

May 7, 1963

E. B. NICHOLS
TRACHEAL DEVICES

3,088,466

Filed May 4, 1960

2 Sheets-Sheet 1

Fig. 1.

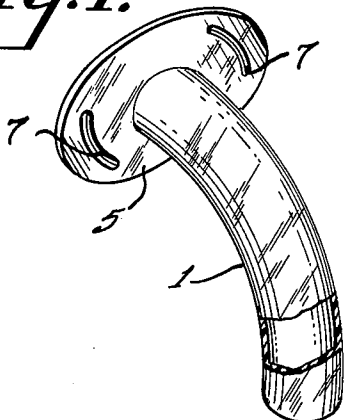


Fig. 2.

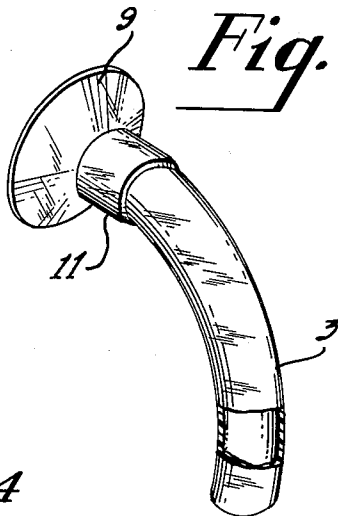


Fig. 3.

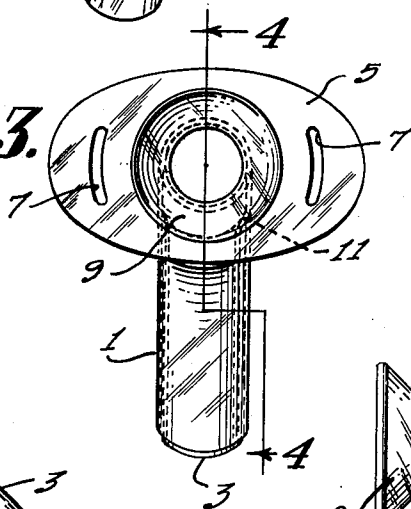


Fig. 5.

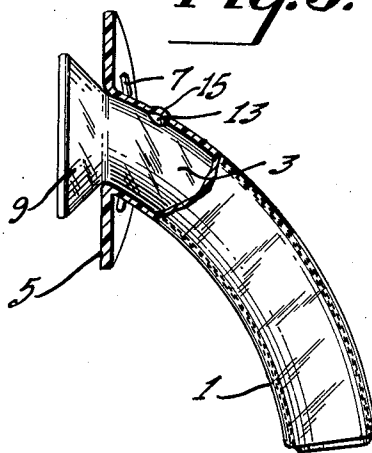
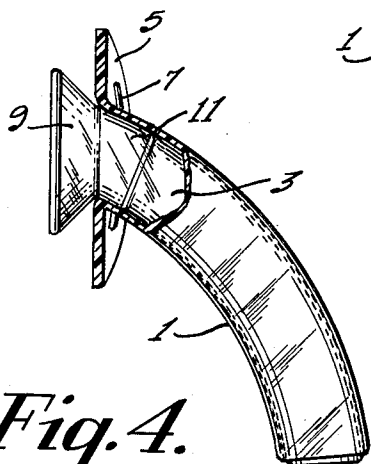


Fig. 4.



