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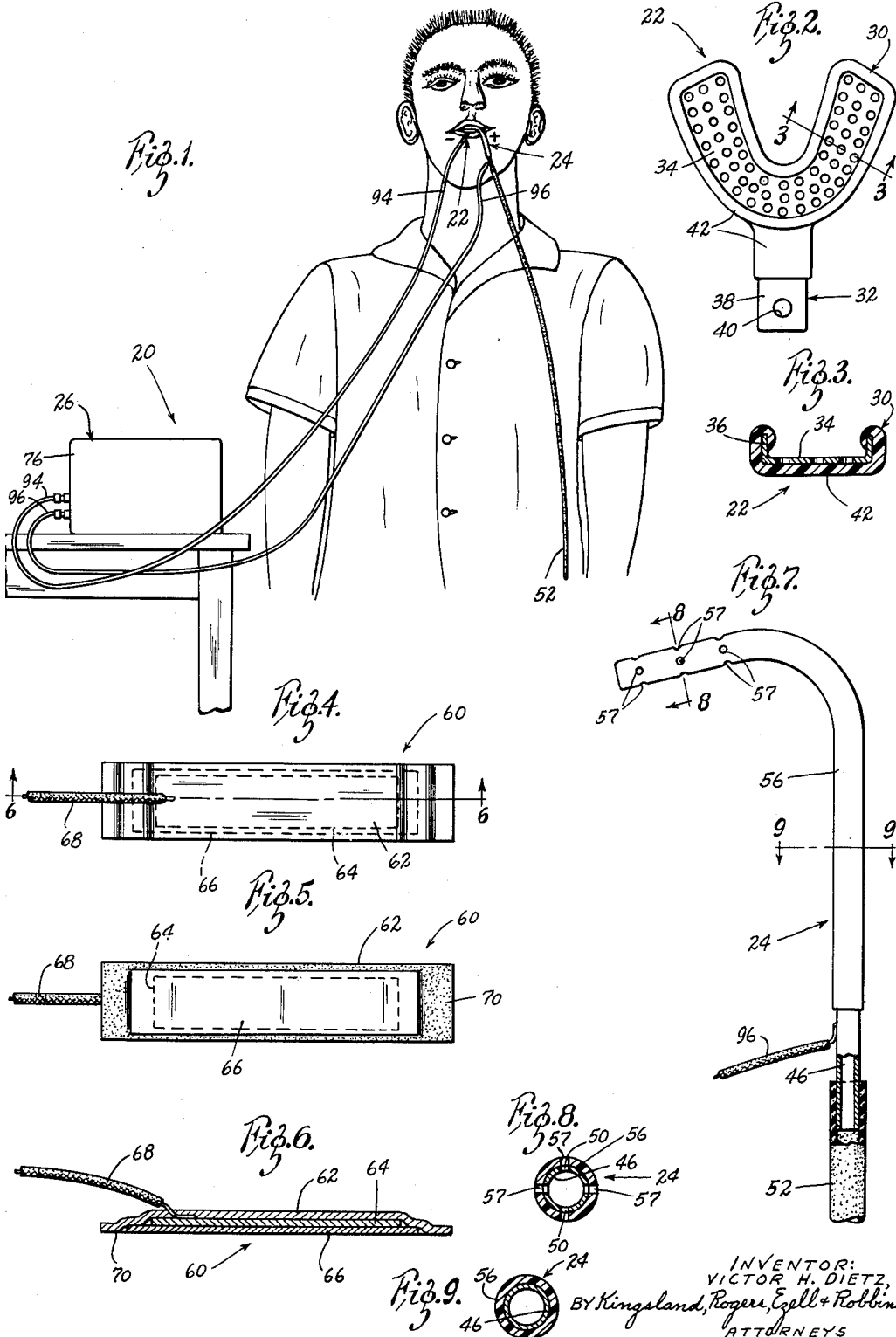
V. H. DIETZ

