OUTBOARD HEATING DEVICE

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ABSTRACT

In a nebulizer an assembly for continuously heating water drawn from a reservoir to a nebulizing chamber comprises a hollow spool for directing water from the reservoir to a heating chamber, an exterior jacket spaced from the spool to provide a heating chamber and a heater surrounding at least a portion of the jacket.

3 Claims, 5 Drawing Figures
OUTBOARD HEATING DEVICE

BACKGROUND OF THE INVENTION

Mist or aerosol producing devices often referred to as nebulizers are commonly used for the treatment of respiratory ailments and are generally considered important for inhalation therapy. Nebulizers generate a fine mist or aerosol of water or aqueous medicament mixtures to yield a high humidity aerosol which is particularly effective for treatment of asthma, pneumonia, bronchitis, emphysema and the like. One such nebulizer, which also functions alternately as a humidifier, is disclosed in co-pending application Ser. No. 45,192 filed June 10, 1970.

For certain patients and in the treatment of a number of respiratory ailments or diseases, it is preferred to have the water or aqueous medicament solution to be nebulized, heated rather than administered cold or at ambient temperature. Heated aerosols are preferred since inspired gases close to body temperatures are less irritating on delicate membranes in the patient's nasal and throat areas as well as in the lungs. Particularly, for patients suffering from asthma or pneumonia, inspiration of cold or even relatively cool air should be avoided to prevent irritation, discomfort as well as undue loss of body heat. Heating of the water also heats the gas to be inhaled and which heated air can hold more moisture thereby achieving a higher humidity.

Heating of water or aqueous solutions to be administered in an aerosol nebulizer is often carried out by the use of immersion-type heating devices. Such heaters are usually of the tube type and contain heating elements enclosed in an outer jacket. The heater tube is immersed within the liquid holding reservoir containing water or aqueous medicament solution which become heated by direct contact with the jacket. Such a heating method may not be satisfactory since contamination of the water or medicament may result from contact with the immersed heater.

Another heater type comprises a blanket heater which contacts only the exterior of the nebulizer liquid holding chamber. Although the contamination problem is thus eliminated instead heat must be transferred through the nebulizer wall. If the walls are made of plastic, unless it is of a high heat resistant type, there is the danger of deforming the plastic, or even causing it to melt which of course is quite objectionable and may defeat the purpose and/or efficiency of the device.

Either of the above-mentioned methods of heating the water is quite time consuming since the whole volume of water present in the nebulizer must be heated to the temperature desired. Obviously, where the nebulizer is to be used on an as needed basis, having to wait for all of the water to heat before the device can be utilized for therapy is in most cases unacceptable. Moreover, the use of blanket heaters, especially for plastic nebulizer jars is even more time consuming since the heat must be transferred through the plastic jar thereby lowering the heating efficiency and causing additional time delay.

Heaters for nebulizers, and especially of the disposable nebulizers are preferably removable for reuse and to allow an operator or therapist the option of installing a heater if desired. The heater should also be one that preferably does not cause contamination of the water or solution to be nebulized for patient inspiration, is preferably inexpensive, relatively simple to operate and one which can be readily adapted to available nebulizers without requiring their extensive redesign.

SUMMARY OF THE INVENTION

It is to the elimination of the problems noted hereinabove as well as to achieve the objects specified that the present invention is directed.

The heating concept and device of the invention involves passing steam or water containing medicament solution to be nebulized through a heating compartment, exterior to the nebulizer or liquid holding reservoir as it is drawn to a nebulizing chamber.

The device consists of an assembly having a passageway system communicating with the nebulizer liquid holding reservoir and nebulizer tube and comprises an inner conduit for directing a liquid stream from the reservoir to a heating chamber, an exterior jacket enclosing the inner conduit but spaced apart therefrom to provide a liquid directing channel and heating chamber therebetween, and a heater around the exterior jacket for providing heat therethrough to the heating chamber.

The device is inexpensively manufactured, easy to use and install, even by inexperienced personnel, and is readily adaptable to present types of nebulizers including disposable humidifier-nebulizers of the type for example disclosed in U.S. application Ser. No. 45,192 filed June 10, 1970. These as well as other advantages will be more evident in view of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side sectional elevation showing assembled components of the assembly of the invention;

FIG. 2 is a sectional elevation of another assembly embodiment;

FIG. 3 is a perspective view of the spool of the assembly;

FIG. 4 is a view of a bushing and cap, the former for installing the assembly components of the device and the latter for closing the passageway system when the heater device is not to be used; and

FIG. 5 is a side sectional elevation of another embodiment of the heating assembly of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, the device of the invention is shown secured to a nebulizer jar adjacent a liquid holding reservoir. More specifically, in the nebulizer jar 44, liquid holding reservoir 40 is defined within the jar. Extending vertically along the nebulizer jar is tube 28 for directing water or aqueous medicament solution from reservoir 40 to a nebulizing chamber (not shown). Normally, as will be appreciated by those skilled in the art, the nebulizer will function by the Venturi principal whereby a stream of air is passed into a nebulizing chamber creating a partial vacuum or low pressure within the chamber. Tube 28 is in communication with the low pressure nebulizing chamber so that a continuous column of liquid in tube 28 will be drawn or siphoned upwardly into the chamber from reservoir 40. Tube 28 is generally circular in cross section although its shape is not particularly critical.