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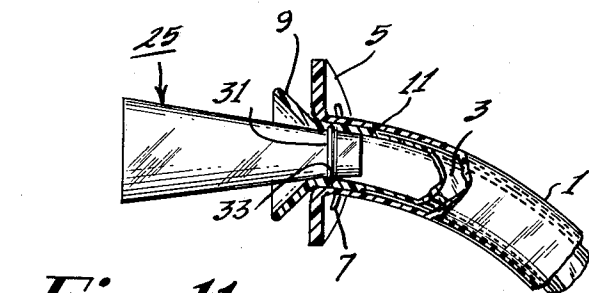
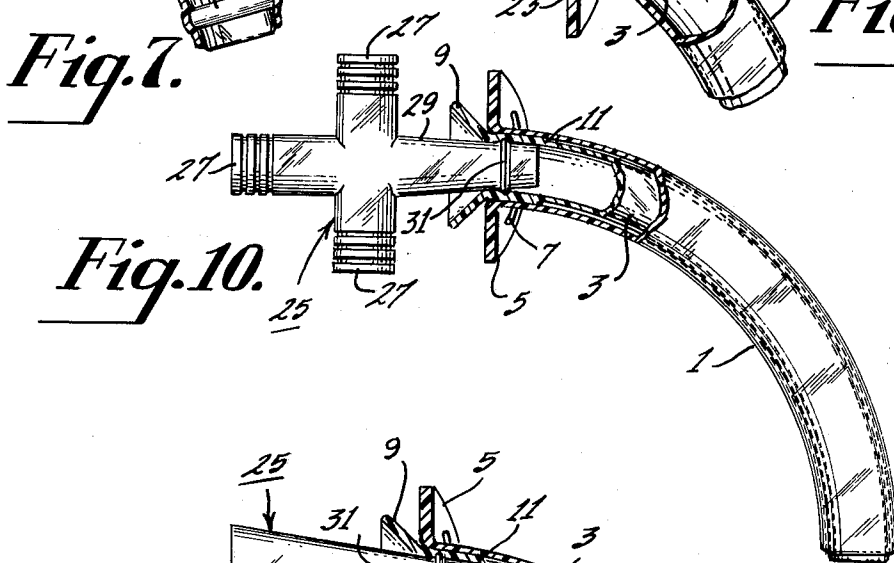
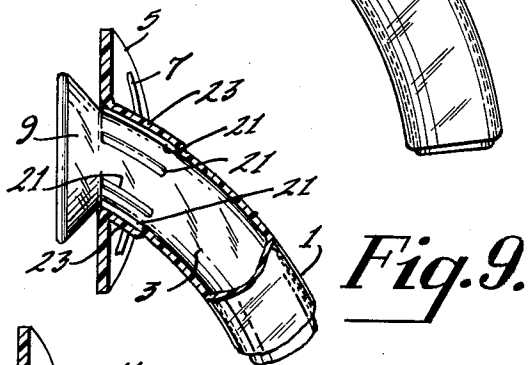
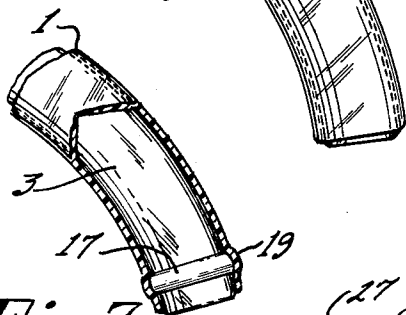
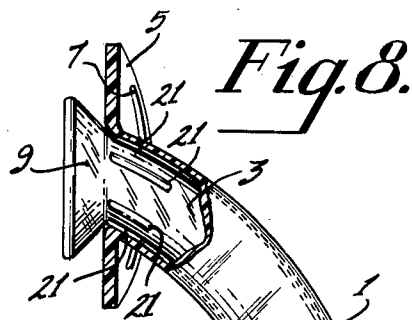
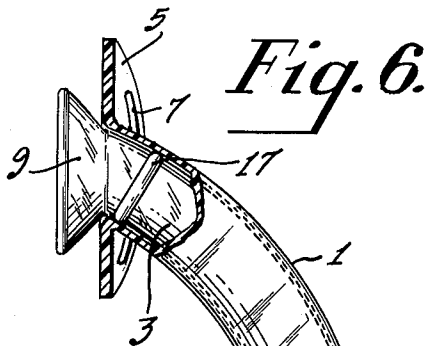
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TRACHEAL DEVICES

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6 Claims. (Cl. 128—351)

This invention relates to surgical appliances, and more particularly to tracheotomy tubes and the like, the present invention being in the nature of an improvement over that disclosed in my earlier patent, No. 2,765,792, granted October 9, 1956.

For persons whose respiratory function has been impaired by reason of certain throat or nasal defects, it is common practice for surgeons to make an incision near the base of the afflicted patient's throat and thus establish communication between the ambient air and the patient's trachea or wind pipe. A tube known as a tracheotomy tube is then inserted into the trachea through this incision to facilitate passage of air into the trachea. Again, there are persons whose larynx may have become diseased and removed by surgery, whereupon they lose the power of speech. Here, too, an incision is made in the throat for reception of a tracheotomy tube in the trachea, an artificial larynx being connected to the tube to enable the afflicted person to speak once more.