3,207,161

IONIZATION DENTAL SYSTEM

Filed May 22, 1961

2 Sheets-Sheet 1



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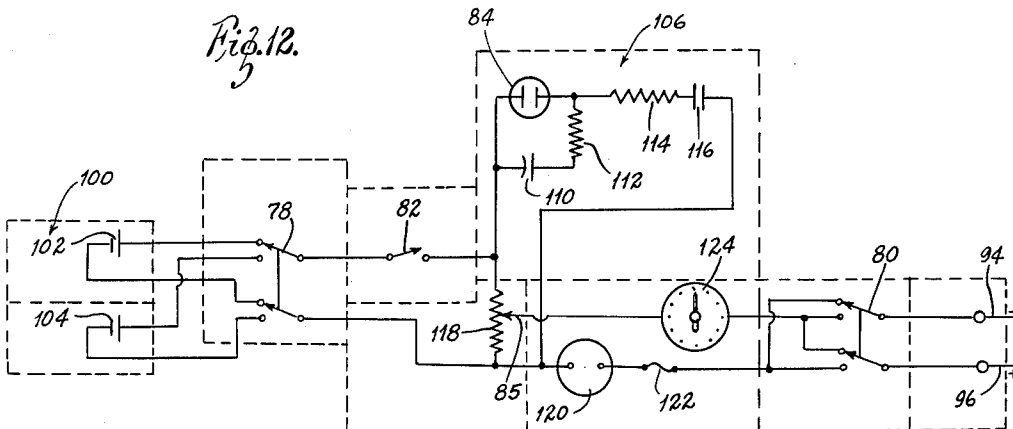
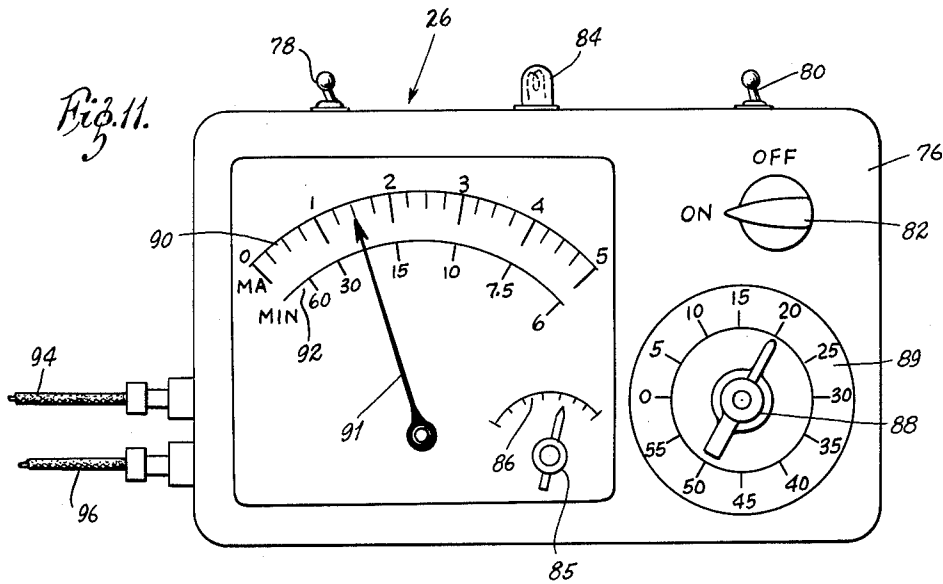
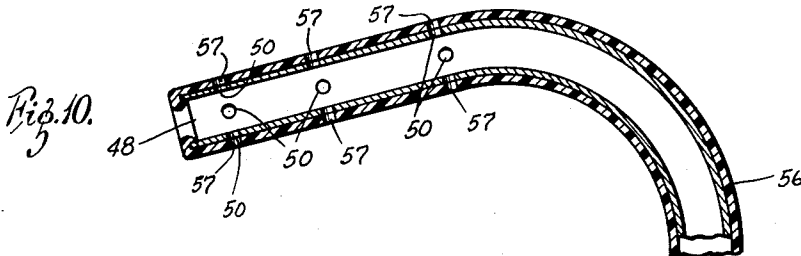
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IONIZATION DENTAL SYSTEM

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This invention relates to improvements in ionization treatment of individuals and in particular is concerned with a fluoride ionization treatment, which is termed hereinafter as electrofluoridizing for use in dental prophylaxis.

