

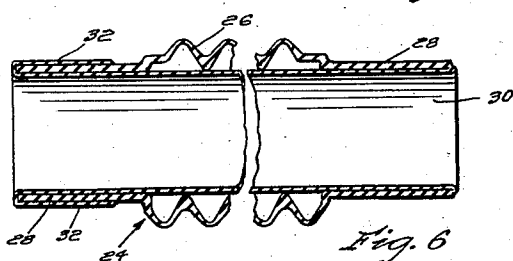
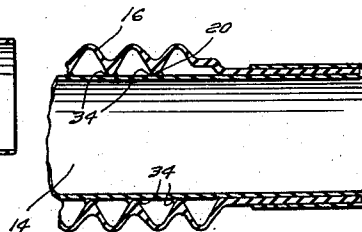
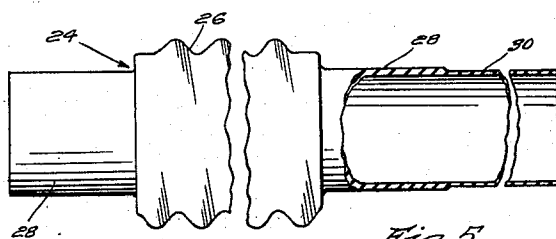
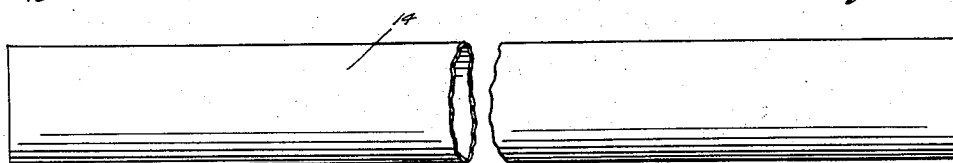
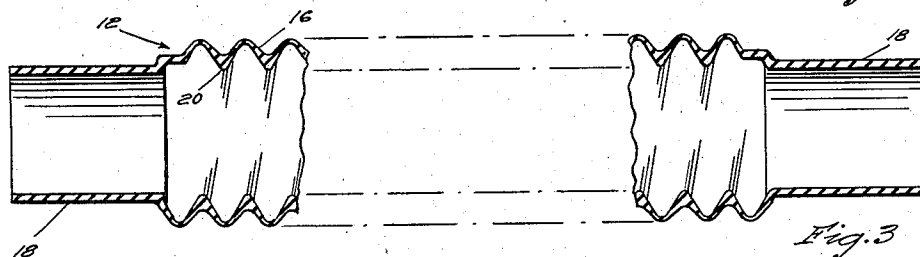
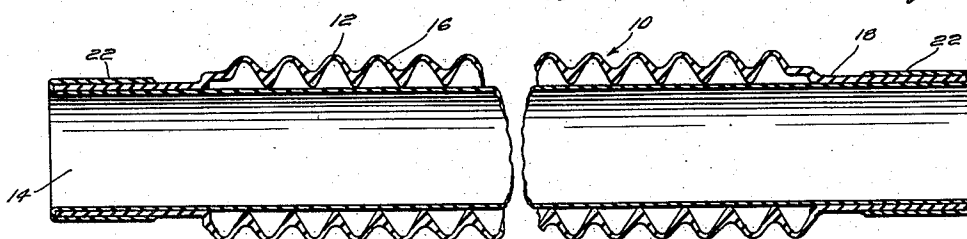
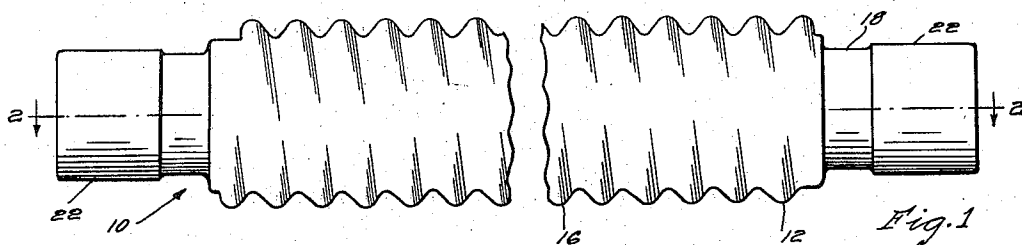
Aug. 11, 1959

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2,898,941

INHALER TUBE

Filed Oct. 10, 1956



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2,898,941

INHALER TUBE

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Application October 10, 1956, Serial No. 615,058

3 Claims. (Cl. 138—55)

The present invention pertains generally to an inhaler tube or conduit, and more particularly to tubes and conduits of the type employed in connection with the administration of inhalation anesthesia during surgical operations and the like.