Tracheotomy tubes of this sort come in pairs, one fitted within the other. The outer tube is inserted into the trachea and may be held in place by means of a neckband. The inner tube is then slid into the outer one and, to prevent accidental removal therefrom, some sort of locking means is usually employed for holding the two tubes together. The outer tube usually remains in the trachea for relatively long periods, while the inner tube is removed frequently for cleaning. Such tubes were customarily made of various metals or of hard rubber. These materials have numerous disadvantages from the standpoints of use, comfort, difficulty to clean and sterilize, proneness to damage, cost, etc., as more fully pointed out in my above identified patent. These disadvantages are all avoided by making the tubes of certain synthetic, plastic materials, such as "nylon," "Lucite" and the like, as proposed in my aforesaid patent. Tubes which are more or less resilient can be made of these plastic materials. By forming the innermost end of the outer one of a pair of such tracheotomy tubes with a radially inwardly thickened wall which is frictionally engaged by the lower or inner end of the inner tube, as taught in my aforesaid patent, the two tubes can be made to engage each other firmly, by reason of the resilience thereof, when the inner tube is fully inserted into the outer tube. This avoids the need for employing extraneous locking means to hold the two tubes in mated relation, yet permitting facile removal of the inner tube when necessary. However, the inwardly thickened wall at the lower, inner end of the outer tube necessarily restricts or limits the diameter of the inner tube and, hence, the size of the passage provided thereby.

The primary object of my present invention is to provide an improved tracheotomy tube structure which will be free from the aforementioned limitation.

More particularly, it is an object of my present invention to provide an improved tracheotomy tube structure the mating tubes of which, while adapted to lockingly engage each other in mated relation, will nevertheless provide a passage of maximum diameter in the inner tube when considered with respect to the inner diameter of the outer tube.

Another object of my present invention is to provide an improved tracheotomy tube structure which makes it possible to produce tubes with thinner walls than those considered feasible heretofore, thereby increasing the capacity of the tubes.

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Still another object of my present invention is to provide an improved tracheotomy tube structure the tubes of which can be mated and separated with great facility, yet which will remain in firmly mated relation once the inner tube is inserted fully into the outer tube.

A further object of my present invention is to provide an improved tracheotomy tube structure as aforesaid which will have a minimum weight for a given size and which, therefore, will produce a minimum of downward pressure on the throat of the wearer.

One of the features of the tracheotomy tube structure of my aforesaid patent is that a seal is provided at the lower ends of the tubes to prevent entry of mucous secretions or other liquids between the tube walls. It is another object of my present invention to retain this advantage without the need for making the wall of the outer tube thicker at its lower or inner end, as in the tube structure of my above-mentioned patent.

Yet another object of my present invention is to provide an improved tracheotomy tube structure the tubes of which can be constructed to firmly engage each other either adjacent the upper ends thereof or adjacent the lower ends thereof, when the tubes are in mated relation, to thereby releasably lock the two tubes in assembled relation and which, even when locked adjacent the upper or outer ends thereof, can still provide an effective seal against entry of mucous or other liquids between the two tubes at the lower or inner ends thereof.

Still another object of my present invention is to provide an improved tracheotomy tube structure as above set forth the inner tube of which can be removed easily from the outer one without distortion and with minimum force.

A further object of my present invention is to provide an improved tracheotomy tube which can withstand safely much mechanical abuse without becoming deformed or otherwise damaged.

A still further object of my present invention is to provide an improved tracheotomy tube structure which is extremely light in weight, which can be put in place very easily by the user and removed, at will, with equal ease, which will cause the wearer a minimum of discomfort, and which can be cleaned and sterilized by well accepted methods without danger of damage thereto.

It is also an object of my present invention to provide an improved tracheotomy tube structure as above set forth which can be manufactured easily, which will have a long life, which is sturdy in construction and which is highly efficient in use.