Fluoride treatment for prevention or reduction of dental caries has been the subject of widespread research. Such treatment is basically preventive in nature and where ingestion of the fluoride is contemplated very little effect is had upon individuals having severe dental caries problems.

By means of this invention there has been provided a system for the treatment of individuals who have advanced cases of dental caries. Particularly, it has been found that by the treatment of this invention rampant caries, dental lesions of the erosive type, and decay and decalcification can be beneficially treated. Essentially, this invention contemplates the provision of an electrode system in which a fluoride composition in an electrolyte carrier is contacted with the teeth of the individual. The electrode system is then energized and the fluoride is ionized to provide fluoride ions in a readily available form to be assimilated into the tooth structure.

In the system of treatment, readily ionizable lithium fluoride is incorporated into a matrix of sodium alginate. The sodium alginate in the mixture with lithium fluoride is in dry form, and when water is added it assumes the form of a gel-like nature with the water acting as an electrolyte for the ionization of the lithium fluoride. The matrix is provided in an electrode mouthpiece tray which is fitted over the teeth. The electrode system is then connected to a source of electrical energy and the circuit is completed back to the individual by another electrode in contact with the body of the individual.

A control device is employed that may be used to regulate the current at a specified level of milliamperes to prevent injurious currents from being used. Further, a timing device and automatic scale is provided so that the proper current level, combined with the time of treatment, may be provided.

The electrode employed for the use of the matrix composition of the lithium fluoride and the sodium alginate is specially formed so that there are no exposed electrically conductive parts that will engage the skin of the individual to cause shock or burn. The other electrode employed upon the body of the individual is also of a form to prevent shock or burn. This other electrode may be in the form of an adhesive bandage provided with an adhesive area whereby it may be readily placed upon the forehead or other substantially smooth surface of the individual and can be of a disposable nature. Still a further form may be in the shape of a saliva tube that can be readily placed in the mouth of the individual, or a simple wrist or hand-held electrode may be used.

The system of treatment is one that can be readily employed by the average dentist with a high degree of beneficial results without the necessity of complicated controls or other requirements. The simplicity of this system with the readily employable components makes the applicability of the system to a wide range of individuals possible.

Further, this system is capable of treating, optimally, all surfaces of all teeth simultaneously. However, it appears preferable to treat one complete dental arch,

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upper or lower, at one time. As the average treatment of one arch is about fifteen minutes, it is simple to treat all exposed surfaces of all teeth within a single appointment if desirable.

The features of applicant's invention pointed out above are objects of the invention. Further objects will appear in the detailed description which follows and will be otherwise apparent to those skilled in the art.

For the purpose of illustration, there is shown in the accompanying drawings a preferred embodiment of this invention. It is to be understood that these drawings are for the purpose of example only, however, and that the invention is not limited thereto.

In the drawings:

FIGURE 1 is a pictorial view showing an individual being treated with the dental treatment system of this invention;

FIGURE 2 is an enlarged plan view of an electrode mouthpiece tray that holds the lithium fluoride and alginate composition;

FIGURE 3 is an enlarged view in section of the line 3-3 of FIGURE 2 showing the structure of the mouthpiece;

FIGURE 4 is a top plan view of a disposable bandage type of electrode;

FIGURE 5 is a bottom plan view of the electrode;

FIGURE 6 is a view in section taken on the line 6-6 of FIGURE 4 showing the construction of a modified electrode;

FIGURE 7 is a plan view of the modified electrode in the form of a saliva tube with the bottom portion being shown partly in section;

FIGURE 8 is an enlarged view in section taken on the line 8-8 showing perforation passages in the saliva tube and the construction of the tube;

FIGURE 9 is an enlarged view in section taken on the line 9-9 of FIGURE 7 showing further details of construction;

FIGURE 10 is an enlarged view in axial section showing the curved end of the saliva tube and its structure;

FIGURE 11 is a view in elevation of an electrical control device employed in the treatment system of this invention; and

FIGURE 12 is a schematic wiring diagram of the control device.

