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(54) Title: AN ULTRASONIC PIEZO NEBULISER

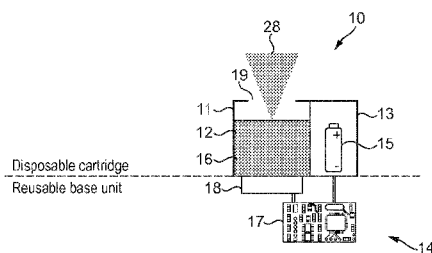


FIG. 1A

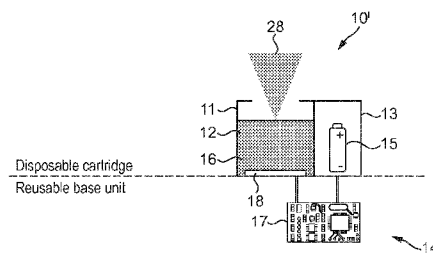


FIG. 1B

(57) Abstract: A device for nebulising a liquid comprising a reservoir of liquid connected to an outlet, and a drive circuit electrically connected to a piezoelectric actuator and a battery. The drive circuit actuates to vibrate the piezoelectric actuator so that it nebulises the liquid in the reservoir. The liquid passes through the outlet as an aerosol. The device is supplied as an assembly where the reservoir of liquid and battery are located in a cartridge which is detachable from a base unit comprising the drive circuit.

AN ULTRASONIC PIEZO NEBULISER**BACKGROUND OF THE INVENTION**

5 The present invention relates to a device for nebulising a liquid.

 Nebulised liquids are used for many purposes. One such use is for therapy, for example, by application to the skin
10 or by inhalation. One example is the nebulisation of sodium chloride for inhalation to assist with the removal of mucus and debris from the lungs. Another example is nebulisation of hyaluronic acid for skin beauty purposes.

15 A device for nebulising liquids to form a mist is disclosed in EP 2626052. It consists of a gas cylinder attached at its top end via a manifold to a separate cartridge containing a liquid to which gas is supplied in order to generate a mist. A face mask is attached at an
20 outlet port on the top of the cartridge by which a user inhales the vapour.

 In order to gain wider acceptance, there is a need for a more disposable version of such nebulisers.

25

SUMMARY OF THE INVENTION

 According to the present invention there is provided a device for nebulising a liquid, the device comprising a
30 reservoir of liquid fluidly connected to an outlet, and comprising a drive circuit electrically connectable to a piezoelectric actuator and a battery; wherein the drive

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circuit is actuatable to vibrate the piezoelectric actuator so that it nebulises the liquid in the reservoir such that the liquid passes through the outlet as an aerosol, wherein the device is supplied as an assembly wherein the reservoir
5 of liquid and battery are located in a cartridge detachable from a base unit comprising the drive circuit. The present invention thus provides a device with few moving parts which is easy to use.

10 Rather than a battery, mains power or some other power source could be used to power the device.

The aerosol preferably comprises droplets of a diameter of less than 10µm.

15

The liquid inside the reservoir may be a saline solution of sodium chloride. In this way, the device is then useable to assist with the removal of mucus and debris from the lungs. The liquid may instead contain hyaluronic acid so
20 that the device can be used for skin beauty purposes.

The piezoelectric actuator may be located in the reservoir to better nebulise the liquid contained in the reservoir.

25

The cartridge is preferably single-use and disposable.

The present invention thus provides a simple device for dispensing a liquid in aerosol form.

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BRIEF DESCRIPTION OF THE FIGURES

The invention will now be described with reference to the accompanying Figures 1A and 1B which each show a cross
5 section view of a nebuliser device.

DETAILED DESCRIPTION

With reference to Figure 1A, there is shown an nebuliser
10 device 10 which comprises a cartridge 11 defining a housing 12 within which is located a reservoir 16 for liquid. The cartridge 11 comprises a piezoelectric actuator 18 located in the reservoir 16 for nebulising the liquid contained therein. The piezoelectric actuator 18 is powered by a
15 battery 15 located in a cavity 13 of the cartridge 11.

The reservoir 16 comprises an outlet 19 for the liquid from the cartridge 11. A valve (not shown in the Figures) is located between the reservoir 16 and the outlet 19 to
20 control the flow of liquid through the outlet 19. Ordinarily, the valve is biased into a closed position to prevent the escape of liquid from the reservoir 16.

