ULTRASONIC DENTAL CLEANING AND TREATMENT DEVICE

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

10,000 - 200,000 cp

LEONARD G. MARTIN
INVENTOR

BY Ralph E. Bitner
ATTORNEY
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FIG. 6

FLUID PRESSURE CONTROL
TEMPERATURE CONTROL
D.C. CONTROL
FREQUENCY CONTROL
U.S. CONTROL

FIG. 7

ULTRASONIC GENERATOR

FIG. 8

ULTRASONIC GENERATOR

FIG. 9

LEONARD G. MARTIN
INVENTOR

ATTORNEY
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Leonard G. Martin, 1 Rosed Ave., Deal, N.J., 07723

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This invention relates to a dental cleaning and treatment device and has particular reference to a clamping means which may be applied to a few teeth and their periodontal tissue to clean and treat them by the application of ultrasonic vibrations in a liquid. Electrolytic, electronic, chemical, mechanical, vibratory, thermal, or other forms of energy, can be used in conjunction with or without ultrasonics. Any individual form of energy may be used with the device. Also any combination of two or more forms of energy may be used.

It is well known that the usual means of cleaning teeth by a toothbrush and toothpaste leaves much to be desired in removing dirt, film, and tartar. The bristles of a toothbrush cannot reach all parts of the tooth and many times remnants of the paste remain after a brushing operation.

The present invention applies a plurality of streams of water or other liquid to all parts of the teeth and gums. These streams of water emerge from perforations or nozzles in an envelope which contains an electric-to-sonic transducer for supplying vibrations to the liquid.

One of the objects of this invention is to provide an improved cleaning and treatment device which avoids one or more of the disadvantages and limitations of prior art arrangements.

Another object of the invention is to clean or treat selected teeth or gums with ultrasonic vibrations, mechanical vibrations, thermal, electrolytic or electronic energy, either alone or in any combination.

Another object of the invention is to apply a cleaning and treatment means to those teeth and gums which need it most.

Another object of the invention is to eliminate bulky denture cleaning structures which are difficult to apply and adjust.

Another object of the invention is to apply medicated liquids, pastes, gels and other type medicaments and medicines to selected parts of the jaw without the danger of swallowing the liquids used.

Another object of the invention is to prevent dilution of medication by salivary secretions.

The invention includes a clamp for covering one, two or three or more teeth. The clamp is made up of two parallel or non-parallel jaws which are coupled together by fixed or resilient means. An envelope is secured to the inside surface of each clamp and a plurality of very small nozzles or openings are provided for the pouring or spraying liquid onto the tooth and gum surfaces and for filling the intermediate spaces. The interior space within each of the envelopes contains an electric-to-sonic transducer such as a quartz crystal for generating high or low ultrasonic vibrations within the envelopes to be transmitted through the intermediate fluids to the teeth and gums.

A pair of conductors in connected to each transducer for connection to an external source of alternating electric power or the ultrasonic source may be in the roof of the device or even distal to the body of the device, that is, in the handle or at the generating unit.

One feature of the invention includes an exit conduit which transfers the liquid from the tooth to a position outside the mouth. The exit may at times be closed or even eliminated.

The U shaped trough formed by the clamp may also be filled with a liquid gel, paste, etc., containing a fluoridating, caries inhibiting, cleansing, bleaching, tartar inhibiting, antiseptic, analgesic, anaesthetic, astringent, emollient, anti-infective, hemostatic, or any other medication singly or in any combination. These liquids, gels, pastes, etc., may then be used in place of the reservoir liquid if so desired. In such cases, the flow of liquid through the stomata, nozzles, or jets, can be stopped or, if desired, slowed down to the degree preferred.

Another feature of the invention includes a handle attached to the cleaning device by a means of a swivel joint so that the device is easy to apply to any part of the jaw, either upper or lower.

Another feature of the invention includes an alternate form in which the ultrasonic vibrations are applied to the surface of a tooth by means of a resilient envelope or parallel envelopes in the form of two or three or more individual balloons, partially filled with liquid, which fits around all parts of the tooth surfaces that can be contacted by such envelopes.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings.

FIG. 1 is a top view of the cleaning device applied to two teeth.

FIG. 2 is a cross sectional view to an enlarged scale showing the swivel joint, the two clamps and the two envelopes containing the ultrasonic transducers.

