

March 3, 1936.

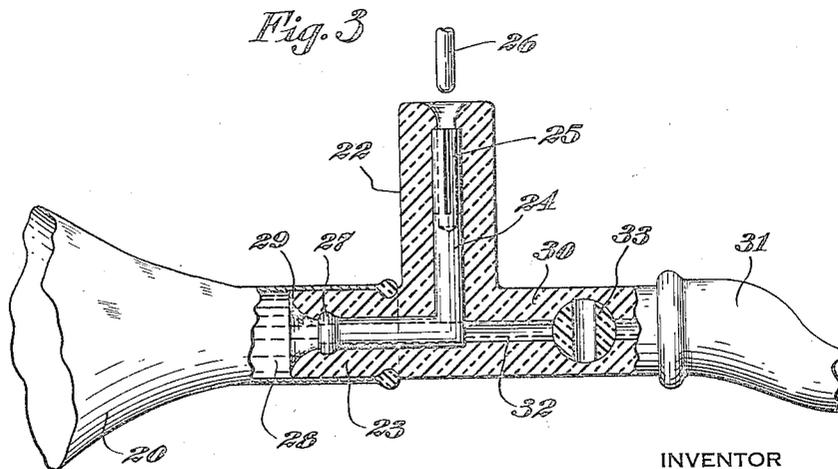
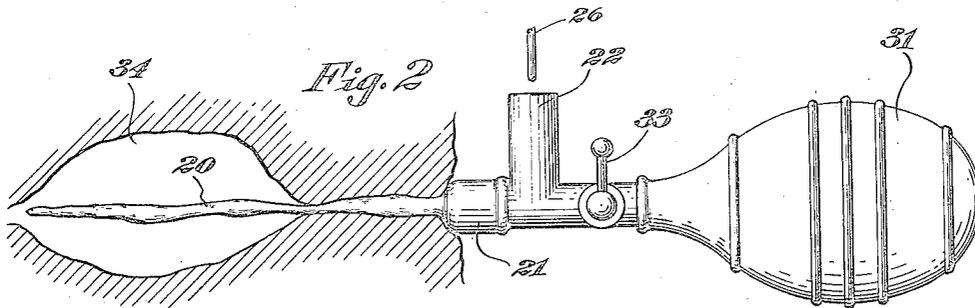
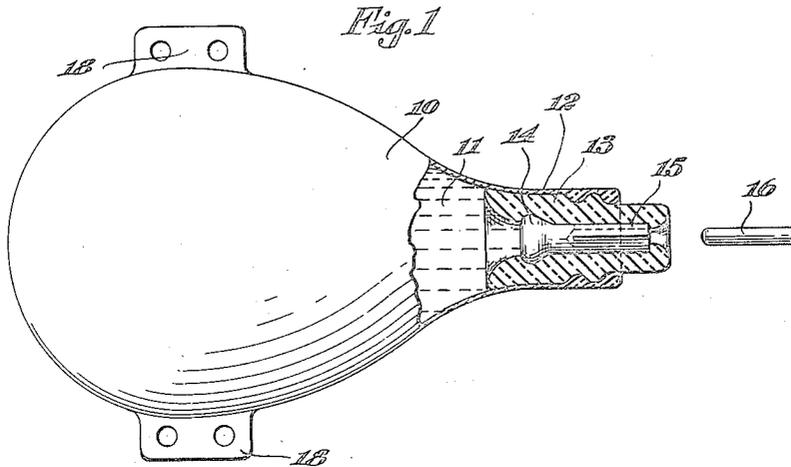
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2,032,859

