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DENTIFRICE.

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To all whom it may concern:

Be it known that I, WILLIAM M. RUTHRAUFF, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Dentifrices, of which the following is the specification.

This invention relates to a dentifrice, and particularly to a dentifrice adapted to build up tooth structure in addition to performing cleaning, polishing and preservative functions, and to directly counteract as well as prevent the processes generally known as dental caries, or tooth decay.

Dental caries generally proceeds in the following fashion:—Acids produced by acid forming bacteria, which are cemented to the tooth surface and protected by gelatinous plaques, dissolve the interprismatic calcium phosphate cementing substance which incases and supports the prismatic enamel rods. The ends of the rods being deprived of their support, are easily broken off and in time as this process continues the enamel is entirely penetrated, when other bacteria having proteolytic action, as well as acid producing bacteria, attack and cause the destruction of the dentin underlying the enamel. The tooth, whether perfectly formed or not, is subjected to these influences from the time of its eruption, and under modern conditions few teeth escape.

It is an object of my invention to counteract and prevent the process just described by providing a dentifrice which will, first, speedily remove the bacteria harboring gelatinous plaques,—second, effectually introduce calcium salts in solution into the interprismatic spaces and other interstices of the teeth,—and third, cause the deposit of the natural cementing substance of the tooth in such spaces; thus impregnating the tooth with calcium salts and rendering it more resistant to dental caries as well as repairing the ravages of the same, while at the same time rendering the tooth capable of receiving so high a polish as to effectually prevent the lodgment thereon, and to render easy the removal therefrom, of gelatinous plaques or other foreign matter.

It is another object of my invention to combine with a dentifrice, designed to deposit cementing substance to protect and support the enamel rods, a hygroscopic medium having affinity for the residual moisture in the tooth so as to draw out this moisture and permit the dissolved calcium salts forming a part of my dentifrice to penetrate and be deposited in the minutest cracks and spaces in the tooth surfaces.

It is a further object of my invention to combine with the two elements above mentioned an abrasive agent which will remove the plaques by which the acid forming bacteria are cemented to the tooth surface so as to sweep away and get rid of these bacteria, while at the same time remedying and counteracting the deleterious effects produced by them.

Other objects and advantages of the invention will appear as the description to follow proceeds.

My invention contemplates the carrying of calcium salts in solution in an acid in a form to be precipitated by the saliva and deposited in the interprismatic spaces and minute crevices of the tooth surface so as to effectively fill and seal these spaces and densify and solidify the outer layer of the tooth. It is obviously important to the most efficient operation of my dentifrice that the calcium salts in solution be introduced into the interprismatic and other spaces before precipitation or deposit takes place. As these spaces are very minute and relatively deep, some special means should be provided to insure the complete filling of the spaces by the acid solution prior to the precipitation of the calcium salt. For this purpose I use a hygroscopic agent such as glycerin for the purpose of producing osmotic action between the secretions which have penetrated the interprismatic spaces and the solution of calcium salts applied to the tooth surface. Glycerin will extract residual moisture from the tooth and replace it with a calcium salt solution, which after it has been introduced in an interprismatic space, will deposit as soon as it is neutralized by the saliva.

My invention further contemplates the production of an alkaline reaction in the mouth as well as the production of sufficient saliva to carry out the chemical reactions upon which the process depends. Acids and flavoring materials are salivary stimulants, and acids increase not only the flow but the percentage of alkaline material in the saliva. My dentifrice being acid, acts as a salivary stimulant. This action may also be augmented by the use of flavoring agents, which at the same time make the

preparation pleasant to use, although this latter feature is not essential to the invention.

Another feature of the invention is the provision which it makes for removing the gelatinous, or so-called "mucin," plaques from the teeth so that the solution of calcium salts may be more easily introduced into the interprismatic spaces and the acid producing bacteria removed. For this purpose an abrasive agent is employed to mechanically clean the tooth surface. The preferable abrasive agent is the calcium salt in minute particles, which may be lodged in the interprismatic spaces and be incorporated with and sealed and cemented in with the calcium salt deposited from the acid solution. The excess of the calcium salt at the same time acts as a protection for the teeth from the acid used to render the calcium salt soluble, because the calcium salt is at least as liable to the acid as is the substance of the teeth. The presence of the excess therefore is proof that the acid employed has completely exhausted itself on the calcium salt in the dentifrice and that none remains to attack the calcium salts of the teeth.

My invention further contemplates the possibility that the mucin or gelatinous plaques may have been deposited in the interprismatic spaces and thus keep out the calcium salt solution or interfere with the proper deposit thereof. To prevent this, I provide some agent which will dissolve such mucin. For this purpose a proteolytic enzym, capable of acting in an acid medium, is the most practicable. I have used pepsin for this purpose, although any proteolytic enzym which is capable of acting in an acid solution, such as papein, may be used. This proteolytic enzym is not essential to the invention, but obviously assists in carrying out the process depended upon.