The lithium fluoride matrix composition employed in this invention preferably employs lithium fluoride in an amount from 5% up to about 35% of the dry sodium alginate. This mixture is in the form of a powder and when water is added in sufficient amounts gelation is caused. The mixing may take place in the mouthpiece electrode, or the mixture may be added to the electrode right after the water addition. Setting takes place in three or four minutes or so.

Lithium fluoride is the fluoride compound that is preferably used in this invention, although it is contemplated that other ionizable fluorides, such as calcium fluoride and similar relatively insoluble fluorides, could also be used without adversely affecting the gelation. However, it has been found that the lithium fluoride is particularly compatible with the sodium alginate and because of its relatively low solubility and yet its high degree of ionization capacity, it is preferred. It may, however, be supplemented by the use of up to about 0.75% of sodium fluoride based on the weight of the alginate. The sodium fluoride, because of its ready solubility compared to the lithium fluoride, provide a rapidly available source of fluoride ion when water is added to form the gel. The sodium fluoride also acts to retard gelation somewhat and can be used to balance the speed of gelation, because of this fact.

Normally, gelation takes place when the water is added

to form an impressionable material in the order of about three to four minutes. The setting time, however, can be reduced by the employment of about 0.25% to 0.50% of sodium chloride, as an accelerator, added to the lithium fluoride composition. The time period for gelation may be reduced to about two and one-half minutes by such addition. Also, the sodium chloride, as a readily soluble electrolyte, is of value in promoting the ionization of the fluoride in this system of treatment. Lastly, the sodium chloride acts as a balance to the use of sodium fluoride. Thus, it makes possible the use of up to about 0.75% of the sodium fluoride based on the weight of the alginate, whereas, otherwise, only up to about 0.50% can be used.

As an actual example for the use of the mixture in the mouthpiece electrode, 10 grams of the sodium alginate may be employed. As much as three and one-half grams of lithium fluoride, 50 mg. of NaCl and 75 mg. of NaF are then added to the alginate. The readily soluble NaF is an immediately available source of fluoride ions and, as a retarder, balances the rate of gelation. Then water is added in sufficient quantities with mixing to form the gel. Setting occurs in two to three minutes.

The use of the sodium alginate as the gel forming material is quite desirable as it has a substantially neutral pH and is physiologically innocuous. At the time of mixture the pH is about 7.8 and after each minute of set the pH is reduced about 0.1 to an average of 7.4. The alginate is a hydrocolloid and sets by gelation upon the addition of water without the requirement of heat. It is contemplated that other vegetable gums may also be employed, such as gum tragacanth, agar agar, although the latter generates somewhat more heat in the gelation and is not quite so desirable upon this point.

In the lithium fluoride and alginate mix composition as described above, the sodium ion is believed to enhance the ionization. At least where sodium fluoride is added, the fluoride ion becomes available sooner. The additional use of sodium chloride for rapid setting and ionization promotion makes available the chloride ion which is in the treatment physiologically indifferent and is desired because it is very helpful for the electrolysis. Besides sodium chloride, sodium sulfate or nitrate may also be employed. Here again the sulfate and nitrate ions are also relatively physiologically indifferent and helpful in electrolysis.

Reference will now be had to the apparatus employed in the system of treatment of this invention. FIGURE 1 shows the apparatus generally identified by the reference numeral 20. As there shown, it comprises a mouthpiece electrode 22, and which is used as a negative electrode, a positive electrode 24, and leads connecting these electrodes to a control unit 26. The control unit provides a source of electrical energy and means for regulating it to the desired current and for a desired period of time.

The mouthpiece electrode is more particularly shown in FIGURES 2 and 3. As there shown, it is comprised of a body portion or a tray portion 30 and a handle portion 32. The body portion 30 is made up of a perforated metallic member 34, which is in the form of a U or a horseshoe conforming to the either upper or lower arches of an individual's teeth. An upstanding rim 36 surrounds the peripheral area of the body portion to form a tray so that the electrode may be filled to a desired level with the matrix. Extending to one side of the body portion, and formed integrally therewith, is a flat metallic extension element 38. The free end is exposed and forms a portion for an electrical clamp and has an opening 40 provided for the insertion of an electrical lead screw, or the like, if said is desired to be used.

