

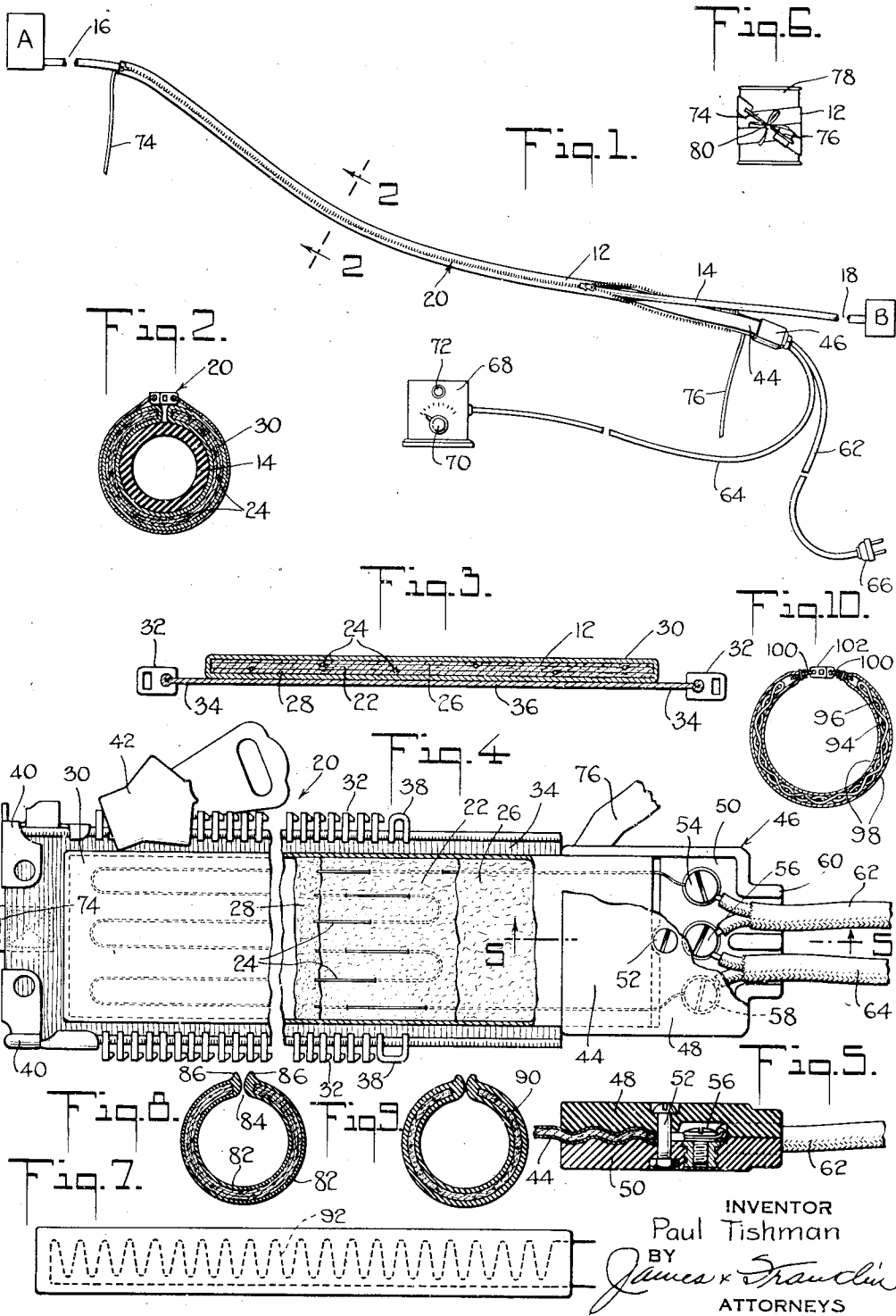
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FLEXIBLE TUBE WARMER

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FLEXIBLE TUBE WARMER

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This invention relates to heating devices, and more particularly to a flexible tube warmer.