METHOD AND MEANS FOR THERAPEUTIC APPLICATION OF HIGH FREQUENCY CURRENT

Filed March 30, 1932

2 Sheets-Sheet 1



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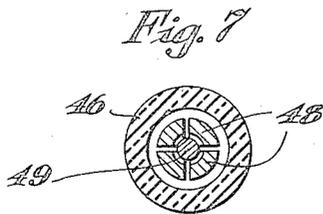
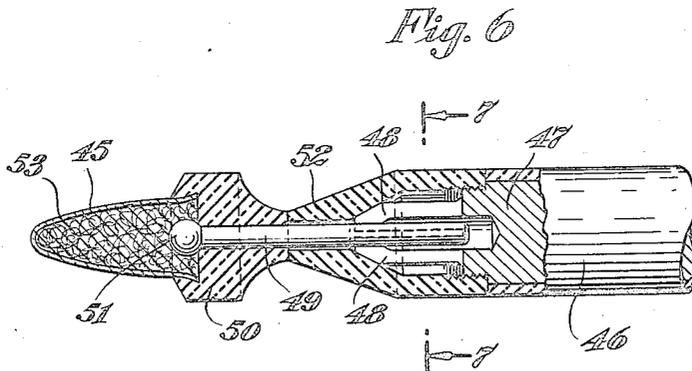
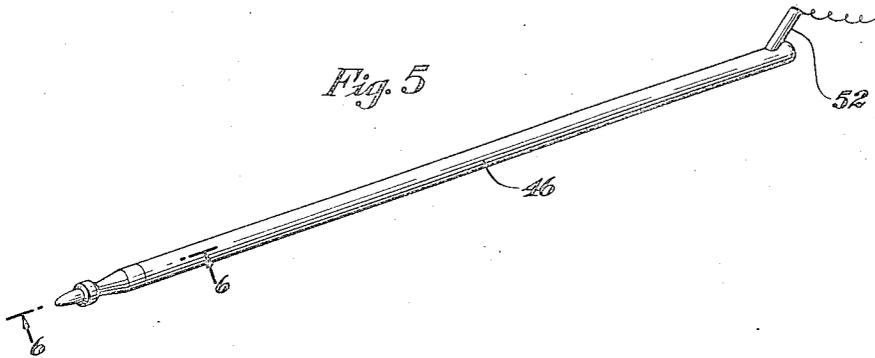
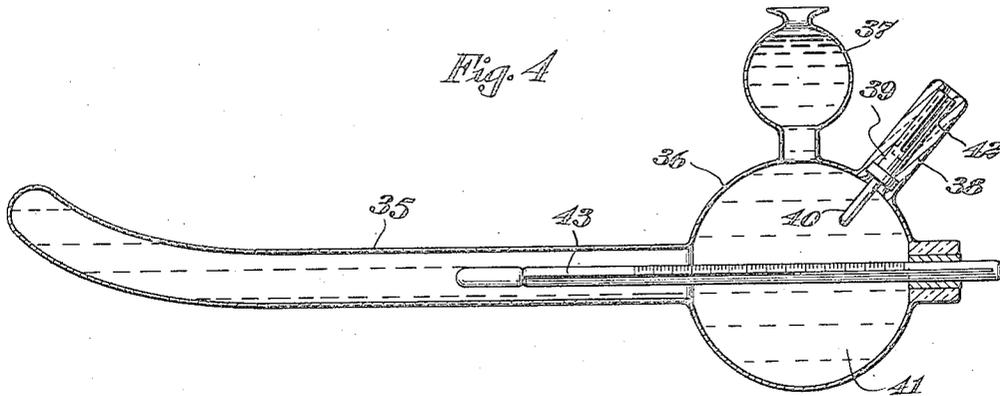
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METHOD AND MEANS FOR THERAPEUTIC APPLICATION OF HIGH FREQUENCY CURRENT

Filed March 30, 1932

2 Sheets-Sheet 2



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METHOD AND MEANS FOR THERAPEUTIC APPLICATION OF HIGH-FREQUENCY CURRENT

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Application March 30, 1932, Serial No. 601,914

5 Claims. (Cl. 174-89)

My present invention relates generally to the surgical or therapeutic arts, and has particular reference to an improved method and means for applying high-frequency current to the human body.

It is a general object of my invention to provide a procedure and a means for passing high-frequency current through portions of the human body under conditions which are simpler and less difficult than those usually encountered heretofore and devoid of many of the dangerous and precarious features of the art as heretofore practiced.

From one aspect, my invention relates to non-surgical diathermy, i. e., to a method and means for utilizing a passage of high-frequency current for the primary purpose of inducing the generation of warmth or heat in the body at particular portions thereof, unaccompanied by any cutting, burning, or similar modification of tissue. From another aspect, my invention relates to diathermy of a semi-surgical character whereby my present invention is adapted to be employed for the mild surgical purpose of effecting superficial desiccation of tissue.