FIG. 3 is a cross sectional view of a portion of the clamp showing how the liquid is forced against the tooth surface by a plurality of small nozzles.

FIG. 4 is a partial cross sectional view similar to FIG. 2 but including an exit conduit for removal of the liquid after it has passed through the cleaning operation.

FIG. 5 is a cross sectional view similar to FIG. 2 but showing an alternate form of the invention in which a sealed container fits over the tooth surface and applies ultrasonic vibrations to the tooth without the use of liquid streams directed against the tooth surface.

FIG. 6 is a plan view of the cleaning and treatment device secured to an operating handle and supplied with power from a power cabinet.

FIG. 7 is a more detailed view of the device shown in FIG. 6 indicating some of the supply components which can be used in a treatment operation.

FIG. 8 is a cross sectional view of an alternate means of applying ultrasonic vibrations to a tooth to determine its condition.

FIG. 9 is a detailed plan view of a portion of the treatment means when applying electrolytic currents to the teeth and gums.

Referring now to FIG. 1, a plurality of teeth 10 are shown with a clamp 11 covering two teeth. The clamp is made up of two jaws 12 and 13, one of these jaws being mechanically coupled to a handle 14 by means of a swivel joint 15. A conduit 16 is connected to the handle 14 for providing liquid to both jaws of the clamp 11. Insulated electric wires may also be passed through this conduit or be attached to the outside of the handle.

FIG. 2 shows the details of the clamp 11. Each jaw 12 and 13 includes a outer thin shell which is preferably made of a metal such as stainless steel or a plastic composition. On the inside of each clamp is an envelope 17 and 18 which is bordered by an inner resilient film 20 and 21. This may also be a firm non- resilient wall. The films or walls may be perforated with small holes but it is preferable to employ small nozzles 22 as shown in FIG. 3 for supplying streams of water or other liquid to the tooth and gum surface. At the lower extremity of each jaw is a strip of sponge rubber 23 or other deformable plastic or rubber or other pliable suitable substances which make contact with the gums below the tooth and seals the space.
between the outer surface of the tooth and the inside surface of the two envelopes. The two jaws are connected together by a telescoping coupling shown in FIGS. 2 and 5. Jaw 12 includes an upper turned-over portion 12A which slides into a flat channel comprising the upper turned-over portion 13A of jaw 13. Within portion 13A is a space 13B in which a spring 24 is positioned. One end of the spring is connected to portion 13A while the other end of the spring is connected to portion 12A. The spring tends to pull the two jaws together. A set screw 19 is added to increase or decrease the tension of the spring.

A weld joint 15 is secured to the upper portion 13A and includes an inner spherical ball 25 and an outer clamping means 26 which fits snugly over the ball surface with a means to adjust the tension. Clamp 26 is secured to a handle 27 which is designed to be held in the hand during the cleaning operation. The handle 27 is hollow and contains a conduit 28 for the passage of a liquid, electrical wires, or even for housing a transducer. The ball 25 also contains a conduit 31 and this conduit communicates with both envelopes 17 and 18. In the device shown in FIG. 2, water or some other liquid is forced through the conduits 28 and 31 to the envelopes 17 and 18 and then through the nozzles or perforations 22 and 23.

One, two, or several transducers 32 are secured to the inner surfaces of jaws 12 and 13 for providing ultrasonic energy which can be transmitted by the liquid in envelopes 17 and 18 to the surface of a tooth or even through the teeth. These transducers 32 are connected to conductors 33 which are brought out through a plug 35 or through a separate conduit in the handle and may be secured to handle 27 for convenience. The conductors 33 may be brought out through conduits 31 and 28 but since these conductors are filled with water or other conducting liquids it is preferable to position them outside the handle 27.

When this cleaning device is operated, it is inserted into the mouth and pushed over the teeth which are to be cleaned. Then, if desired, the liquid is turned on and electrical power is switched onto conductors 33 so that the transducers will be operated. As the liquid moves through envelopes 17 and 18 and then is ejected through nozzles 22, the high frequency sonic power, if desired, is transmitted to the surfaces of the teeth and gums by the intermediate fluid whether supplied by the nozzles or not. Jet sonic nozzles to form geyser effects may be used in another modifcation of the above device. In this form of the invention the transducers which lead to build up a pressure of varying degrees as desired around the teeth and gums and can eventually spray through the surface between the sponge rubber 23 and the outer surface of the gums or can be evacuated by another conduit.