Tee fitting 21 extends from jar 44 and provides a cavity 35 which communicates with both tube 28 and reservoir 40. Tee fitting 21 has an inboard or inwardly extending portion 23 and an outboard or outwardly ex-
tending portion 46 which portions project in opposite directions from the central axis of tube 28. Preferably tee fitting 21 is circular in cross-section although this is not critical so long as components of the outboard heater assembly can be secured thereto.

The outboard heater assembly of the invention consists of a hollow spool 18, an exterior jacket 20, bushing 24 and heater 25. Spool 18 incorporates a hollow interior which provides a conduit 22 through which liquid travels between inlet port 37 and outlet port 39. Spool 18 is also provided with radially extending end flange 48 which provides for sealing engagement with the interior surface of inboard portion 23 of tee fitting 21. Sealing engagement of those components is important so that unheated cool water or solution passing through the heater device from reservoir 40 must pass first through inlet port 37 and thereafter is directed through the assembly rather than passing directly into tube 28 by leakage between flange 48 and inboard portion 23. In the embodiment shown in FIG. 1, the interior surface of inboard portion 23 of the tee fitting is uniformly tapered so as to be narrower in diameter toward the nebulizer reservoir. In that way as spool 18 is placed into cavity 35, flange 48 will fit snugly against the narrowing interior of inboard portion 23 for sealing engagement.

It should be appreciated that other methods of sealing engagement between spool 18 and inboard portion of tee fitting 21 may be used. For example, referring to FIG. 2, inboard portion 23a may be provided with collar 41 against which flange 48 of the spool may be sealingly engaged. For this purpose, it may also be advisable to incorporate a washer 43 or gasket or O-ring so as to further ensure against liquid leaking between the collar and flange. Other similar and equivalent methods of sealingly engaging these components may also be utilized within the purview of the invention.

Referring again to FIG. 1, spool 18 includes an outwardly or radially projecting collar 31 which collar includes multiple orifices 32 (note also FIG. 3). At the forward end of the spool is a liquid outlet port 39. An exterior jacket 20 having a rear seating flange 27 covers spool 18 as shown and is spaced therefrom to provide channel 16 between these two components.

A collar 31 extends radially from the spool surface with a plurality of orifices 32 as shown so that water or aqueous solution may flow from forward outlet port 39 along channel 16 toward tube 28 as it is drawn upw ardly into a nebulizing chamber. In addition, collar 31 provides further support for spool 18 so that it is properly aligned to provide a uniform channel 16 between its outer surface and jacket 20.

Bushing 24 secures the components to tee fitting 21 and is provided with interior threads 23 for threadedly engaging outboard portion 26 of tee fitting 21. With exterior jacket 20 in place, seating flange 27 and collar 31 become engaged as bushing 24 is tightened so as to provide a liquid tight seal therebetween when the device is in operation. For this purpose, O-rings, gaskets, washers or the like may be installed or incorporated between engaging portions of the bushing, jacket rear flange 27, and spool collar 31.

Referring to FIG. 1, the heating assembly device of the invention operates as follows:

With the components in place, as water or aqueous medicament solution is drawn upwardly through tube 28 into a nebulizing chamber as previously explained, water is also drawn from reservoir 40 into inlet port 37 of the spool. A multi-orificed cover 34 is shown which acts as a screen or filter to prevent large particles from entering the nebulizer passageways although such a cover is entirely optional. The unheated liquid passes from inlet port 37 toward outlet port 39 through conduit 22. Forwardly disposed from outlet port 39 and along the remaining exterior surface of spool 18 adjacent spaced jacket 20 is the heating chamber 14. Heater body 25 which is maintained at any desired temperature for required heating of the water passing through the heating chamber, substantially contacts the exterior of jacket 20 and which heat is then transferred through the jacket wall into the heating chamber. Thus, cool water arrives at outlet port 39 and thereafter becomes heated by being exposed to the warm interior surface of jacket 20. This heated water or aqueous medicament is then drawn along channel 16 toward tube 28 through orifices 32 and into tube 28 to be nebulized and thereafter inspired by a patient.

Heater body 25 may be any kind of a suitable heater so long as it sufficiently contacts jacket 20 to provide the necessary heat increase for liquid in the heating chamber. The heater may be of a fixed temperature or may be variable as desired. It will be appreciated that some heat may pass through spool 18 so that liquid passing along conduit 22 will be somewhat heated before reaching port 39. However, where the spool is made of a plastic or synthetic resin material, heat transfer through the walls will not be extremely significant, and at any rate would simply further heat the liquid which is desired.