In accordance with the present invention, the walls of the two tracheal tubes are preferably made of uniform thickness along their lengths, but the walls of either one or both tubes may be deformed somewhat to provide one or more frictional locking elements. These elements, which may be annular ridges extending entirely around the tubes, or one or more small protuberances or depressions, or one or more short, longitudinally extending ribs, or the like, may be formed at either the inner or the outer ends of the tubes. Where such deformations are formed in only one tube, they will frictionally engage the wall of the other tube to hold the tubes firmly in mated or assembled relation. If desired, however, both tubes may be formed with complementary, cooperating protuberances which will engage each other when the two tubes are assembled. In either case, the two tubes will be releasably locked to each other in assembled relation. If the tubes are formed with annular or circumferential deformations at their inner ends, the engaging protuberances will provide a seal against entry of mucous secretions between the tubes after the manner of the tube structure of my above-noted patent. However, since the wall at the lower end of the outer tube need not

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be thickened according to the present invention, in contrast to that of my aforesaid patent, the two tubes can be made to have a fairly snug fit and thereby provide a mucous seal at their lower ends anyway. Preferably, therefore, the tube-locking deformations are formed at the upper or outer ends of the tubes. One way of accomplishing this, for example, is by slightly enlarging the diameter of the inner tube adjacent to its upper end. Other ways include the provision of the aforementioned deformations or enlargements on one or both of the tubes at their upper ends. By providing the locking deformations or elements at the upper ends of the tubes, the tubes can be made of thin walls and with maximum internal diameters whereby the capacities thereof will be increased. At the same time, the force required to withdraw the inner tube from the outer one is a minimum, thus making the improved tracheotomy structure of the present invention easy to use and to service.

The invention itself, both as to its organization and mode of use, as well as additional objects and advantages thereof, will be more readily understood from the following description of several embodiments thereof, when read in connection with the accompanying drawings in which

FIGURE 1 is a perspective view of one form of outer tube of a pair of cooperating tracheotomy tubes according to my present invention,

FIGURE 2 is a similar view of one form of inner tube adapted to mate within, and cooperate with, the outer tube of FIGURE 1,

FIGURE 3 is a front view of the tubes of FIGURES 1 and 2 in mated relation,

FIGURE 4 is a side elevation of the mated tubes of FIGURE 3 the outer tube being shown partly broken away and in section to more clearly show the relation of the two tubes when they are fully mated,

FIGURES 5, 6 and 8 are views similar to FIGURE 4, but showing various other forms of tracheotomy tubes in accordance with my present invention,

FIGURE 7 is a fragmentary, sectional view showing a modified form of the embodiment of FIGURE 6,

FIGURE 9 is a fragmentary, sectional view showing a modified form of the embodiment of FIGURE 8,

FIGURE 10 is a side elevation, partly in section, of a modification of the tube structure of FIGURE 4 and with an adapter connected to the inner tube at the mouth thereof, and

FIGURE 11 is a view similar to FIGURE 10 but showing a somewhat different form of adapter connected to the inner tube.

Referring more particularly to the drawings, wherein the same reference numerals designate like parts throughout, there is shown, in FIGURES 1 to 4, a tracheotomy tube structure comprising an outer tube 1 which is curved longitudinally to conform to the shape of the upper end of the trachea, and a correspondingly curved inner tube 3 which is insertable into the tube 1 for nested, mating relation therewith. The outer tube 1 is adapted to be inserted into the trachea through an opening formed in the neck of the user. This is done in well known manner with the aid of a suitable pilot or obdurator (not shown), after which the obdurator is removed. The inner tube 3 is then inserted into the outer tube. The tubes 1 and 3 are preferably made of synthetic materials which are light in weight and which are immune from attack by mucous or other glandular secretions of the body to help minimize any discomfort to which the user might be subjected. Various synthetic resin materials more fully set forth in my aforesaid patent, and of which nylon is an example, are deemed most suitable, especially since such materials possess resilience useful for a purpose presently to be set forth.

At its upper or entrance end as considered when it is within the trachea, the outer tube 1 is formed with a

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plate 5 which fits against the neck of the user. The plate 5 helps to conceal the incision or opening at the front of the neck when the tube 1 is fully inserted into the trachea. The plate 5 has a pair of transverse slots 7 with which the clips of a neck band (not shown), as more fully described in my aforesaid patent, engage for retaining the tube 1 in place. The tube 3 is formed with a funnel-like mouth 9 at its upper or entrance end, the smaller diameter end of the mouth 9 engaging the plate 7 when the tube 3 is in fully inserted position within the tube 1.