Referring now to FIG. 4, the device is the same as shown in FIG. 2 except that an additional nozzle 36 has been secured to the metal portion of jaw 17 at its lower portion. A rubber tube 37 is secured to this nozzle and permits the excess fluid to flow out of the clamp and into a receptacle exterior of the mouth. If it is necessary to build up a pressure between the outer tooth surface and the orifices 22, a contractor can be inserted into tube 37 for reducing the flow. A pump may also be used to pulsate and increase or decrease the pressure if desired.

The device shown in FIG. 5 contains jaws 17 and 18 as shown in FIG. 2. This form also includes a telescoping means shown in FIGS. 2 and 4. Spring 24 and two telescoping portions 12A and 13A. On the inner side of the envelopes (or several envelopes in parallel) 38 is positioned having the same general outline as a tooth when applied to the tooth or teeth. This container holds a heavy oil and is designed to fit inside the cleaning device but outside the teeth. When alternating electric power is applied to transducers 12 and 13, the ultrasonic vibrations may be transmitted to the material within container or containers 38. This material may be a heavy oil or some other liquid which transmits ultrasonic vibrations. This type of cleaning device merely loosens the dirt, film, and tartar and it must be washed away by other means after the device has been removed or a mechanical vibratory arrangement can be used in the modification using the multiple balloon-like envelopes (partially filled with an ultrasonic conducting liquid) with perforations or nozzles between the balloons for fluids to enter and wash away the debris.

Referring now to FIGS. 6 and 7, the cleaning and treatment device 11 is shown in combination with an operating handle 40 and a power supply cabinet 41. The handle 40 contains all the conduits and electrical wires necessary for the operation of the device and, in addition includes a vibration means 42 (shown in cross section). The vibration device may include a small electric motor and a cam driven drive shaft, but the preferred motor means is a magnetic vibrator device having a stator core 43, an electrical winding 44, and a movable armature 45. The armature 45 is connected to a drive shaft 46 which is coupled directly to the treatment device 11.

The power supply cabinet contains all the electrical and hydraulic equipment for supplying the treatment device. Power is derived from an alternating power supply by means of a plug 47 and line 48. Within the cabinet is mounted an "on and off" switch 49, a small motor 50 and a pump 51 which pumps fluid 52 through a flexible conduit 54. The pressure and the amount of fluid pumped through the conduit 54 may be controlled by a valve 55 coupled to a control knob 56 available for manual adjustment on the front of the cabinet.

A second control means is the regulation of the temperature of the liquid which is pumped into the device 11. To control the temperature, a heater 57 is mounted adjoining the exit conduit of the container 53 and is connected to the power lines in series with a controlling adjustable resistor 58. This resistor 58 is coupled to another knob 60, also available at the front panel 59.

It is often desirable to apply a direct current to a tooth with an intervening layer of electrolyte in order to apply (plate) a layer of a counteracting chemical, such as a fluoride salt, or to remove a layer of some foreign substance, such as tartar. For this purpose an electrolytic unit may be incorporated in the applicator device and a direct current is used to either plate teeth or to remove certain tartar forming films. A circuit shown in FIG. 7 includes a rectifier 61 which transforms AC to DC and then applies the current through a reversing switch 62, an ammeter 63, and an adjustable resistor 64 to control the current to the tooth and a terminal in device 11. The variable resistor 64 is under control of knob 59 at the front panel.

Ultrasonic power may be generated in a wide variety of ways, such as a quartz crystal, a vacuum tube oscillator, a transistor oscillator, or a magneticostatic oscillator. All these devices are old in the art and will not be shown in detail. A frequency control knob 65 controls the applied frequency of the oscillator 66 while another knob 67 controls the amplitude of the ultrasonic power. Knob 67 may be coupled to a variable rheostat 69 similar to components 58 and 64. As used in the specification and claims, the term "frequency" designates a frequency within the range of 10,000 to 200,000 cycles per second.

FIG. 9 shows an absorptive pad 68 with one or two conductive terminals 70. The pad is soaked in an electrolyte solution and then placed next to the tooth surface which is to receive an application of a chemical. When the current is turned on, meter 63 indicates the current through the electrolyte. This reading then measures the amount of "plating" film deposited. The meter reading also tells the operator when the electrolyte is exhausted by indicating a current reading considerably less than the starting value.