An insulating covering 42 is formed on the bottom of the body portion and around the side rims and over the top thereof into the interior as particularly shown in FIGURE 3. This insulated covering 42 extends over to the handle portion adjacent the body portion. The insulating covering insures that no metallic part will come into con-

tact with the lips or soft tissues of the mouth of the patient and thereby properly directs the flow of fluoride ions to the external tooth structure and lessens the possibility of burns or electrical shocks.

It will be noted that the bottom of the tray comprising the metal portion 34 is perforated and exposed. This makes better electrical contact possible between the lithium fluoride and sodium alginate matrix, and, by virtue of the perforations, better adhesion of the matrix into the tray is also insured. The internal beading 36 of the insulating material primarily assists in the retention of the set alginate mixture in the tray.

The saliva tube electrode 24 shown in FIGURE 1 is more particularly shown in FIGURES 7 through 10. As there shown, it comprises a metallic electrically conductive saliva tube 46, which has an opening 48 at one end. A number of perforations 50 are also provided adjacent this end. The opposite end of the metallic tube is connected to a saliva hose 52 that may be led to a convenient source of drainage. An electrical lead may be attached to the lower end of the metal saliva tube as shown in FIGURE 7. An insulating covering 56 extends over the free end of the saliva tube and into the shank of the tube. This covering extends adjacent the opening 48 and is provided further with perforations 57, which are in registry with the aforementioned perforations 50 of the metal tube. By providing these perforations, additional saliva tube passages for the saliva are made available.

A modified electrode 60 is shown in FIGURES 4 through 6 that may be used in place of the saliva tube electrode. As there shown, this electrode is in the form of a disposable bandage type of structure. It employs a fabric backing 62 over which is centrally placed a metallic foil 64 of somewhat lesser area than the backing. Covering the metallic foil is a layer of porous and water absorbable fabric 66. This may be cotton, moleskin, or other water absorbable material. An electrical lead 68 may be soldered or otherwise electrically connected to the metallic foil and provides a source of electrical contact to the electrode. Through the inherent impermeability of the metallic foil, the complete electrode, when placed upon the skin, excludes air breathing of the skin pores causing a slight amount of sweating. The moist skin thus passes current more efficiently than dry skin.

For the purpose of adhesively securing the electrode to a smooth skin surface of the individual, an adhesive area 70 is provided around the peripheral border of the bottom of the fabric backing. This is most particularly shown in FIGURE 5.

The control device 26 is shown in FIGURES 11 and 12. As shown in FIGURE 11 the control device is incorporated in a housing 76 provided with a battery selector switch 78 and a polarity reversal switch 80. An on-off switch 82 is employed to turn the current on or off. A flasher bulb 84 is also provided to indicate the operation of the device.

The control means for varying the current and the time period of current flow is provided by a potentiometer knob 85, which, in combination with an indicating scale 86, determines the proper setting which may be used as a reference, or this scale may be peripherally disposed as an integral part of the potentiometer. A potentiometer scale is proposed in order that the dentist may test the initial strength of newly purchased batteries, or to test the strength of the batteries in use by merely joining the leads by their alligator clamps. A time indicating knob 88 is provided which may be employed in registry with a time period scale 89 graduated in minutes to indicate the time period for the setting of the current.

In order to indicate the current generated through the control device, a current meter comprising a milliamper scale 90 and an indicating needle 91 are provided. The scale is calibrated in milliamperes from zero to five, the upper limit of the five milliamperes being the generally

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accepted limit applicable for treatment to individuals. In registry with the milliamperage scale is a time period scale indicated by the reference numeral 92.

It will be particularly noted that the milliamperage scale 90 and the time period scale 92 are in particular registry with one another. The milliamperage scale reads clockwise from zero to five minutes, while the time period scale reads counterclockwise. The time period scale is particularly graduated in order that when any milliamperage reading is provided the needle will fall on the time period scale at a point to indicate a product of 30 milliamperage minutes. This corresponds to the accepted Prinz formula for ionization treatment of individuals. Thus, for example, as shown in FIGURE 11, the indicating needle 91 registers 1.5 milliamperes on the current scale 90. The needle falls on the time period scale 92 at 20 minutes and the product of the time and the current will be 1.5 milliamperes times 20 minutes equaling 30 milliamperage minutes. By this means once the current has been established the necessary time period to provide the 30 milliamperage minutes can be directly read off the time period scale and the time period knob 88 may be turned to the proper position. Thus, it will be noted that in FIGURE 11, to effect the proper combination of the current reading with time period scale, the knob 88 for the time period setting has been turned to the 20 minute position.