In the practice of non-surgical diathermy, it has been customary to apply a conductive electrode to the portion of the body to be treated, the electrode usually being in the form of a sheet, and composed of conducting material such as metal foil. In the employment of such electrodes, great care has always been necessary to establish a firm contact with the body and to avoid minute air gaps between the electrode and the body. In applying electrodes of this character to irregular contours, difficulties have frequently been encountered which have never, to my knowledge, been successfully obviated. For example, in applying electrodes of this metallic character to hairy portions of the body, it has been almost impossible to establish a firm contact. Frequently, if not regularly, the electrodes have been wetted, usually with a soapy solution, to facilitate the establishment of firm contact. Where the electrodes are kept in position for a considerable period of time, it has usually been necessary to rewet them from time to time. Even with this precautionary procedure, it has been notoriously difficult to maintain firm contact, especially where movements of the body cause the electrodes to slip or slide or similarly alter their position.

The establishment of a firm contact, where conductive electrodes of the customary character have been employed, is essential for the reason that concentration of the current, due to uneven

contact, causes burns which are all too frequently of a severe character. In fact, special care must always be taken in removing the electrodes to avoid burning at the point or points or edge of the electrode which is last to break contact with the body.

In accordance with my present invention, I am enabled to establish satisfactory and safe contact with even the most irregularly contoured portions of the body, and also with hairy portions or the like, and this desirable object is achieved without the necessity for any special precautions or wetting or soaping and with no danger or likelihood of causing burns.

I have found that a high-frequency current, if properly generated and sustained, can be caused to pass through the human body for non-surgical and semi-surgical diathermic purposes, where the electrode has an outer or exterior surface of non-conductive or dielectric material. I have found, further, that remarkably satisfactory results are achieved where the electrode is almost totally devoid of solid conductive material such as metal and where the current is conducted to the area of application by means of a conductive fluid.

Briefly, my invention resides, from one aspect, in an electrode consisting of a hollow applicator or contact-making portion, the applicator being of dielectric material, a mass of conductive fluid in the applicator, and a means for establishing a direct electrical connection with such fluid.

In one embodiment of my invention, the applicator is of an elongated character and substantially rigid, being composed, for example, of glass or the like. Such an applicator is peculiarly adaptable for insertion into interior cavities of the body.

In another, and preferred, embodiment of the invention, the applicator is of a flexible, bag-like character, being composed of flexible dielectric material such as rubber or the like. An electrode of this type is of peculiar effectiveness in establishing contact with such portions of the body as the armpits, the abdomen, the head, or other irregular or hairy portions. An electrode composed of a distensible, bag-like applicator, adapted to contain a conductive fluid, is also of great utility in establishing firm contact with irregular internal cavities, especially where the cavities are accessible only through relatively constricted passages.

Other features of my invention lie in an improved means for gaining valuable information as to the heat which is actually generated in the tissues, in a means for controllably varying the

amount of fluid in the applicator, in the manner of efficiently and safely establishing direct electrical connection with the fluid in the applicator, and in other structural improvements which result in the production of an efficient and feasible instrumentality.

Where the electrode is to be used for semi-surgical purposes such as desiccation, a preferred embodiment is constructed with the hollow applicator in the form of an operative tip arranged at the forward end of a suitable handle, the tip being filled with the conductive fluid and being provided with means, preferably extending rearwardly through the handle, for establishing a direct electrical connection with the fluid.

I achieve the foregoing objects, and such other objects as may hereinafter appear or be pointed out, in the manner illustratively exemplified in the accompanying drawings, wherein—

Figure 1 is a plan view of an electrode constructed in accordance with my present invention with a portion shown in cross-section;

Figure 2 is a view of a modified form of electrode, illustratively showing the manner in which it may be applied to an interior cavity;

Figure 3 is an enlarged, cross-sectional view similar to Figure 2 and showing certain details of construction;

Figure 4 is a longitudinal, cross-sectional view of a modified type of electrode;

Figure 5 is a perspective view of an instrument or electrode designed for semi-surgical purposes.