The primary and general object of my invention resides in the provision of a flexible tube warmer for medical and hospital purposes, or the like. In medical practice there is frequent occasion for conducting a fluid from a source or container to the body of a patient, as, for example, in intravenous injections, continuous drip rectal feedings, eye douches, or the like, the fluid being conducted through a relatively long slender flexible rubber tube. The heater of the present invention may be used to warm the fluid to the desired body temperature, and is made flexible so as to readily follow the contour of the tube about which it is placed.

It is important in this field of work to avoid contamination of the otherwise sterile equipment. The flexible rubber tube is connected at its ends to suitable devices, and it is an object of my invention to devise a heater which may readily be applied to an intermediate part of the tube without necessitating disconnection of the ends of the tube which might expose the same to contamination. The heater is accordingly made in the form of a long narrow flexible jacket which is openable longitudinally and thereby adapted to be readily placed around the tube to be heated, intermediate its ends.

To the accomplishment of the foregoing and other objects which will hereinafter appear, my invention consists in the flexible tube heater elements and their relation one to the other, as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by a drawing, in which:

Fig. 1 shows one form of the invention and the manner in which it is applied to a flexible tube in order to warm the same;

Fig. 2 is a section taken in the plane of the line 2-2 of Fig. 1;

Fig. 3 is a section through the heating jacket, with the same open to flat condition;

Fig. 4 is an enlarged partially sectioned plan view showing the ends of the jacket;

Fig. 5 is a section taken in the plane of the line 5-5 of Fig. 4;

Fig. 6 shows how the heating jacket of Fig. 1 may be applied to a container;

Fig. 7 indicates a modified way of disposing the heating wires within the heating jacket;

Fig. 8 is a transverse section through a modified form of heating jacket;

Fig. 9 is a modification of the arrangement shown in Fig. 8; and

Fig. 10 is another modification.

Referring to the drawing, and more particularly to Fig. 1, the invention comprises a long narrow openable heating jacket 12 which is readily applicable to a slender flexible tube 14 connecting two pieces of equipment schematically indicated at A and B. In Fig. 1, tube 14 is broken at 16 and 18 merely to indicate the fact that the tube may be and ordinarily is of greater length than is shown on the drawing. The ends of the tube are not disconnected from the terminal pieces of apparatus A and B. The jacket is openable to the flat condition indicated in Fig. 3, but may be held in closed condition about tube 14 by means of a fully separable slide fastener generally designated 20. By reason of this construction, it is unnecessary to disconnect the tube 14 from either of the terminal pieces of apparatus A and B when applying the jacket 12 thereto.

Considering the arrangement in greater detail, the jacket 12 comprises a center sheet or strip of asbestos material 22 through which there is appropriately threaded a high resistance heating wire 24. This wire is preferably arranged in loops extending longitudinally of the jacket, in order to attain the greatest degree of flexibility of the jacket for bending the same closely about the tube to be heated. The wire may be passed beneath and above the asbestos strip 22, as is clearly shown in Fig. 4, thus anchoring the heating conductors in spaced relation. Additional strips of asbestos material 26 and 28 are placed on either side of the center strip 22. The resistance wire is thus completely surrounded by asbestos.

The three layers of asbestos material are themselves housed within a surrounding layer of rubber 30. This casing of rubber provides a waterproof protection for the heating wires and the asbestos material carrying the same.

The interlocking elements 32 of the slide fastener 20 are secured to the edges 34 of a fabric strip 36. It is conventional practice to mount the elements on strips or tapes which are in turn secured to the object to be closed by the slide fastener. In the present case, however, the total width of the fabric strip 36 is comparatively small, and it is therefore entirely feasible to arrange for the slide fastener manufacturer to secure the elements 32 directly to the edges of strip 36. It will be understood, however, that if desired the conventional tapes may be employed,

and these may in turn be sewn to a separate strip of fabric. In such case, the strip 36 is replaced by three strips in overlapping relation. The strip 36 is secured to the rubber casing 30 in any desired fashion, as by cementing or, more preferably, by adhering the parts with rubber during the treatment or vulcanization of the jacket.

Slide fastener 20 is of the fully separable type and includes ordinary end stops 38 at one end and a fully separable bottom end stop 40 at the other end. The slider 42 is of conventional type.

