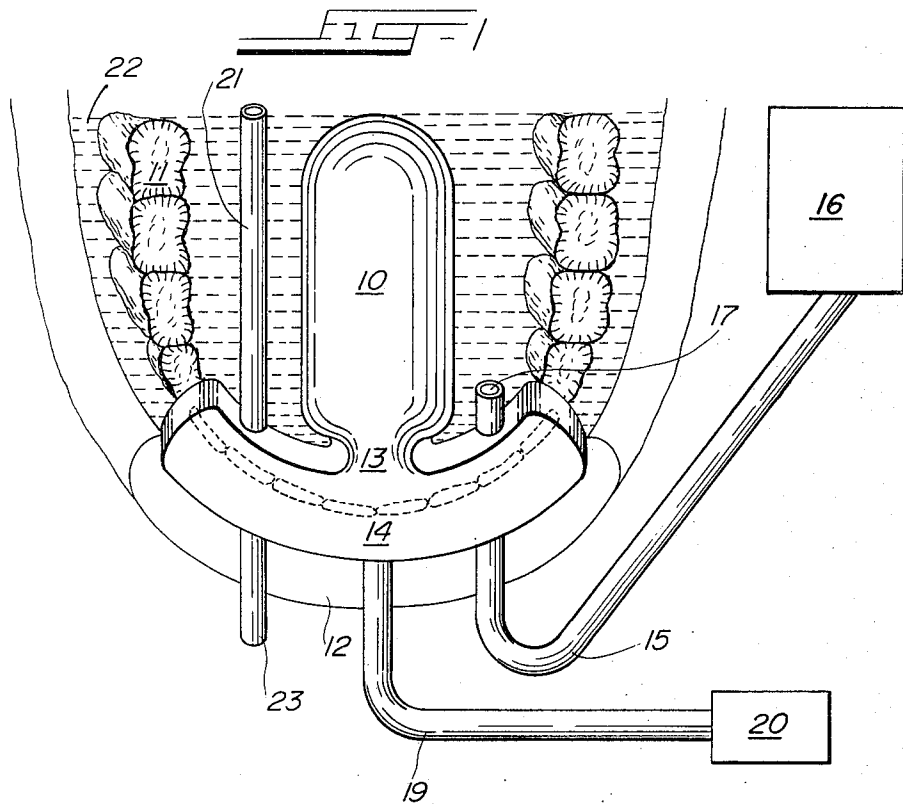
Primary Examiner—Joseph Scovronek
Assistant Examiner—Dale Lovercheck

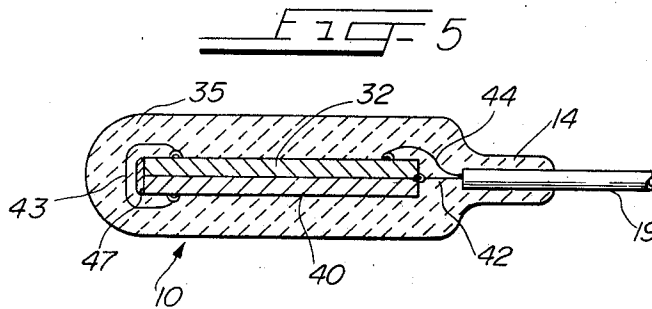
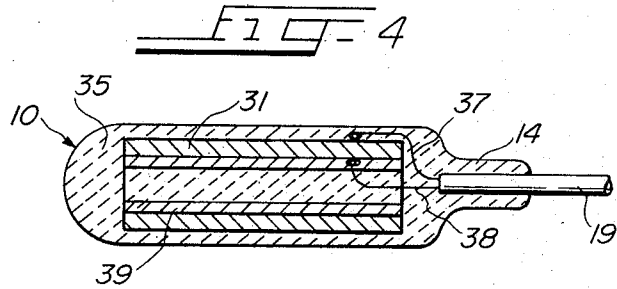
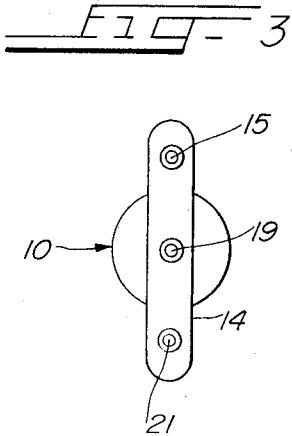
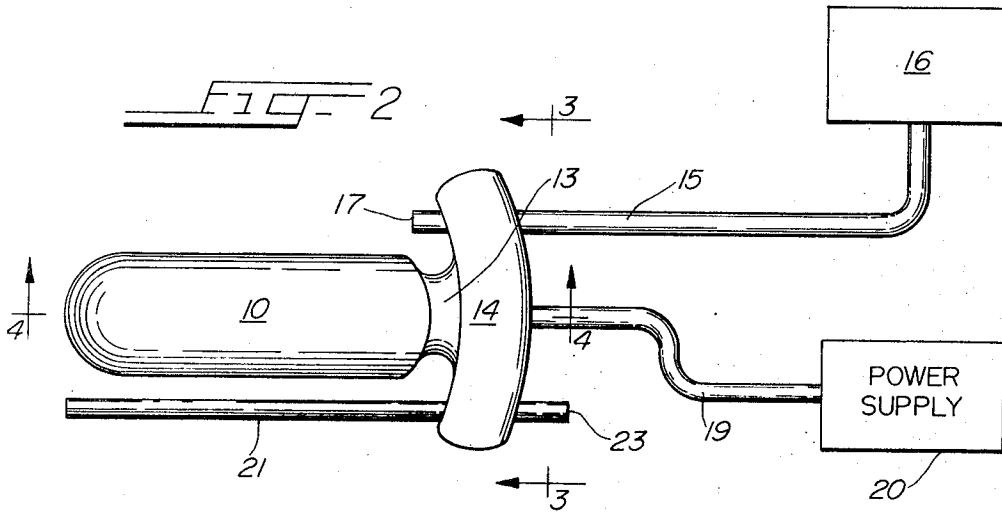
[57] **ABSTRACT**