The pepsin or other proteolytic enzym is particularly useful in combination with the remaining ingredients because the acid medium first activates the pepsin to digest the mucin plaques from the surface and out of the minute interstices in the teeth. While this action is taking place the solution of calcium salts permeates the tooth, penetrating the full depth of the interstices in it (especially when assisted by the glycerin). Later, and after the pepsin has had ample time to perform its digesting function, the gradual seepage of saliva into the interprismatic spaces neutralizes the acid solution and causes the deposit of tri-basic calcium phosphate and the enveloping of minute particles of the abrasive agent employed so as to solidify the enamel. The enzym and its activating agent thus coöperate with the glycerin and with the saliva to first thoroughly clean and thereafter repair the tooth.

The following compound will illustrate a practical dentifrice made according to my invention, although it is of course to be understood that many of the substances may be replaced by other substances having substantially the same chemical action:—

Take fifty pounds of impalpable powdered tri-basic calcium phosphate, combine with it and thoroughly mix one pound of gum tragacanth as a binding agent. Thoroughly mix with this an acid solution which can be made in the following manner:— Take 3580 c. c. of distilled water, 158 c. c. of hydrochloric acid and 11850 c. c. of glycerin. If a proteolytic enzym is to be employed, it can be added to the acid solution, the manner depending upon the particular enzym to be employed.

After thoroughly mixing the calcium phosphate and the acid solution, during which mixing the hydrochloric acid combines with a portion of the calcium phosphate, rendering it soluble and forming mono-basic phosphate and calcium chlorid. In case it is desirable to add flavoring material, this can be added to the paste during the process of mixing, which should continue for several hours.

In the manufacture of the above dentifrice, other calcium salts may be added, or entirely substituted, which are capable of entering into solution in an acid, and which can be again precipitated on contact with the saliva, in such a manner as to cause the solidification of the enamel.

Furthermore, in the manufacture of the product which I have invented, other acids than hydrochloric acid may be employed, such, as, for example, lactic acid, which combining with tri-basic calcium phosphate forms mono-basic calcium phosphate and calcium lactate, or any other acid which is capable of dissolving calcium phosphate or other calcium salts, which are employed, and which, in so combining with them, will render them soluble in a form in which they may be deposited in the interprismatic spaces, which at the same time does not have other objectionable features. My invention further provides that it is not confined to the action of glycerin alone for hygroscopic action, but that other agents, such as the calcium chlorid, or other agents having sufficient difference of density to cause osmosis.

In the above formula for the manufacture of my invention, the use of gum tragacanth is not essential. Its purpose is simply to keep the abrasive material and the solution of calcium salts from separating, when allowed to stand for any length of time. In its place may be used gum arabic, Indian gum or other binding agents.

The use of tri-basic calcium phosphate is not an essential part of my invention, as other abrasive agents which will not chemi-

cally combine with the calcium solution may be used, such for instance as silex, or it may be eliminated entirely, as the essential part of my invention constitutes a liquid, containing in solution calcium salts capable of penetrating the interprismatic spaces of the enamel, and there be precipitated by the action of the saliva and deposited.

The value of my invention is not limited to its action upon the enamel alone, but to other exposed tooth surfaces. Perhaps its greatest value is in the treatment of tooth surfaces where the peridental membrane has been destroyed and the cementum has been exposed or even penetrated. The action of the calcium salts upon the cementum would be to increase its density by the precipitation of calcium phosphate into the minute external spaces.

In the treatment of pyorrhea, very frequently the cementum is entirely planed away, or broken through, exposing the dentin. In this case, the soluble calcium salts will penetrate the dental tubuli and there be deposited, producing a solidification of the outer surface of the dentin, so exposed, and thus effecting a condensation or solidification, which is a protection to the tooth from the action of the bacteria and acids which may penetrate these tubuli and lead to the destruction of the tooth.

Wherever there has been superficial caries or disintegration of surfaces of the tooth, whether of the enamel, cementum or dentin, there is extreme sensitiveness. Tooth surfaces which have been subjected to over instrumentation, abrasion from improper brushing of teeth, or erosion, likewise are very sensitive and this sensitiveness increases when these surfaces have been covered for a time by gelatinous plaques in which there has been acid fermentation. The use of my invention increases the density of these surfaces in a short time, so that this sensitiveness entirely disappears, and clinical results indicate that it is the only means known by which this can be obtained, with the possible exception of silver nitrate, which in a similar way will deposit in these spaces, but is objectionable because of the fact that it darkens or blackens the tooth.

The value of my invention is that it deposits in the minute external spaces of the tooth, calcium phosphate, which is the natural cementing substance of the tooth. Its daily use, therefore, tends to constantly restore the minute quantities of calcium phosphate which are destroyed by the action of decalcifying secretions or to gradually fill up surfaces which have not been perfectly developed.

