

PATENT SPECIFICATION

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(54) APPARATUS FOR USE IN INHALATION THERAPY

(71) We, IMS LIMITED, a Corporation organized under the Laws of the State of Delaware, United States of America, of 1886 Santa Anita Avenue, South El Monte, California 91733, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for use in inhalation therapy.

The increase in lung and respiratory diseases has resulted in greater use of nebulizers for the treatment of such diseases. Medication must be added to nebulizers continuously or at intervals. The present invention is primarily concerned with those medications which are added to a nebulizer at periodic or irregular intervals. At present, such medication is usually added with an ordinary syringe which is loosely received in the addition port of the nebulizer. This loose connection allows contaminated ambient hospital air to be drawn or sucked through the port and nebulizer into the patient's respiratory system. This practice is highly undesirable and can lead to serious infections and complications of the lungs and respiratory system. At present, this contamination can be prevented only by shutting down or disconnecting the nebulizer during the addition of medication. This procedure is inconvenient, and requires supervision of nursing personnel to assure that the practice is followed.

The present invention provides apparatus for use in inhalation therapy comprising an injector for liquid medication and a nebulizer: the injector comprising a cylindrical vial having an open end and a closed end, a resilient plug inserted at least partially in said open end of said vial, a

plurality of outwardly extending rings upon said plug engaging the walls of said vial with a press fit, a cylindrical member an end of which is closed, said cylindrical member holding a needle extending inwardly into said cylindrical member and having a sharpened inner end, said cylindrical member having a tip extending outwardly from the closed end of said cylindrical member and communicating with the needle, said tip being an elongate member of generally circular cross-section and having a central fluid passage extending substantially the length of the tip, said tip having three zones, a first which is cylindrical, a second or intermediate zone which is tapered, and a third or outlet zone which is cylindrical but of smaller external diameter than said first zone, interlocking means on said cylindrical member and co-operating interlocking means on said plug arranged so that, upon interlocking of said plug with said cylindrical member, said vial is first held in an assembled but non-operating position in which said plug has not been pierced by said needle and, so that, upon further interlocking of said plug with said cylindrical member, said plug is pierced by said needle and said needle communicated with said vial and said plug is locked securely to said cylindrical member to permit aspiration upon withdrawal of said vial or to permit expulsion of the contents of said vial upon exertion of axial pressure on said vial, through said tip; and the nebulizer comprising an outlet adapted to lead to the patient, means within said nebulizer for forming particles of liquid medication for inhalation therapy to be carried in an air stream through said outlet, and a medication introduction port opening into the interior of said nebulizer arranged so that, in use, the port opens into the interior of the nebulizer above the level of liquid medication therein,

medication introduction port being adapted to at least partially receive and to form a seal with said tip, to allow liquid medication to be introduced into said nebulizer by the exertion of axial pressure on said vial.

The apparatus provides for the safer introduction of additive medication to nebulizers. The apparatus tends to overcome the problems referred to above by providing a connection between the source of medication to be added and the nebulizer that does not permit air (for example, contaminated hospital air) to enter the nebulizer.

Apparatus for use in inhalation therapy constructed in accordance with the invention will now be described, by way of example, with reference to the drawings, in which:

Figure 1 is a perspective view the apparatus; and

Figure 2 is an enlarged sectional view of the apparatus.

Turning to the drawings in greater detail, an injector includes a generally cylindrical hollow tubular holder 10 having an open end 12 and a closed end 14. A cylindrical vial 16, which is closed at one end, has a resilient plug or stopper 18 inserted in its open end sealing on the inside walls of the vial 16 by means of outwardly-extending rings. The stopper 18 generally, although not necessarily, has a thin imperforate central diaphragm portion. The stopper 18 is provided with an externally threaded projection 20 thereon.

Within the tubular holder 10, there is provided a thrust portion in the form of a cylindrical member 36. The cylindrical member 36 holds a needle 22 extending inwardly into the cylindrical member and a tip 24 extends outwardly from the end of the cylindrical member which is closed. The tip 24 is provided with a fluid passage 26 terminating in an opening 28. The tip 24 is of generally circular cross-section and has a first cylindrical zone 30, a second zone 32 which is tapered and a third cylindrical zone 34 having a smaller external diameter than zone 30.

The lower end of needle 22 (as seen in the drawings) extends through a hole 38 in the closed end of the cylindrical member 36. The upper end (as seen in the drawings) of needle 22 has a sharp terminal portion 40 having a hole 42 therein. The cylindrical member 36 also has internal threads 44 in proximity to its upper end, the threads on the projection 20 and the threads 44 being adapted when made up to cause said sharp terminal portion 40 of the needle to puncture said stopper 18. When the projection 20 is made up with threads 44, the stopper 18 functions as a piston to expel the contents of the vial 16 through

needle 22 and passage 26 if said vial 16 is advanced into said tubular holder 10.