One end of jacket 12 is projected beyond the slide fastener 20 and beyond the convolutions of heating wire to form a flexible connecting portion 44 leading to a molded connection block 46. This block may be molded integrally about the end 44 of the jacket, particularly if molded of hard rubber, but in the present case the block is illustrated as made of upper and lower halves 48 and 50 held together by a suitable bolt 52. The end 44 of the jacket is held in sinuous relation between the halves of the block, as is clearly shown in Fig. 5, thus securely anchoring the parts together. The interior of the block is provided with appropriate contact screws 54, 56, and 58. The neck 60 of the block is provided with two entrant openings through which flexible conductor cords 62 and 64 extend. Cord 62 leads to a wall outlet plug 66, as is clearly shown in Fig. 1, while cord 64 leads to a heating control resistor 68. The parts may be arranged in various ways for temperature control, but inasmuch as only a small range of control is needed in the present case, I prefer to employ an ordinary variable resistor connected directly in series with the heating wires of jacket 12.

Thus, referring to Fig. 4, one conductor from cord 62 leads directly to the heating wire, while the other is connected to the center screw 56 which in turn is connected to one of the conductors in the cord 64. The other conductor in cord 64 is connected to screw 58 and thence to the heating wire. The small casing 68 in Fig. 1 contains a variable resistor the resistance of which is varied by a suitable control knob 70. This resistor is connected directly in series between the two conductors of cord 64. If desired, a small pilot light 72 may be provided in casing 68 in order to indicate when the jacket is being supplied with heating current.

The heating effect of the jacket may also be varied by partially opening the slide fastener, thus varying the length of jacket which is usefully applied for warming the tube. The opened part of the jacket tends to fall away from the tube and has no useful heating effect. It is therefore not essential to provide a separate heating control device such as is here illustrated.

The ends of the fabric backing 36 preferably have sewn thereto ties or tapes 74 and 76. These are convenient for occasional use in tying a part of the apparatus to a nearby object, such as a table or bedstead, in order to hold the tube 14 in place. However, they are also useful in making it possible to apply the heater to miscellaneous objects other than a tube or conduit such as the tube 14. Referring to Fig. 6, for example, I show the heater left in flat condition and wound spirally about a container 78. The tapes 74 and 76 are tied together at 80 to hold the jacket about container 78.

It is not essential to employ a slide fastener to hold the openable jacket in closed condition. Thus, referring to Fig. 8, I show a modified form

of the invention in which the rubber casing 82 is thickened somewhat and so treated during vulcanization as to make the same self-supporting in configuration. The jacket is longitudinally slit at 84, and the point of separation is preferably provided with outwardly turned lips 86 so as to facilitate the insertion of a tube such as the tube 14 within the jacket. It will be understood that the tube is simply pressed inwardly between the lips 86 which spread apart far enough to receive the tube. The jacket is characterized by a resilience which causes the lips 86 to normally move toward one another and thus maintain the jacket in approximately cylindrical configuration.

The arrangement shown in Fig. 9 differs from that previously described, in another respect, namely the mounting of the heating conductors in the asbestos material. In the arrangement of Fig. 9, only a single layer 90 of asbestos fabric is employed, instead of three layers. The heating conductor is woven in the fabric during the manufacture of the fabric, and is so disposed therein as to be securely held in place and surrounded on both sides by asbestos material, thus protecting the rubber from direct contact with the heating conductors.

Fig. 10 shows still another modification of the invention using a slide fastener, and illustrating the feasibility of employing varnished silk or the like in lieu of the outer layers of asbestos or the outer layers of rubber, or in this case in lieu of both. Referring to Fig. 10, the resistance wires 95 are carried in a relatively light-weight asbestos grid 96. Inner and outer layers of a suitable insulating fabric 98 are provided. This fabric is preferably silk impregnated or varnished with an appropriate material such as liquid synthetic resin or the like. This material provides an adequate heat insulation for the relatively low or moderate temperatures encountered in the present device, and it also provides an efficient electrical insulation. The tapes 100 of the slide fastener 102 may be stitched directly between the laminations 98, as is clearly shown in the drawing.