Jacket 20 is preferably made of a material having good heat transfer quality. Aluminum or similar lightweight and relatively inexpensive metal is preferred. More effective liquid heating may be accomplished by reducing the distance across conduit 22 so that the volume of liquid in the conduit at any time will be reduced. It will be evident that where the amount of water passing through the conduit is less, it will be heated to a higher temperature than a larger amount of water, assuming the same flow velocity and heating temperature.

Referring to FIG. 5, there is shown an alternative embodiment of a spool 48 having a modified means of sealing engagement with nebulizer passageway components. More specifically, the spool shown includes an inlet port 47 and outlet port 49, collar 57 and orifices 61 quite similar to equivalent parts of the spool shown in FIG. 1. The nebulizer, a portion of which is shown, is altered somewhat from that shown in FIG. 1 so that the passageway system from the reservoir 52 includes lower tube 52 and upper tube 50, the lower tube being in communication with the reservoir and the upper tube extending toward and communicating with a nebulizing chamber (not shown). The end portion 51 of the spool 48 extends into L-shaped or elbow fitting 54 which directs the water or aqueous medicament solution from lower tube 52 into the heating apparatus assembly. As shown, L-shaped fitting 54 is tapered and narrows inwardly so that the end 51 of the spool can be maintained in sealing engagement therewith. Accordingly, as the spool is urged inwardly against the interior surface of fitting 54, the sealed engagement is improved. Again, an O-ring, gasket or the like may be used between the exterior surface of inboard spool end 51 and fitting 54 if desired to improve the seal and en-
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sure against seepage or leakage of cool water from the interior of the assembly with the warm water side.

The jacket shown includes a sheath portion 60 through which heat is transferred and which interiorly defines the heating chamber between its inner surface and spaced exterior surface of spool 48 in a manner described in FIG. 1. The jacket also includes a threaded end member 64 which threadedly engages outwardly extending threaded connecting portion 56 of a nebulizer jar. Spool end 51 will be urged into tapered portion 54 as jacket bushing member 64 is further engaged and urges spool collar 57 inwardly (from left to right). The engagement of jacket bushing member, spool collar and threaded connecting portion provides a liquid tight seal between these abutting component portions. The components are assembled by first inserting spool end 51 into engagement with L-shaped member 54 of a nebulizer passageway system and thereafter simply threadedly engaging the jacket portion 24 until the components are firmly in place.

The device shown in FIG. 5 operates quite similar to that shown and discussed hereinabove regarding FIG. 1. Water or aqueous medicament solution will be drawn upwardly from reservoir 62 through lower tube 52, into inlet port 47, through conduit 45, through outlet port 49 and into heating chamber 65. Heat transferred from heater body 25 through jacket 60 will increase the water temperature passing through the heating chamber and the heated water will then pass along channel 66, through orifices 61 and finally through upper tube 50 to be nebulized for patient inspiration.

When heating of the water or solution to be nebulized is no longer desired, the assembly can be simply removed by disengaging bushing 24 (FIG. 1) or jacket 60 (FIG. 5) and removing the jacket and spool. Thereafter, a cap 68, shown in FIG. 4, may be threadedly engaged to the threaded outwardly extending nebulizer portion to close off the port after the removal of the assembly components. The nebulizer will then function normally without heating. It will be evident that the assembly described offers a most efficient and simple means of heating water or aqueous medicament solutions to be delivered to a patient without the requirement of heating the entire body of water or solution in the nebulizer jar reservoir or its contamination by inserting heating elements or components. Except for the heat transferring jacket previously described and the heater itself, the assembly components may be molded plastic such as polyethylene, polystyrene and styrene containing copolymers and terpolymers for example, ABS plastics, etc. Especially useful are polyphenylene oxides such as NORYL resins because of their high temperature characteristics. Accordingly, the device may be relatively inexpensive so that all components except for the heater may be disposable thereby eliminating possible contamination of other nebulizers.

I claim:
1. In a nebulizer having a tube for drawing liquid from a reservoir to a nebulizing chamber, an improved heater assembly comprising:
a. an inner conduit comprising a hollow spool having an inlet port adjacent said reservoir and an outlet port communicating with a heating chamber,
b. an exterior jacket spaced apart from said inner conduit whereby said jacket and conduit cooperate to define said heating chamber therebetween,
c. means communicating with said reservoir for directing liquid thereto from said conduit inlet port, and
d. a heater surrounding at least a portion of said jacket for providing heat thereto, whereby liquid is drawn from said nebulizer reservoir, through said conduit and into said heating chamber prior to nebulization in said nebulizing chamber.
2. The assembly of claim 1 including a channel between said heating chamber and said nebulizer tube and communicating therewith for directing heated liquid from said heating chamber to said tube.
3. The assembly of claim 2 wherein said nebulizer includes a cavity between said reservoir and said tube and wherein said spool extends into said cavity and is in sealing engagement therewith whereby liquid must pass successively through said conduit, heating chamber and channel prior to being drawn into said nebulizer tube.

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