In connection with the administration of an inhalation anesthesia wherein a standard and conventional gas machine is utilized, the circulation of gases and the cycle of operation generally follows the same pattern, namely, as follows:

(1) The gases are fed in the proper proportions from their tanks to a mixing chamber.

(2) From the mixing chamber, the gaseous mixture goes to a rubber bag.

(3) From this bag, the gas flows outward through one inhaler tube to the inhalation mask worn by the patient, and said gas is inhaled by the patient.

(4) When the patient exhales, some unused gases, and the exhaled air passes backward through another inhaler tube to the machine through a container or filter of soda lime, which extracts and neutralizes certain undesirable and deleterious constituents of the exhaled air, mainly, carbon dioxide.

(5) From this chamber, the purified exhaled air passes into the rubber bag, is mixed with fresh gases in the bag, and the cycle is repeated.

The inhaler tubes mentioned above which are utilized in connection with the described apparatus and in the carrying out of the above-described cycle of operation are flexible tubes or conduits preferably constructed of conductive rubber or the like. In order to prevent kinking of these inhaler tubes while at the same time maintaining maximum flexibility thereof, said tubes have heretofore been provided with circumferentially extending corrugations. Not only does this construction eliminate kinking, but it also minimizes deterioration of the tubing due to ozone cracking and the like when the tubing is bent for relatively long periods of time. However, even though inhaler tubes of this corrugated construction have generally proven to be advantageous for the reasons set forth, the corrugated tube construction has in turn posed additional problems and has resulted in certain disadvantages, as will now be explained.

One of the problems confronting the anesthesiologist during a lengthy anesthesia is the gradual increase of the percentage of carbon dioxide in the patient's blood. This is due for the most part to the presence of so-called dead-air spaces found in the inhaling system. In connection with this, it has been found that one of the primary areas that permits a certain amount of exhaled air to accumulate is the corrugated inhaler tube. Minute quantities of the exhaled air will accumulate in the tube interior at the bottoms of the corrugations, gradually becoming more concentrated. As the anesthesia time lengthens, the inhaled gases will therefore contain a higher percentage of carbon dioxide.

Another undesirable characteristic of the corrugated inhaler tube is the increased turbulence of the gases,

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caused by their passage over the corrugations present in the tube interior. Furthermore, the interior corrugations enable a gradual accumulation of debris to develop in the bottoms of the tube corrugations, which accumulation is virtually impossible to remove. The presence of mold in the tube interior has been found to exist in spite of repeated washing and sterilization.

Attempts have been made in the prior art to overcome the above problems and disadvantages by providing a helical design for the tube corrugations, but while this has proved helpful to a limited degree, it has not successfully solved the problem.

Accordingly, a primary object of the instant invention is the provision of a non-kinking inhaler tube having maximum flexibility, and which tube is so constructed as to remove any possibility of exhaled air accumulating therein.

Another object of my invention is the provision of an inhaler tube of the character described so constructed as to minimize turbulence of gases and exhaled air passing therethrough.

A further object of the instant invention is the provision of an inhaler tube having exterior helical corrugations whereby to impart to said tube maximum flexibility while at the same time maintaining the tube free from kinking, said tube further being characterized by a smooth interior surface that readily lends itself to thorough cleansing and sterilization.

Still another object of my invention is the provision of a simple and economically feasible method for manufacturing inhaler tubes of the type described.

Other objects, features and advantages of the invention will become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

In the drawings which illustrate the best mode presently contemplated by me for carrying out my invention:

Fig. 1 is a side elevation of an inhaler tube constructed in accordance with my invention;

Fig. 2 is a section taken on line 2—2 of Fig. 1;

Fig. 3 is a sectional view of the external wall per se which forms a part of my invention;

Fig. 4 is a side elevation of the interior wall per se which forms a part of my invention;

Fig. 5 is a side elevation, partly in section, illustrating a modified method of manufacture with respect to my improved inhaler tube;

Fig. 6 is a side elevation in section showing the tube of Fig. 5 in finished form; and

Fig. 7 is a fragmentary side elevation, in section, showing a slightly modified tube construction.

It has been found desirable to provide an inhaler tube having a helical corrugated outer wall wherein the tube is highly flexible but at the same time is non-kinking, and at the same time to provide said tube with a smooth interior surface. Thus, in effect, the tube combines the advantageous features of being corrugated with the desirable and advantageous features of a smooth interior surface, all of which features have hereinbefore been explained in detail.