Figure 6 is an enlarged, cross-sectional view through the operative end of the device of Figure 5; and

Figure 7 is a cross-sectional view taken substantially along the line 7—7 of Figure 6.

In Figure 1, I have shown an applicator 10 which is composed of flexible, dielectric material such as sheet rubber or the like. The applicator is substantially bag-like in characteristics and is adapted to accommodate a conductive fluid 11 which may, for example, be a liquid electrolyte such as salt water or the like. I have shown the applicator 10 provided with a neck 12 in which a plug 13 is mounted in any convenient and liquid-tight manner. The plug 13 is of dielectric or insulating material, but is not necessarily flexible.

The plug 13 is provided with a bore in which an electric terminal 14 is snugly mounted. At its rear portion the terminal is provided with the fingers 15 or with a similar attachment arrangement, whereby a rod-like contact member 16 may be readily inserted and removed, through the rear end of the bore, into firm and direct electrical contact with the terminal 14. The forward end of the terminal 14 is preferably disposed rearwardly of the forward edge of the plug 13, somewhat in the manner shown, so that it is virtually disposed in a recess 17. The terminal 14 is preferably metallic in character.

In order to facilitate the attachment of the applicator to the body, I prefer to associate lugs 18 therewith, preferably in the form of integral webs or fins arranged at spaced portions of the applicator 10. These lugs are adapted to receive and engage with straps or the like for securing the electrode in firm contact to the body portion through which the high-frequency current is to be passed.

The applicator of Figure 1 is not necessarily refillable with fluid, and, in fact, it is preferably permanent in nature subsequent to its manufacture. Where a liquid conductive fluid is used,

care is taken during manufacture that all air and gases are absent from the interior of the applicator, the entire space being taken up by the liquid 11.

In employing the electrode of Figure 1, it is not necessary to employ any wetting or soaping procedures, nor need any particular precautions be taken in applying the same to hairy or irregular portions of the body. The entire electrode being flexible and deformable in nature, it is a comparatively simple matter to apply it to the portion to be treated and to hold it in firm contact with this portion by means of straps or the like which engage the fins or lugs 18 or similar lugs arranged at convenient points. When secured in place, the electrode adjusts and conforms itself readily to the particular contours involved by virtue of its inherent deformable character. Contact is then established between the human body and one terminal of one source of suitable high-frequency current; and a similar electrical connection is then made between the other terminal of the current source and the connector 16. When the latter is then inserted into contact with the terminal 14, the circuit is closed, and the high-frequency current is conducted through the fluid 11 into a virtually direct contact with the area of the body which is to receive the current. The contact is, of course, not strictly direct because a wall of dielectric material separates the body from the fluid 11; but if the high-frequency oscillations are properly generated and sustained, the current will pass in the contemplated manner and will induce the desired warmth in the body contacted by the electrode.

It is to be noted that there is no danger of any sparking or burning. Whether the body portion be irregular or hairy, or whether the applicator is dry or wet, or whether it is applied or removed without any special precautions, is immaterial.

In Figures 2 and 3, I have shown a similar construction in which means are provided for varying the amount of fluid in the applicator. An applicator 20 of distensible, dielectric material such as stretchable sheet rubber or the like, is secured at its rear end 21 in fluid-tight manner with a connector 22 shown in detail in Figure 3. One portion 23 of the connector constitutes a plug similar to the plug 13 of Figure 1. The central portion of the member 22 is adapted to accommodate an electric terminal 24 having an attachment portion 25 adapted to receive the contact 26. The terminal 24 is suitably shaped to arrange its forward tip 27 in direct contact with the fluid 28, and the tip 27 is preferably arranged in a recess 29.

The portion 30 of the member 22 serves as a plug for a reservoir member 31 which may, for example, be in the form of a rubber bulb or the like. A bore 32 extends through the member 22 to establish communication between the interior of the applicator 20 and the interior of the reservoir 31. In the arrangement shown, the terminal 24 is provided with a bore through the portion which lies in the bore 32, so that the passage of fluid between the applicator 20 and the reservoir 31 is not impeded.

In the bore 32 is a valve member 33 adapted to be adjusted to open or seal the bore communication 32.