In operation, the vial 16 containing liquid medication is partially made up with the holder 10 simply by turning the vial and the threads on projection 20 into the threads 44. The threads are made up only so far that the vial is held in an assembled but non-operating position, the stopper not being punctured by the needle. The tip 24 is then inserted in the port of a nebulizer 46 as is more fully hereinafter described. The threads are then further made up until the threads on the projection 20 on the stopper 18 are fully made up with threads 44. At this point, the sharp terminal portion 40 has punctured the stopper 18, and the needle 22 is communicated with the vial 16, and the stopper 18 is locked securely to the cylindrical member 36. It will be noted that the piercing is carried out by a screw action rather than by an axial movement of the vial. By applying a slight further force on the vial, the vial can be advanced into the holder causing the stopper to expel the contents of the vial through the tip 24 into the nebulizer 46.

The nebulizer, indicated generally by 46, has an outlet passage with an inlet 48, and an outlet 50. The outlet 50 is connected to an airflow apparatus 52 having a regulatory flow valve 54. The air leaving at an outlet 56 is ducted to the patient. The airflow apparatus 52 is familiar to those skilled in the art, and need not be described in more detail.

The nebulizer 46 is provided with an air jet 58, a liquid capillary 60, and a dispersing ball 62. Liquid medication from a pool 64 enters the capillary 60 at an opening 66. The high velocity air in jet 58 draws the liquid up the capillary to its tip 8 where a meniscus or particle starts to form. When the liquid particle has become sufficiently large, it is carried away by the jet stream and impacts ball 62 which atomizes the particle into finer particles. The finer particles are carried to the patient. The heavier particles collect on the ball 62 and the inside surfaces 70 of the nebulizer, and eventually return to the liquid pool 64. Additional air may be introduced at an opening 72.

This opening may, however, be closed off. Medication is introduced from vial 16 via a port 74. The exterior of tapered zone 32 engages the interior of port 74 which prevents contaminated air from being drawn into and through the nebulizer. The zone 34 is smaller in external diameter than the internal diameter of port 74, and hence is receivable therein. The zone 30 is larger in external diameter than the internal diameter of port 74. Hence, a seal is formed on the tapered zone 32.

WHAT WE CLAIM IS:—

1. Apparatus for use in inhalation therapy comprising an injector for liquid medication and a nebulizer: the injector comprising a cylindrical vial having an open end and a closed end, a resilient plug inserted at least partially in said open end of said vial, a plurality of outwardly extending rings upon said plug engaging the walls of said vial with a press fit, a cylindrical member an end of which is closed, said cylindrical member holding a needle extending inwardly into said cylindrical member and having a sharpened inner end, said cylindrical member having a tip extending outwardly from the closed end of said cylindrical member and communicating with the needle, said tip being an elongate member of generally circular cross-section and having a central fluid passage extending substantially the length of the tip, said tip having three zones, a first which is cylindrical, a second or intermediate zone which is tapered, and a third or outlet zone which is cylindrical but of smaller external diameter than said first zone, interlocking means on said cylindrical member and co-operating interlocking means on said plug arranged so that, upon interlocking of said plug with said cylindrical member, said vial is first held in an assembled but non-operating position in which said plug has not been pierced by said needle and, so that, upon further interlocking of said plug with said cylindrical member, said plug is pierced by said needle and said needle communicated with said vial and said plug is locked

securely to said cylindrical member to permit aspiration upon withdrawal of said vial or to permit expulsion of the contents of said vial upon exertion of axial pressure on said vial, through said tip; and the nebulizer comprising an outlet adapted to lead to the patient, means within said nebulizer for forming particles of liquid medication for inhalation therapy to be carried in an air stream through said outlet, and a medication introduction port opening into the interior of said nebulizer arranged so that, in use, the port opens into the interior of the nebulizer above the level of liquid medication therein, said medication introduction port being adapted to at least partially receive and to form a seal with said tip, to allow liquid medication to be introduced into said nebulizer by the exertion of axial pressure on said vial.

2. Apparatus as claimed in claim 1, wherein the interior of the port is adapted to engage the exterior of the tapered intermediate zone to provide the seal.

3. Apparatus as claimed in claim 1 or claim 2, wherein there is provided air flow apparatus for forcing air out of the nebulizer.

4. Apparatus for use in inhalation therapy substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

ABEL & IMRAY,
Chartered Patent Agents,
Northumberland House,
303-306 High Holborn,
London, WC1V 7LH.