It is not the claim of my invention that it will result in the filling of large cavities, where the enamel rods have been broken down, but rather, by a process, similar to that of pertrification, or of the depositing of minerals, in the formation of ore deposits, the calcium phosphate may be gradually deposited in minute spaces, gradually causing condensation.

The clinical evidence is that teeth which have been brushed with this preparation for a period of six months undergo a marked change in their appearance. The enamel becomes whiter in color and acquires a translucent almost transparent, pearl like quality. Such surfaces acquire a brilliant polish, in fact the surface appears to be glazed, this glaze being even more pronounced when examined under a strong magnifying glass. The surface will appear to be perfectly solidified, exposing an amorphous structure. Likewise the cementum and dentin is whitened and assumes more nearly the color and appearance of enamel and the usual sensitiveness of such surfaces entirely disappears, so long as they are kept free from the decalcifying action of accumulations of mucin and are subjected to the action of my preparation. As evidence that the loss of sensitiveness is due to calcifying action, one has only to treat these surfaces for a few days with an acid solution, such, for example, as the citric acid of lemon, or even grape fruit. As the calcium phosphate has been dissolved from the interprismatic or external spaces of the tooth, these surfaces again become very sensitive. Upon the first indication of sensitiveness, the sensitiveness can again be quickly overcome by applying, at frequent intervals, my invention to these surfaces.

An important field for my dentifrice is in the treatment of pyorrhea. To cure pyorrhea it is necessary first to remove deposits and necrotic root and alveolar tissue. This should be done by careful instrumentation. Afterward it is of supreme importance that the blood clot be maintained in the pocket to seal it and protect granulation tissue from infection; that the bacterial mucin plaques be eliminated particularly from the gingival margin, where they are a source of infection; and that the tissues be stimulated to raise their resistance to bacteria and reduce inflammation till the normal regenerative process can be carried out. One of the most frequent causes of failure in the treatment of pyorrhea is the infection of granulation tissues owing to the accumulation of bacterial plaques.

My dentifrice has the capacity to promote each of the conditions tending to quick and perfect recovery. It contains calcium ions and particularly calcium chlorid, which causes and maintains a blood clot to seal the pocket and protect the granulation tissue from infection; the calcium ion also stimulates the leucocytes and is a marked anti-

phlogistic agent raising the resistance of the tissues to bacterial; and the pepsin and abrasive efficiency keep the gingival margins (as well as the rest of the mouth) free from bacterial plaques.

I claim:—

1. A calcifying dentifrice comprising a soluble calcium salt adapted to permeate the minute spaces in the tooth surface and be there transformed and deposited by the saliva in the form of the natural cementing substance of the tooth, in combination with an agent for more effectively causing the solution to permeate and completely fill up such spaces.

2. A calcifying dentifrice containing the calcium salts of which the teeth are composed, held in solution by an acid, so as to be converted by the saliva into the natural cementing substance of the tooth and deposited in the external spaces of the tooth, sealing up these spaces and thereby causing a calcification or solidification of the tooth's surface; and an agent possessing hygroscopic action by which the calcifying solution may be more effectively introduced into the external enamel spaces of the tooth, by virtue of the affinity of said hygroscopic vehicle for the residual moisture of the tooth's structure; and an abrasive which will not chemically interfere with said calcifying action.

3. A calcifying dentifrice containing tri-basic calcium phosphate, of which the teeth are composed, held in solution by hydrochloric acid, so as to penetrate into the external spaces of the enamel and dentin and there be converted by the saliva into tri-basic calcium phosphate and deposited, sealing up these spaces, glycerin, a hygroscopic agent, by which the calcifying solution may be more effectively introduced into the external enamel spaces of the tooth, and calcium phosphate, an abrasive agent, which will not chemically interfere with said calcifying action.

4. A calcifying dentifrice containing a calcium salt held in solution by an acid capable of being neutralized by the saliva to deposit the calcium salt in combination with a hygroscopic medium to augment the penetrative power of the solution into the interprismatic spaces of the teeth, and a proteolytic enzym which, activated by the acid, performs tooth cleaning functions prior to the deposit of calcium salts in the interprismatic spaces of the teeth.

5. A dentifrice comprising tri-basic calcium phosphate in excess in combination with an acid, a hygroscopic medium and a proteolytic enzym.

6. A dentifrice comprising tri-basic calcium phosphate in combination with an acid, glycerin, and a proteolytic enzym.

7. A dentifrice comprising tri-basic calcium phosphate in combination with an acid, glycerin, and a proteolytic enzym, and an abrasive agent.

In witness whereof, I hereunto subscribe my name to this specification in the presence of two witnesses.

WILLIAM M. RUTHRAUFF.

Witnesses:
SEBASTIAN HINTON,
MYRTLE J. MILLER.