The control device 26 is provided with a pair of leads 94 and 96 which provide a source of electrical energy to the system. The leads 94 and 96 may be connected to the previously described electrodes 22 and 24 as shown in FIGURE 1, and, for the position shown and the particular position of the battery selector switch 78, the lead 94 is the negative lead while the lead 96 is the positive lead. It will be understood that instead of the batteries as a source of direct power, alternating current with a rectifier may be employed.

The schematic wiring diagram for the control device is shown in FIGURE 12. As there shown, the electrical energy source is shown in section 100 comprising two batteries 102 and 104, each battery being of 67.5 volts, as an example. Either battery may be thrown into the circuit by operation of the battery selector switch 78. The off-on switch 82 is connected in series with the battery source. A conventional flasher circuit 106 is shown connected in parallel in the circuit so that the flasher bulb 84 flashes when the circuit is energized. The flasher circuit comprises a condenser 110 and a resistor 112 in parallel with the flasher bulb and a resistor 114 and condenser 116 in series. The entire circuit is connected in parallel to the main leads of the control devices 94 and 96.

The potentiometer adjustment knob 88 is adapted to provide a variable current depending upon its adjustment with relation to a potentiometer resistance 118.

The milliammeter is shown generally indicated in the circuit as element 120 and a fuse 122 is provided for circuit protection and for protection to the individual. The time period adjustment control, comprising the adjustment knob 88 and the scale 89, is generally indicated by element 124, likewise connected to the circuit in series. The battery polarity reversal switch 80 is shown comprising a ganged switch for reversal of the leads 94 and 96 to opposite terminals of the battery where battery polarity reversal is desired. Such battery polarity reversal may be desired for application of additional electrical dental or medical techniques to an individual apart from the fluoride treatment system of this invention.

Operation

In the system of treatment of this invention the lithium fluoride and sodium alginate matrix is first prepared as previously described. Upon the addition of water to the dry powder lithium fluoride and sodium alginate preparation with the suitable amounts of NaCl and NaF modi-

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fiers, and upon mixing, gel forms. This is effected in a rubber bowl. This mixture is then, in the viscous state, placed directly in the mouthpiece electrode tray 24.

The tray is then placed in the mouth of the individual with the upper teeth or lower teeth, as the case may be depending upon which is being treated, being impressed into the matrix immediately before setting, which occurs in the space of two to three minutes or so. The individual may hold the tray in place by grasping the handle. The mouthpiece tray 22 is the negative electrode and the positive electrode may be either the saliva tube electrode 24 or the bandage type of electrode 60. If the cloth and adhesive electrode 60 is employed, it is preferably secured to the forehead of the individual, although an arm, wrist or hand surface or other relatively smooth surface may be employed where desired.

Once the system has been connected, as shown in FIGURE 1, the potentiometer 85 is turned to its most counterclockwise position to provide the highest resistance in the circuit and the lowest current possible for safety purposes. Then the on-off switch is turned to the on position. The potentiometer knob 85 is then turned toward the clockwise position to increase the current. This is accomplished slowly to a point where the increase in current causes just a very slight tingling sensation in the individual, which normally occurs at about two to three milliamperes and may, in exceptional instances, be as high as five or even less than two. After this tingling sensation is first recorded by the individual, the potentiometer knob is backed off to provide a reduction of about 0.5 milliamperes for complete safety and comfort. Once the current setting has been established as set forth, the time period is read off the scale 92, and, as an example for the current reading of 1.5 milliamperes of FIGURE 11, the time period reading would be 20 minutes. The time period control knob 88 is then turned to the 20 minute position on the minute scale 89 of the control device. The timer then provides an automatic 20 minute treatment after which it breaks the circuit. This establishes a milliamperage and time in minutes product of 30 milliamperage minutes which is the established rating provided under the accepted Prinz formula.