It will be understood that, if desired, an outer jacket of rubber may be provided on a device such as that shown in Fig. 10, in which case the essential change from the arrangement shown in Fig. 2, for example, resides in the substitution of varnished silk for the outer layers of asbestos. The particular advantage of the arrangement shown in Fig. 10 resides in its exceedingly light weight. When the heater is very light in weight, no difficulty arises by reason of extra sag or pull on the terminal element which may, for example, be a needle in the patient. To obtain the desired lightness, the slide fastener is preferably made of aluminum. Moreover, the connection block, such as the block 46 shown in Fig. 1, is eliminated and the control box lead 64 is connected to the wall outlet plug 66. In other words, the series connection shown in Fig. 4 is transferred from the heater to the wall plug. In such case the connection block 46 may be lightened or even entirely eliminated, the end of the cord then being stitched in the end of the jacket to hold the same in place.

The control box 68 preferably includes a sensitive fuse dimensioned to open the heater circuit should any short-circuit occur between the loops of resistance wire, thus preventing any substantial increase in temperature over the moderate temperature desired for the present purposes.

Fig. 7 schematically illustrates a modified arrangement of the resistance wire, in accordance

with which the resistance wire is bent in short loops 92 extending transversely of the heating jacket, instead of being bent to form long loops disposed longitudinally of the heating jacket as previously described. This arrangement has a slight advantage, in that accidental contact between adjacent loops represents but a negligible short-circuit at only slight potential difference. However, the longitudinal loops result in greater transverse flexibility and therefore are preferable when using the arrangement shown in Figs. 1 through 4.

It is believed that the mode of constructing and using, as well as the many advantages of my improved flexible tube warmer, will be apparent from the foregoing detailed description thereof. The jacket is readily applied to a tube to be heated. The terminal elements need not be disconnected and this avoids contamination and, even where contamination is unimportant, avoids the inconvenience of disconnecting or rearranging the apparatus. The jacket is flexible and may therefore be used with flexible tubes. When opened, the jacket may be used as a flat ribbon heater and may be wound about not only a container but also about the arm or leg of a patient for purposes of ordinary local heating.

It will also be apparent that while I have shown and described my invention in preferred forms, many changes and modifications may be made in the structures disclosed, without departing from the spirit of the invention, defined in the following claims.

I claim:

1. A flexible tube heater for medical purposes or the like, said heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a flexible rubber tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, resistance wiring in said jacket, a wall outlet plug, and a flexible electric cord interconnecting said plug and said jacket.

2. A flexible tube heater for medical purposes or the like, said heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a flexible rubber tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, resistance wiring in said jacket, a heating control device, a wall outlet plug, and wiring interconnecting said plug, said jacket, and said control device.

3. A flexible tube heater for medical purposes or the like, comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and provided with slide fastener elements along the edges thereof and fully separable end stops at the ends thereof, a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around a tube intermediate the ends of the tube without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, and resistance wiring in said jacket.

4. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and provided with slide fastener elements along the edges thereof and fully separable end stops at the ends

thereof, a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around a tube intermediate the ends of the tube without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, resistance wiring in said jacket, a wall outlet plug, and a flexible electric cord interconnecting said plug and said jacket.

5. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and provided with slide fastener elements along the edges thereof and fully separable end stops at the ends thereof, a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around a tube intermediate the ends of the tube without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, resistance wiring in said jacket, a heating control device, a wall outlet plug, and wiring interconnecting said plug, said jacket, and said control device.

6. A flexible tube heater for medical purposes or the like, said heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a flexible rubber tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, said jacket comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, and a layer of rubber surrounding said asbestos material in order to waterproof the jacket.

7. A flexible tube heater for medical purposes or the like, said heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a flexible rubber tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, said jacket comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, a layer of flexible rubber surrounding said asbestos material in order to waterproof the jacket, a wall outlet plug, and a flexible electric cord interconnecting said plug and said jacket.

8. A flexible tube heater for medical purposes or the like, said heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a flexible rubber tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, said jacket comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, a layer of flexible rubber surrounding said asbestos material in order to waterproof the jacket, a heating control device, a wall outlet plug, and flexible electric cords interconnecting said plug, said jacket, and control device.

9. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed

by the asbestos material, a layer of flexible rubber surrounding said asbestos material in order to waterproof the jacket, slide fastener elements along the edges of said jacket, fully separable end stops at the ends thereof, and a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around a tube intermediate the ends of the tube without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected.

10. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, a layer of flexible rubber surrounding said asbestos material in order to waterproof the jacket, a backing strip of fabric outside said jacket, slide fastener elements along the edges of said jacket, and fully separable end stops at the ends thereof, said elements being secured to said fabric backing strip, and a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around a tube intermediate the ends of the tube without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected.

11. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, said jacket comprising resistance wires at the inside and at the outside, the rubber of said jacket being formed to bring the edges of said jacket toward one another to naturally assume a generally cylindrical configuration with an openable space between the edges, whereby the tube to be heated may be pressed through said slit into the jacket.

12. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, said jacket comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, a layer of flexible rubber surrounding said asbestos material in order to waterproof the jacket, the rubber of said jacket being formed to bring the edges of said jacket toward one another to naturally assume a generally cylindrical configuration with an openable space between the edges, whereby the tube to be heated may be pressed through said slit into the jacket.

13. A flexible tube heater comprising a long narrow flexible jacket, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around a tube intermediate the ends of the tube, without necessitating disconnection of the ends of the tube from the devices to which the tube is ordinarily connected, said jacket comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, a layer of flexible rubber surrounding said asbestos material in order to waterproof the jacket, a heating control resistor, a wall

outlet plug, and flexible electric cords interconnecting said plug, said jacket, and said resistor, the rubber of said jacket being formed to bring the edges of said jacket toward one another to naturally assume a generally cylindrical configuration with an openable space between the edges, whereby the tube to be heated may be pressed through said space into the jacket.

14. Heating apparatus comprising, in combination, terminal pieces of apparatus interconnected by a flexible rubber tube, and a flexible tube heater surrounding said tube, said heater comprising a long narrow flexible jacket which is readily and quickly openable longitudinally and thereby adapted to be readily placed around the tube without necessitating disconnection of the ends of the tube from the terminal pieces of apparatus, resistance wiring in said jacket, a wall outlet plug, and a flexible cord interconnecting said plug and said jacket.

15. Heating apparatus comprising, in combination, terminal pieces of apparatus interconnected by a flexible rubber tube, and a long narrow flexible heating jacket, said jacket being readily and quickly openable longitudinally and provided with slide fastener elements along the edges thereof and fully separable end stops at the ends thereof, and a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around or removed from the tube without necessitating disconnection of the ends of the tube from the terminal pieces of apparatus.

16. Heating apparatus comprising, in combination, terminal pieces of apparatus interconnected by a flexible rubber tube, and a long narrow flexible heater jacket, said jacket comprising a foundation strip of asbestos material, resistance wires supported in place and protectively housed by the asbestos material, and rubber material surrounding said asbestos material, said jacket being readily and quickly openable longitudinally and thereby adapted to be readily placed around the tube without necessitating disconnection of the ends of the tube from the terminal pieces of apparatus.

17. Heating apparatus comprising, in combination, terminal pieces of apparatus interconnected by a flexible rubber tube, and a long narrow flexible heating jacket, said jacket being readily and quickly openable longitudinally and comprising a foundation strip of asbestos material, resistance wire supported in place and protectively housed by the asbestos material, rubber material surrounding said asbestos material, slide fastener elements along the edges of said jacket, fully separable end stops at the ends thereof, and a slider for opening or closing the slide fastener, whereby the jacket is adapted to be readily placed around the tube without necessitating disconnection of the ends of the tube from the terminal pieces of apparatus.

18. Heating apparatus comprising, in combination, terminal pieces of apparatus interconnected by a flexible rubber tube, and a long narrow heating jacket, said jacket comprising resistance wires at the inside and flexible rubber at the outside, the rubber of said jacket being formed to bring the edges of the jacket toward one another to naturally assume a generally cylindrical configuration, with an openable space between the edges, whereby the jacket may be readily and quickly applied to or removed from the tube without disconnecting the ends of the tube from the terminal pieces of apparatus.

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