Various means are provided, in accordance with the present invention, to maintain the tubes 1 and 3 releasably locked to each other when they are in mated relation. Generally speaking, an enlargement on the surface of the inner tube 3 at some suitable point or points along its length for pressingly engaging the inner surface of the outer tube is employed for this purpose. The resilience of the material of the tubes insures sufficient pressure and/or friction between the inner tube enlargement and the other tube to maintain the two tubes suitably locked to each other. The enlargement may be in various forms.

In the embodiment shown in FIGURES 1 to 4, the enlargement comprises a circumferential collar 11 of slightly larger diameter than the outside diameter of the tube 3 and molded integrally therewith adjacent to the mouth 9. This collar is shown exaggerated in the drawings for the sake of illustration. I have found that the collar 9 will be very effective if made of a thickness of only about $\frac{1}{32}$ to $\frac{1}{16}$ inch where the spacing between the tubes is of the order of about 0.005 inch. This is because of the resilient character of the material of the tubes 1 and 3 whereby only a slight enlargement of the outside diameter of the inner tube is sufficient to obtain an effective locking engagement of the two tubes. Thus, the outside diameter of the inner tube 3 and the inside diameter of the outer tube 1 may be made such that the tube 3 can be freely inserted into the outer tube 1 but with a close fit therebetween. Accordingly, for a given internal diameter of the outer tube 1, the internal diameter of the inner tube 3 can be made fairly larger than was possible with the tube structure of my aforesaid patent, thereby increasing the capacity of the tracheal device. Moreover, the walls of the tubes can be made thinner to thereby further increase the capacity. If desired, the collar 11 may be formed on a slight taper to widen as it approaches the mouth 9. This will assure a firmer grip between the two tubes when they are fully mated.

To release the grip between the tubes 1 and 3 and withdraw the inner tube from the outer one, the index finger and thumb of one hand are placed behind the tapered mouth in substantially diametrically opposed relation with the nails of these digits against the plate 5. By then forcing or wedging these digits in slightly toward the axis of the mouth 9, the inner tube 3 can be readily forced out of frictional locking engagement with the outer tube 1 for facile removal of the tube 3 from the tube 1.

In the form of the invention shown in FIGURE 5, the enlargement on the inner tube 3 is in the form of an outwardly protruding protuberance or "bump" 13 in proximity to the upper end of the tube 3. The outer tube 1 may be formed with a complementary, hollow protuberance 15 which is aligned with the protuberance 13 when the tubes 1 and 3 are fully mated. The hollow protuberance 15 thus forms a seat which receives the protuberance 13 to even more positively, yet still releasably, lock the two tubes together in mated relation. While only one pair of cooperative protuberances 13 and 15 has been shown in FIGURE 5, it will be understood that a plurality of such protuberances may be provided on the tubes 1 and 3 in circumferentially spaced relation therearound.

In FIGURE 6, the enlargement or protuberance takes the form of an outwardly projecting, annular ridge 17 on the tube 3 in proximity to its upper end. This ridge 17 frictionally engages the inner surface of the tube 1 by reason of the resilience of the material of the tubes. Al-

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though the close fit between the tubes 1 and 3 at their lower ends, when constructed with the dimensions set forth above, usually suffices to provide an effective mucous seal, it is sometimes desirable to provide a more positive seal. In such cases, the modification of FIGURE 7 is advantageous. Here, the inner tube 3 is formed with the outwardly projecting, annular ridge 17 near its lower or inner end, and the outer tube 1 is formed with a corresponding, complementary ridge 19 which is hollow internally for reception of the ridge 17. The cooperating ridges 17 and 19 not only serve to releasably lock the two tubes together, but also to provide a positive seal against the entry of fluid between the tubes. At the same time, this form of my present invention permits making the tubes of maximum capacity.

Another form of locking enlargements is shown in FIGURE 8. Here, the enlargements comprise one or more longitudinally extending ribs or flanges 21 which frictionally engage the inner surface of the tube 1. When, as illustrated in FIGURE 8, a plurality of ribs 21 are employed, they are distributed circumferentially about the tube 3, and they may be of graduated length to simplify insertion and removal of the tube. If desired, corresponding protuberances 23 may be formed in the tube 1. The ribs 21 can then be received in the hollow protuberances 23 and seated therein as shown in FIGURE 9.