One manner of using the electrode is illustrated, more or less diagrammatically, in Figure 2. The fluid is caused to flow into the res-

ervoir 31, and the petcock 33 is closed. This deflates the applicator 20, which may then be inserted into the illustrative interior body cavity 34. The petcock 33 is then opened, and the reservoir 31 is manipulated as by squeezing to force the fluid into the applicator 20, thereby distending the latter to any desired degree. For example, the applicator 20 of Figure 2, when distended by the fluid, will adjust itself automatically to the irregular contours of the walls of the cavity 34. When the applicator has been distended to the proper or desired amount, the petcock 33 is again closed, and the electrode is then ready for use in the same manner as the electrode of Figure 1, except that it has been feasibly and effectively applied to the walls of an interior body cavity. It may be noted that a firm contact with such walls has heretofore been utterly unfeasible, if not impossible, for non-surgical diathermic purposes by the methods or instruments of customary practice.

Obviously, the device of Figures 2 and 3 is not necessarily limited to employment to interior cavities or portions of the body. The variable extensibility of the applicator, and the means for controlling the amount of fluid in it, are features which may be of equal value and utility in connection with the establishment of satisfactory electrical contact with other portions of the body, for example, under the armpits, or under the back of a patient lying on his back.

In Figure 4, I have illustrated a form of electrode in which the applicator 35 is of rigid material such as glass or similar dielectric material. In this form of the invention, an enlargement 36 is preferably arranged at the rear end of the applicator, and a reservoir 37 which may be used for filling purposes is associated with the enlargement 36. In a neck 38, an electric terminal 39 is arranged to establish a direct electrical connection at 40 with the fluid 41 in the applicator. Connection is established in the conventional manner with the rear portion 42 of the terminal 39.

The applicator 35 has been illustratively shown in elongated form, and is designed primarily for insertion into body cavities. The establishment of suitable electrical connections is accomplished as hereinbefore described in connection with Figure 1, and the walls contacted by the applicator 35 are subjected to the diathermic treatment which results from the passage of high-frequency current.

In the methods heretofore employed for attempting to pass high-frequency current through the walls of interior cavities, applicators of metallic or conductive material have sometimes been employed. Not only have these applicators been subjected to the same dangers and difficulties hereinbefore illustratively specified in connection with similar metallic electrodes applied to the exterior of the body, but an accurate knowledge and constant control of the amount of heat actually generated by the passage of the current has never been feasibly capable of accomplishment. To insert a thermometer into a metallic applicator which establishes a direct electrical connection with the cavity wall to be treated serves merely to measure the heat of the air in the applicator, but this is grossly inadequate to afford even an approximate idea of the heat actually generated in the tissue. With my present electrode, the employment of a liquid conductive fluid affords the convenient opportunity to obtain more accurate information as to the actual heat gener-

ated in the tissue, since the liquid electrolyte is usually a good conductor of heat. As a result, the employment of a thermometer 43 immersed in the conductive electrolyte 41 affords a simple and expedient method of gaining information as to the amount of heat actually generated by the passage of high-frequency current through the areas contacted by the applicator 35.

In all of the embodiments of my present invention, including that of Figure 4 and the subsequent embodiment presently to be described, it is to be borne in mind that the conductive fluid, which is preferably, though not necessarily, liquid, does not serve as a mere transmitter of heat to the areas contacted by the applicator, but serves as a conductor of the electric current itself. The walls of the applicator in each case serve, virtually, as the dielectric of an electrical condenser through which the high-frequency current passes by virtue of its characteristics.

In Figures 5-7, I have illustrated a modified construction which shows the manner in which my present invention may be employed for semi-surgical purposes such as superficial desiccation. The applicator corresponding to that of the previous embodiments is composed of an operative, hollow tip 45, preferably of a dielectric material such as glass, mounted upon the forward end of a handle 46. The handle is preferably constructed with an interior conductive member 47 which terminates at its forward end in the split jaws 48. These jaws are adapted to accommodate a rearwardly extending electric terminal rod 49 which is mounted in the insulating head 50 which carries the tip 45, and which is provided at its forward end with the contact portion 51 arranged in the interior of the tip 45, and hence in direct electrical connection with the fluid contained in the tip 45. A threaded connector member 52 is adapted to engage with corresponding threads on the handle 46 so that the tip, and the rod 49, may be withdrawn from the handle for possible replacement by a different type of, or differently configured, applicator tip. When the operative forward end of the device is screwed onto the handle 46, the beveled interior surfaces of the member 52 have a wedging action upon the jaws 48 to establish a firm grip and contact between these jaws and the rod 49. At the rear end of the handle a terminal 52 may be provided to facilitate connection with the source of high-frequency current.