A sonic transducer is held inside the mouth, gripped by human teeth, and sealed by human lips. A cup containing a cleaning fluid is connected via a hollow tube into the interior of the mouth. The level of the cleaning fluid rises to a predetermined level inside the mouth, which level is controlled by the position of an overflow tube associated with the transducer. The transducer energizes the fluid inside the mouth with sonic energy to clean the teeth.

16 Claims, 6 Drawing Figures







APPARATUS AND METHOD FOR SONIC CLEANING OF HUMAN TEETH

This invention relates to apparatus for cleaning human teeth, and more particularly to a novel apparatus and method for conveniently and efficiently cleaning the teeth with sonic energy.

Heretofore, sonic energy has been used for cleaning dentures. The dentures were removed from the mouth and immersed in a small tank containing a sonically activated liquid, whereby the dentures were cleaned efficiently and rapidly. Attempts have also been made to employ sonic energy to clean natural human teeth. These attempts have employed sonic transducers in the form of a toothbrush-like probe which could be applied directly over the surface of the teeth and gums. This device is similar to a mechanical toothbrush. However, the use of such a probe is too time consuming, and the method does not find popular acceptance.

Accordingly, an object of this invention is to efficiently and rapidly clean human teeth by sonically energizing the mouth cavity. More particularly, an object is to so energize the liquid after the mouth cavity is partly filled with a liquid, which serves as a medium for the transmission of sonic energy from the transducer throughout the mouth cavity to the surfaces of all the teeth.

An additional object of this invention is to provide waterproof sonic transducers which may be held inside the mouth while it is sealed by the lips. Here, an object is to use the mouth itself as a sealed cavity, within which the transducer is suspended.

A further object of this invention is to provide means for partly filling the mouth cavity with a sound conducting liquid which serves as a transmission medium for conducting sonic energy generated by a transducer to all of the teeth. Here, an object is to provide a sealed sonic transducer, within the mouth cavity, which is immersed within a cleaning liquid inside the mouth cavity.

A still further object of this invention is to provide a waterproof electroacoustic transducer that can be conveniently held in the mouth while the teeth and lips serve to hold the transducer in place and seal the mouth cavity.

An additional object of this invention is to provide a small reservoir for holding a measured quantity of cleaning fluid sufficient to fill the mouth cavity. Here, an object is to provide a conduit from the reservoir to the mouth cavity, whereby the mouth cavity may be filled with fluid to a predetermined level.

The present invention eliminates the time consumption and therefore, the objection to the use of a sonic probe for cleaning natural human teeth. As a result, there is a convenient and efficient procedure for enabling a rapid and thorough cleaning of human teeth. The basic principle employed by the invention is to cause the mouth to assume the function of a container filled with a cleaning fluid. At the same time, a sonic transducer is held within the fluid, partly filling the mouth cavity. Upon activation of the transducer, the teeth which are effectively immersed in the fluid are sonically cleaned with high speed thoroughness.

Additional objects will become more apparent to those skilled in the art by the description of the invention which follows, when taken with the accompanying drawings in which:

FIG. 1 is a perspective view of the inventive transducer structure, the lower set of natural human teeth, the lower human lip, and cleaning fluid inside the mouth;

FIG. 2 is a plan view of one embodiment of the invention using a cylindrical electroacoustic transducer;

FIG. 3 is an end view taken along the line 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view taken along the line 4—4 of FIG. 2 and illustrating a cylindrical transducer element;

FIG. 5 is a cross-sectional view, similar to FIG. 4, illustrating an alternate transducer employing ceramic discs; and

FIG. 6 is a perspective view of a similar disc-type transducer.