FIG. 8 is a diagram showing still another application of ultrasonic vibrations. In this case a quartz crystal 71 is secured to a clamp wall 72 and a small plastic bag 74...
is positioned between the crystal and the tooth surface. A thick oil 73 is in the bag for transmitting the ultrasonic vibrations to and through the tooth. On the other side of the tooth is another bag 75, this bag containing the usual heavy liquid 76 and also supporting an acoustic lens 77 which receives the waves after passing through the tooth and focuses them onto a quartz plate 78. Plate 78 is part of a small cathode ray camera tube 80 having a cathode 81, a focusing gun 82, and a high voltage anode covering 83. A terminal socket plug 84 is connected to a source of power 85 and to a television receiving tube 86.

The operation of the device as shown in FIG. 8 is as follows: an ultrasonic generator 87 applies alternating current of a very high frequency to the crystal 71. Sonic waves are generated and traverse the bag 73, the oil 74, the tooth 86, bag 75, oil 76, and are focused by lens 77 so that an image of the tooth and its cavities (if any) are formed at the second quartz crystal 78. The cathode ray camera tube 80 generates a cathode beam which is deflected by deflection coils (not shown) so that the surface of the quartz crystal 78 is scanned in the same manner as a regular light camera tube. The sonic vibrations incident on the quartz create minute areas of electrostatic charge and thereby modulate the scanned cathode ray from cathode 81. The variations in current are detected by a sensing electrode and amplified before being applied to television receiving tube 86.

The ultrasonic waves are deflected or masked by variations in tooth structure so that cavities, fillings, or voids will show up in the focused image both at the quartz plate 78 and at the fluorescent screen of receiving tube 86. This type of examination does not cause destruction of the tissues as a prolonged X-ray examination can do. Also, the image on the receiver tube 86 can be seen at once, there is no lost time in developing an exposed film. Focusing of the image on crystal 78 can be done in several ways, the most convenient being by varying the frequency of the generator 87. Such an examination takes considerably less time than the usual X-ray examination.

From the above description and drawings it should be obvious that a novel type of dental cleaning device has been developed. This device can be applied easily by any person in the home to clean selected teeth without the necessity of going to a dentist.

The foregoing disclosure and drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense. The only limitations are to be determined from the scope of the appended claims.

1. A dental cleaning device comprising; a clamp which covers at least one tooth, said clamp including two jaws coupled together by resilient means; an envelope secured to the inside surface of each clamp, said envelopes each including a perforate flexible sheet positioned next to the tooth surface when applied to a jaw, the interior space within each of the envelopes connected to a conduit and a liquid source; an electric-to-sonic transducer in each of said envelopes for generating high frequency vibrations within the envelopes, and a pair of conductors connected to said transducers for connection to an external source of alternating current power.

2. A dental cleaning device as claimed in claim 1 wherein strips of deformable material are positioned at the edges of the clamps to make contact with the gums and other teeth and thereby form a liquid tight seal.

3. A dental cleaning device as claimed in claim 1 wherein an exit conduit is connected to one of said clamps for discharging the liquid after it has traversed the envelopes and the perforations therein.

4. A dental cleaning device as claimed in claim 1 wherein a handle is coupled to one of said jaws by means of a swivel joint, said handle and joint each containing a conduit for the passage of a liquid.

5. A dental cleaning device as claimed in claim 1 wherein said envelopes are filled with a heavy oil for efficient transfer of ultrasonic energy.

6. A dental cleaning device as claimed in claim 1 wherein said handle contains an electro-mechanical motor means for applying mechanical vibrations to said jaws within the range of 20 to 400 cycles per second.

7. A dental cleaning and treating device as claimed in claim 1 wherein a direct current power supply is connected through said handle to an electrode within the clamp and to the tooth under treatment, and an absorbent strip is positioned between the tooth and the electrode for the electrolytic passage of current.

8. A dental cleaning and treating device as claimed in claim 1 wherein a heating means is positioned adjoining said liquid source for raising the temperature of the liquid to a desired value.

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RICHARD A. GAUDET, Primary Examiner.
WILLIAM E. KAMM, Examiner.