Referring now to the drawings, there is shown generally at 10 an inhaler tube constructed in accordance with the instant invention. The tube 10 comprises an outer wall 12 and an inner liner wall 14, each of which is constructed of suitable flexible material, preferably conductive rubber. It will be understood that the term "conductive rubber" applies to a rubber having a high carbon content whereby to make the rubber relatively conductive with respect to electrical charges. This term is well known in the art, and rubber of this type is commonly used in connection with surgical apparatus to prevent excessive build-up of static electric charges dur-

ing operating room procedures. As will be noted, the wall 12, which may be most simply manufactured by dipping, comprises a central corrugated portion 16, the corrugations of which are helically disposed, said portion extending for substantially the length of the tube 10 but terminating sufficiently short of each end thereof to leave a short length of plain cylindrical tubing 18. As will be clearly seen in Figs. 2 and 3, the inner diameter of cylindrical end portions 18 is substantially equal to the inner diameter of the central corrugated portion 16 when measured from the innermost extremity 20 of the latter.

The inner liner wall or tube 14 is also preferably constructed of conductive rubber, and like outer wall 12, may be most simply manufactured by dipping. As will be apparent, the outer diameter of tubular wall 14 is substantially equal to the inner diameter of outer wall 12 whereby to provide a snug lining therein. In addition, the tubular wall 14 is somewhat longer than its associated outer wall 12 before being assembled therewith and preferably is somewhat thinner in wall thickness.

The completed inhaler tube 10 is assembled by sliding the liner 14 through outer wall 12 until the opposite ends of the former extend outwardly from their associated and adjacent cylindrical end portion 18 a substantially equal distance. The exposed ends of the liner 14 are then folded back as shown at 22 (Fig. 2) over their associated cylindrical end portion 18 and secured thereto by any desirable means, such as cementing. Thus it will be seen that the assembled tube 10 comprises a unitary inhaler conduit which is non-kinking due to the presence of the corrugations 16, but which nevertheless, has a smooth interior surface as defined by the liner 14.

It has been found in practice that the simplest method of manufacturing the completed inhaler tube 10 is to separately dip the outer wall 12 and the inner liner wall 14 and then assemble these elements in the manner described. If desired, however, the inhaler tube 10 may be formed from one integral element 24 as shown in Figs. 5 and 6. In connection with this particular manufacturing technique, the integral element 24 is once again preferably constructed of conductive rubber and is most easily dipped to arrive at the configuration now to be described. Referring to Fig. 5, it will be seen that the element 24 comprises a helical corrugated portion 26 which has extending from each end thereof a length of straight, cylindrical tubing 28, all in a manner very similar to aforescribed outer wall 12. In this form of my invention, however, one of the cylindrical end portions 28 has integrally extending therefrom an elongated, slightly thinner, straight cylindrical tubing 30 which eventually forms the inner liner wall for the completed inhaler tube. More specifically, the tubing 30 is sufficiently long so that upon being brought back through the element 24, a sufficient length of the tubing will be exposed outside the opposite end of said element, whereby said exposed tubing may be folded back over the outer surface of the then adjacent cylindrical end portion 28, as shown at 32 (Fig. 6) and secured thereto as by cementing or the like. As will be obvious from inspection of Fig. 6, the completed inhaler tube resulting from this particular method of manufacture is essen-

tially identical in all respects to the tube 10 aforescribed, the only difference being that whereas the latter tube is constructed of two separate elements which are assembled together in the manner described, the former tube is made from one integral element.

In some instances, it may be desirable to attach or adhere the innermost extremities 20 of the corrugations 16 to the liner tube 14 as shown at 34 in Fig. 7. It has been found that such a construction aids in reducing kinking of the inner liner wall. This securement may be achieved either by applying liquid cement or other adhesive material to the portions 20 of the corrugations 16 so that the inner liner wall will adhere thereto when moved to its completed or operative position, or else by partially curing either the portions 20 or the outer surface of liner 14, whereupon complete curing will take place after these elements are brought into contact with each other, thus causing adhesion between the parts as shown at 34. Whether the portions 20 and liner 14 be secured together by cementing or by the partial-curing method, it will be understood that these elements can quite simply be maintained in pressurized contact with each other during the adhering operation by the insertion of a bar or rod (not shown) within the liner 14, said bar or rod being of a sufficient diameter to cause the outer surface of liner 14 to press against the portions 20. After the portions have become securely adhered to each other, the bar or rod would then, of course, be removed, and the tube would be ready for use.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described except in so far as indicated by the scope of the appended claims.

I claim:

1. A flexible inhaler tube of the character described consisting of a normally corrugated outer wall having circumferentially extending corrugations for substantially the length of said tubing but terminating short of each end thereof whereby to leave a relatively short, straight, cylindrical portion at each tubing extremity, and a straight, cylindrical inner wall of greater length than said outer wall snugly mounted therein, the end portions of said inner wall being bent back into engagement with the outer surface of said outer wall cylindrical portions and secured thereto.

2. The inhaler tube of claim 1 further characterized in that said inner and outer walls are secured to each other at spaced intervals throughout the tube length.

3. The inhaler tube of claim 1 further characterized in that said inner and outer walls are each constructed of conductive rubber.

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