The basic principles of the invention are disclosed in FIG. 1, wherein a transducer 10, is held between the teeth in a human mouth, preferably while the user holds his head in a position with the face looking downwardly. A lower set of teeth is seen at 11, and a partly broken away lower lip is seen at 12. The upper set of teeth and the upper lip are not seen in FIG. 1. However, it should be apparent that the strip portion 14 on the transducer 10 is gripped between the teeth and that the lips may also be pressed against or beyond the strip portion 14 or around tubes 15, 19, 21 to thereby form the mouth into a closed container.

The strip portion 14 contains three spaced positions extending from the outside to the inside of the mouth. A tube 15 is placed at one end of the strip portion 14 as illustrated in order to connect a cup or reservoir 16 to an orifice 17 inside the mouth. A waterproof cable 19 is molded integrally with the strip portion 14 and emerges from the center thereof connecting the power source 20 to the transducer 10. An overflow tube 21 extends from a predetermined level 22 inside the mouth, to an overflow port 23 outside the mouth.

By an inspection of FIG. 1, it should be apparent that the teeth may grip the strip portion 14 and that the lips may form the mouth into a sealed container. If the reservoir 16 is then lifted above the level of the mouth, gravity causes a cleaning liquid to flow from the reservoir 16 through the tube 15 and out the orifice 17 into the mouth. Inside the mouth, cleaning liquid rises to the level 22 where it begins to flow through the overflow tube 21 and out the port 23.

The sonic transducer 10 may employ any well known transducer material, such as piezoelectric crystals, polarized ceramics, magnetostrictive nickel, or another suitable material operating at any suitable cleaning frequency. For the purposes of illustration, the transducer 10 is here shown in FIG. 4 as employing a cylindrical tube 31 of polarized ceramic, such as lead zirconate-titanate. An alternate transducer construction employs a pair of ceramic discs 32, 40 as illustrated in cross-section in FIG. 4, and in perspective in FIG. 6.

The transducer 10 is covered by a waterproof sound conducting enclosure 35 which may be a molded rubber or rubber-like potting compound. The transducer covering 35 extends from the transducer 31 at one end to a rectangular strip portion 14 at the other end. The transducer 10 is dimensioned so that it may be conveniently clamped by the teeth and sealed by the lips, when the transducer 10 is inserted into the mouth cavity. At one end of the strip portion 14 is the flexible tubing 15 which is attached to the cup-like container 16.

The free end 17 of the tubing 15 projects a minimum distance through the strip portion 14. At the opposite end of the strip portion 14 is inserted an overflow tubular member 21, which extends approximately the full length of the transducer 10. This tube 21 is approximately the equivalent in length of the transducer 10; however, the tube 21 may be made adjustable. The overflow tube 21 may extend along the side of the transducer, and may project away from the strip portion 14 side by any suitable distance.

Through the center of the strip portion member 14 is sealed a two-conductor waterproof cable 19, which makes electrical connection between the transducer 10 and the power supply 20. The power supply 20 may be any type well known in the art. However, care is used to avoid electrical shock hazards.

The cross-sectional view of FIG. 4 illustrates a use of a polarized ceramic cylinder 31, as the transducer element. The electrodes from the ceramic cylinder are connected by the wires 37, 38 in the cable 19. A layer of low acoustic impedance material 39, such as corprene, is cemented to the inner wall of the ceramic tube 31 to decouple the inner vibrating surface of the cylinder. A rubber-like waterproof encapsulating material 35 is molded in place to surround and complete the assembly.

Another type of transducer construction that is particularly advantageous for use in this invention is illustrated in FIGS. 5 and 6. In this arrangement, two ceramic discs 32 and 40 are cemented together with their common electrode surfaces connected to cable 19 by a wire 42. The outer common electrodes are connected together by a wire 43 and then by wire 44 to the other conductor of the cable 19.

In this embodiment, the ceramic discs 32, 40 are driven by alternating current of a frequency corresponding to the planar resonant frequency mode of the discs. As a result, there is an efficient radial vibration in the ceramics, thereby giving rise to efficient radiation of sound from the peripheral edge surface of the disc assembly.

A strip of low acoustic impedance material such as corprene 47 is applied to a circumferential portion of the peripheral edge of the discs 32, 40, at the surface of an arcuate projection of the throat and nasal area. The use of the corprene 47 prevents radiation of sound toward the region of the throat when the transducer is operated inside the mouth. Thus, more energy is concentrated in the direction facing the teeth, whereby the efficiency is improved.

The inventive teeth cleaning device can be efficiently used for sonically cleaning natural human teeth. The cleaning process may be described as follows:

1. The transducer portion of the structure is placed inside the mouth.

2. The front teeth clamp the strip portion 14 to hold the transducer in position.

3. The lips come together on or beyond the outside edge of the strip portion 14 to effect a seal around the projecting members 15, 19 and 23.