The treatment aforementioned provides for a high level of fluoride ionization for the electrofluoridizing treatment of rampant caries and other conditions of the teeth that are benefited by fluoride treatment. It is to be understood that also the system may be used for preventive treatment and any level of fluoride ionization may be provided by increasing or decreasing the fluoride concentration in the sodium alginate mix.

It will also be understood that the apparatus of this invention may be employed for any medical ionization or electrolysis treatment of individuals with or without the fluoride treatment. Thus, by the provision of the electrode, automatic timing upon a set current control can be established. Such further applications may be used by reversing the polarity to prevent adverse gum conditions, recessive demineralization of the jaw bone, and atrophy, and for other accepted medical and dental treatments.

Various changes and minor alterations may be made in the system of this invention as will be readily apparent to those skilled in the art. Such changes and alterations are within the scope and teaching of this invention as defined by the claims appended hereto.

What is claimed is:

1. A mouthpiece electrode for use in dental work, said electrode being formed in a substantially flat U-shaped body and having a handle joining said body at a medial portion, said body and handle being formed from a rigid electrically conductive material, an upstanding insulated rim extending peripherally around said body and an insulated covering for said handle adjacent the joinder of the handle with said body and extending along said handle to a point near a free end thereof

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while leaving the end exposed for an electrical connection.

2. A mouthpiece electrode for use in dental work, said electrode being formed in a substantially flat U-shaped perforated body and having a handle joining said body at a medial portion, said body and handle being formed from a rigid electrically conductive material, an upstanding vertical rim extending around the periphery of said body and an insulating plastic coating covering the bottom of the body and extending over the outer sides of said rim and the top thereof, said coating covering the handle adjacent the joinder of the handle with said body and extending along said handle to a point near a free end thereof while leaving the end exposed for an electrical connection.

3. A saliva tube electrode for use in the mouths of individuals, said electrode comprising a tubular electrically conductive metal saliva tube having a curved end with an opening thereon and being engageable in the mouth of an individual with an opposite end adapted to extend over the outside of the jaw of an individual, means for connecting the outside end of said metal saliva tube to an electrical lead and an insulating covering for said curved end having an opening registering with the opening in the metal saliva tube to provide a saliva passage into the tube, said insulating covering extending toward the outside end to provide insulation for the portions of the mouth and jaw engageable by the electrode.

4. A saliva tube electrode for use in the mouths of individuals, said electrode comprising a tubular electrically conductive metal saliva tube having a perforated curved end engageable in the mouth of an individual with an opposite end adapted to extend over the outside of the jaw of an individual, means for connecting the outside end of said metal saliva tube to an electrical

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lead and an insulating covering for said curved end having perforations registering with the perforations of the metal saliva tube to provide saliva passages to the interior of said metal saliva tube, said insulating covering extending toward the outside end to provide insulation for the portions of the mouth and jaw engageable by the electrode.

References Cited by the Examiner

UNITED STATES PATENTS

496,244	4/93	Barret	128—172.1
679,239	7/01	Mossberg	128—172.1
1,389,662	9/21	Irwin	128—172.1
1,615,508	1/27	Fukuyama	128—399
1,655,554	1/28	Lev	128—406
1,989,282	1/35	Kimble et al.	128—416
2,055,540	9/36	Karnofsky	128—409
2,123,980	7/38	Warwick	128—172.1
2,151,738	3/39	Buhse	128—172.1
2,308,037	1/43	Abadjieff	340—309.1
2,432,346	12/47	Smith	340—309.1
2,659,372	11/53	Andersen	128—406
2,816,040	12/57	Rabchuk	106—38.4
2,864,371	12/58	Parodi	128—419
2,866,461	12/58	Suzuki	128—419
2,878,129	3/59	Rabchuk	106—38.4
2,915,066	12/59	Parodi	128—419
2,949,107	8/60	Ziegler	128—2.1
3,019,787	2/62	Simmons	128—172.1
3,049,806	8/62	Cofresi	32—32
3,118,450	1/64	Freeman et al.	32—1

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