Sometimes, it is necessary to give a patient wearing a tracheotomy tube structure of the type described above special treatment of one sort or another. For example, it may be necessary to supply oxygen to him to facilitate breathing, or to supply medication, and so on. In other cases, it may be necessary to connect an aspirator to the patient to remove fluids. For these and similar purposes, an adapter 25 of material similar to that of the tubes 1 and 3 can be coupled to the inner tube 3. The form of adapter shown in FIGURE 10 has three tubular inlets 27 and a somewhat tapered, tubular outlet 29. The outlet 29 is formed with an outwardly protruding, annular protuberance or ridge 31 similar to the ridge 17 of FIGURE 6. The ridge 31 frictionally engages the tube 3 at the mouth thereof to be frictionally locked in place by reason of the resilience and dimensions of the involved parts. An aspirator can be connected to one of the inlets 27, a supply of oxygen to another, and a supply of medication to a third, each to be used as needed. The adapter 25 can be removed easily by simply holding one hand against the mouth 9 and pulling the adapter forwardly to release the hold at the ridge 31.

An adapter 25 having a single, tapered, tubular inlet, as shown in FIGURE 11, is sometimes useful in lieu of the multi-inlet adapter of FIGURE 10. Here, again, the adapter is formed with an outwardly projecting ridge 31 which may be seated in an annular groove 33 formed in the inner surface of the tube 3 adjacent the mouth thereof. This arrangement affords a somewhat more positive locking engagement between the adapter 25 and the tube 3 while still permitting facile separation thereof.

Although I have shown and described several forms of tube structures according to my present invention, it will be obvious that other, equivalent structures, as well as variations in those described and shown, are possible within the spirit of the present invention. I therefore desire that the foregoing shall be taken merely as illustrative and not in a limiting sense.

I claim as my invention:

1. A tracheal device comprising an outer tube adapted to be inserted into the trachea of a user and having an entrance end for reception of an inner tube therein, and

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an inner tube insertable into said outer tube through said entrance end thereof to be mated therewith, said inner tube having a corresponding entrance end and a radial enlargement adjacent thereto adapted to frictionally engage the inside surface of said outer tube when said tubes are in mated relation to thereby releasably hold said tubes in said mated relation.

2. A tracheal device according to claim 1 characterized in that at least one of said tubes is of resilient material, characterized further in that the inside diameter of said outer tube and the outside diameter of said inner tube are such that said inner tube can be freely inserted into said outer tube but with a close fit between said tubes, and characterized still further in that said inner tube enlargement pressingly engages said outer tube when said inner tube is mated with said outer tube, the pressing engagement of said enlargement with said outer tube causing said outer tube to frictionally engage said inner tube at said enlargement by reason of the resilience of said one tube whereby to releasably hold said tubes in mated relation.

3. A tracheal device comprising an outer tube adapted to be inserted into the trachea of a user and having an upper, entrance end and a lower end when disposed in the trachea, and an inner tube insertable into said outer tube through said upper, entrance end thereof to be mated in nested relation therewith, said inner tube then also having corresponding upper, entrance and lower ends, said tubes having complementary deformations within the bores thereof in proximity to their said upper, entrance ends to engage each other when said tubes are in said nested relation to thereby releasably lock said tubes in said relation.

4. In combination, a tracheal device comprising an outer tube adapted to be inserted into the trachea of a user and having an entrance end for reception of an inner tube therein, an inner tube insertable into said outer tube through said entrance end thereof to be mated therewith and also having an entrance end corresponding to said entrance end of said outer tube, means comprising a radial enlargement on said inner tube adjacent to its said entrance end for engaging said outer tube and releasably locking said tubes in mated relation, and a tubular adapter inserted into said inner tube at its said entrance end, said adapter also having a radial enlargement adapted to engage said inner tube within the bore thereof adjacent said entrance end thereof for releasably locking said adapter to said inner tube.

5. The invention set forth in claim 4 characterized in that said inner tube has a seat adjacent its said entrance end for reception of said adapter enlargement therein to thereby releasably lock said adapter to said inner tube.

6. The invention set forth in claim 5 characterized in that at least one of said inner tube and said adapter is of resilient material, and characterized further in that said adapter and said inner tube pressingly engage each other at said enlargement by reason of the resilience of said material whereby said adapter and said inner tube are releasably locked to each other.

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