4. Water, with an optional addition of a flavored detergent, is placed in the container 16. With the head bending forward over a washbowl, the container 16 is lifted, thus causing the liquid to run through tube 15 and enter the sealed mouth cavity. The liquid rises to the top of the transducer 10 and then overflows

through the tube 21 when the desired level 22 is reached.

5. The power supply 20 is turned on to activate the transducer 10, whereby intense sonic energy is generated throughout the liquid filling the mouth cavity and the surrounding teeth.

6. The teeth and gums are rapidly and thoroughly cleaned of all foreign particles, and any forming plaque is removed from the surface of the teeth.

The advantage of the cleaning procedure described herein is that there is a very convenient and simple method for sonically cleaning teeth. Thus, the invention cleans natural human teeth by the simple procedure of forming the mouth cavity into a sonic cleaning tank filled with a cleaning liquid. An electroacoustic transducer immersed therein generates intense sonic energy in the liquid, which is propagated to all the teeth to achieve rapid and thorough sonic cleaning.

Although I have described several embodiments of the invention, various modifications may be made therein. Accordingly, the appended claims are to be construed to cover all equivalent structures falling within the scope and spirit of the invention.

I claim:

1. An apparatus for sonically cleaning natural human teeth comprising an electroacoustic transducer means shaped and dimensioned to fit inside the mouth cavity behind the teeth and be sealed therein by the lips, support means associated with said transducer means and shaped to be held clamped between the front teeth while said transducer is sealed inside the mouth cavity by the lips, liquid conveyor means attached to said support means to enable passage of a liquid into the entirety of the mouth cavity with the face pointing downwardly, said liquid being conveyed into the mouth cavity through said support means, and means for driving said electroacoustic transducer to generate sonic energy in the liquid submerging the transducer inside said mouth cavity.

2. The invention in claim 1 and support means associated with said transducer means to be held clamped between the teeth while said transducer is placed inside the mouth.

3. The invention in claim 2 wherein said liquid conveying means is associated with said transducer support means to enable said liquid to flow from an external source into the mouth cavity, after said transducer support means is clamped by said teeth.

4. The invention in claim 3 and liquid overflow means associated with said transducer support means for establishing a predetermined level of said liquid in the mouth cavity.

5. The invention in claim 1 wherein said transducer includes a polarized ceramic tube.

6. The invention in claim 1 wherein said transducer includes at least one polarized ceramic disc.

7. The invention in claim 6 wherein said transducer driving means comprises means for supplying alternating current of a frequency corresponding approximately to the planar resonant frequency of the ceramic disc.

8. The invention in claim 6 wherein a portion of the peripheral edge of said ceramic disc is covered with a low acoustic impedance pressure release material.

9. The invention in claim 6 wherein the portion of the peripheral edge of said ceramic disc occupying a pro-

jection of the throat and nasal area is covered with a low acoustic impedance pressure release material.

10. An apparatus for sonically cleaning human teeth comprising a waterproof electroacoustic transducer means shaped and dimensioned to fit inside the mouth cavity behind the teeth and sealed thereto by the lips, support means associated with said transducer means and shaped to be held clamped between the front teeth while said transducer is sealed inside the mouth cavity by the lips, liquid conveyor means attached to said support means to enable passage of a liquid into the entirety of the mouth cavity with the face pointing downwardly, said liquid being conveyed into the mouth cavity through said support means, overflow means attached to said support means for controlling the level of the liquid in the mouth cavity, and means for driving said electroacoustic transducer to generate sonic energy within the liquid inside said mouth cavity.

11. The invention in claim 10 wherein said transducer means includes a cylindrical tube of polarized ceramic.

12. The invention in claim 10 and means comprising a liquid storage container attached to said liquid conveyor means.

13. The invention in claim 10 wherein said trans-

ducer means includes a polarized ceramic disc.

14. The invention in claim 10 wherein said transducer driving means comprises means for supplying alternating current of a frequency corresponding approximately to the planar resonant frequency of the ceramic disc.

15. The invention in claim 13 and a pressure release means blocking transmission of sonic energy from said disc toward the user's throat.

16. A method for sonically cleaning natural human teeth including the following steps:

1. holding an electroacoustic transducer inside the mouth cavity;
2. using lips to seal the mouth cavity into a container for holding the transducer;
3. filling the sealed mouth cavity to a predetermined level with a sound conducting liquid which is fed into the mouth cavity through an opening contained within the portion of the transducer which is held between the pressed lips while the face is pointing downwardly; and
4. applying energy means for driving said transducer to generate sonic energy in said sound conducting liquid.

* * * * *

30

35

40

45

50

55

60

65