The tip 45 is preferably filled with an absorbent carrying medium 53, such as cotton or the like, which facilitates the permanent accommodation in the tip of the conductive fluid such as a liquid electrolyte. In using the instrument of Figures 5-7, an electrical connection is established, as hereinbefore described, between one terminal of the high-frequency source and the body to be treated. The other terminal of the high-frequency source is connected at 52, whereby the conductive fluid in the tip 45 is brought into direct electrical connection with the high-frequency current. When the handle 46 is wielded so as to apply the tip 45 to a selected portion of the body, usually for the purpose of removing skin blemishes or the like, the circuit is closed by the passage of the high-frequency current through the dielectric material of the tip 45. Since this current is more concentrated than that which passes through the relatively more expansive areas of the applicators hereinbefore described, a semi-surgical diathermic effect is produced which results in superficial desiccation. I have

found, however, that the effect is not one of burning or searing, as might be the case where a conductive tip is applied directly to the body, but is of a peculiarly safe and harmless character which accomplishes the desired results by the mere passage of the current and without any hot sparking or burning.

Although I have illustrated an electric terminal, in each case, arranged in a relatively protected and enclosed portion of the applicator, it will be understood that under certain circumstances different arrangements might be feasibly provided for establishing the desired electrical connection with the conductive fluid. For example, a flexible wire or group of wires might be caused to extend into immersed relation with the fluid in any of the applicators herein described. Similarly, the material of the applicator need not necessarily be so soft and flexible as to be distensible; nor need it necessarily be as hard and as rigid as glass. Various dielectric materials may be employed to meet differing requirements.

It will be obvious that changes in the details herein described and illustrated for the purpose of explaining the nature of my invention may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended that these details be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. A high-frequency electrode comprising a freely distensible bag-like applicator composed of stretchable dielectric sheet material, a source of high-frequency current, an electric terminal extending from one terminal of said current source into said applicator so as to establish a direct electrical contact with fluid in said applicator; and means carried by the applicator for feeding varying amounts of fluid into it to effect desired distentions thereof.

2. A high-frequency electrode comprising a freely distensible bag-like applicator composed of stretchable dielectric sheet material, a source of

high-frequency current, an electric terminal extending from one terminal of said current source into said applicator so as to establish a direct electrical contact with fluid in said applicator, and means carried by the applicator for feeding varying amounts of fluid into it to effect desired distentions thereof, said means comprising a reservoir of fluid supply, a conduit between said reservoir and the applicator, and means for selectively opening or closing said conduit.

3. The herein-described method of passing high-frequency current through the wall of an interior body cavity, which consists in establishing an electrical connection between the body and one terminal of a source of high-frequency current, inserting into said cavity a collapsed yet distensible dielectric container, thereupon feeding a conductive fluid into said container so as to distend the latter and force it into contact with the cavity wall, and finally establishing an electrical connection between the other terminal of said current source and the conductive fluid within said container.

4. A high-frequency electrode comprising a freely distensible, bag-like applicator composed of stretchable, dielectric, sheet material, a conductive fluid therein, a source of high-frequency current, an electric terminal extending from one terminal of said current source into said applicator and into direct contact with said fluid, and means carried by the applicator for varying the amount of fluid therein.

5. A high-frequency electrode comprising a freely distensible, bag-like applicator composed of stretchable, dielectric, sheet material, a reservoir of variable capacity carried by said applicator, whereby filling the reservoir with conductive fluid and then reducing its capacity will feed a predetermined quantity of said fluid into the applicator to distend the latter, a source of high-frequency current, and an electric terminal extending into the applicator and adapted to make direct electrical connection between one terminal of said current source and the fluid in said applicator.

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