The nebuliser device 10 also comprises a base unit 14
25 which is separate from the cartridge 11. The base unit 14 comprises a drive circuit 17 which is powered by the battery 15 located in the cartridge 11.

In use of the device 10, a cartridge 11 containing
30 liquid to be nebulised connects to the base unit 14. In this position, the drive circuit 17 electrically connects to the battery 15 and the piezoelectric actuator 18 located in the

- 4 -

cartridge 11. The base unit 14 is then operated to actuate the piezoelectric actuator 18 which causes the liquid contained in the reservoir 16 to nebulise, pass through the valve, and out of the device 10 as an aerosol spray 28.

5

An alternative to the nebuliser device 10 of Figure 1A is the nebuliser device 10' shown in Figure 1B. In this alternative device 10', the piezoelectric actuator 18 is located in the base unit 14, rather than in the reservoir 16 of the cartridge 11. As shown in Figure 1B, the piezoelectric actuator 18 is located on the base unit 14 such that it is next to the reservoir 16 when the cartridge of the cartridge 11 is connected to the base unit 14 to ensure efficient nebulisation of the liquid when the base unit is operated.

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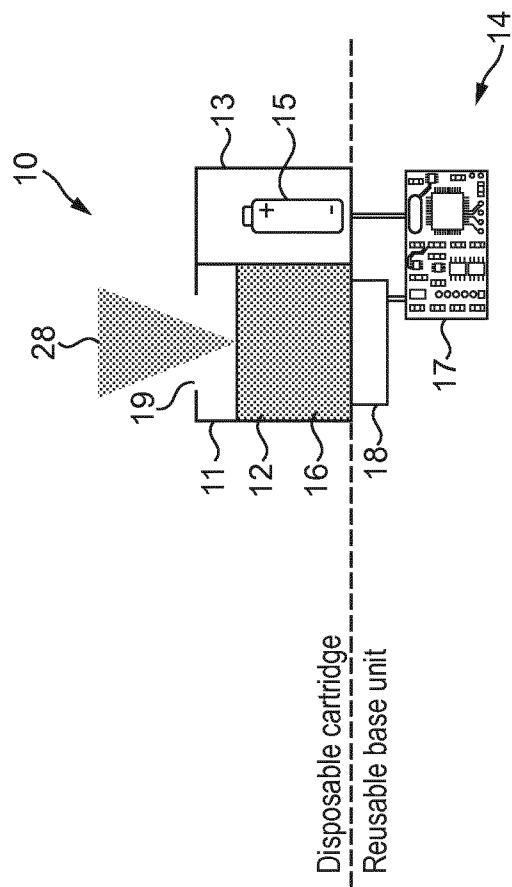
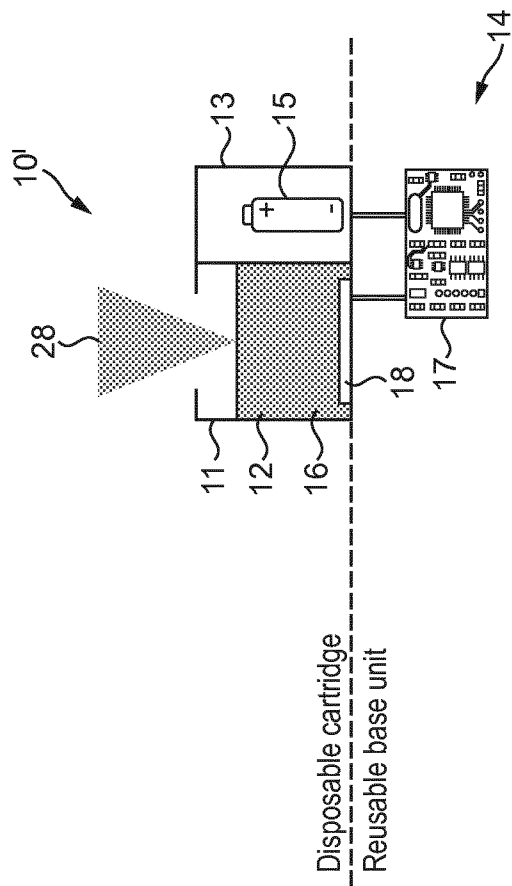
In either nebuliser device 10;10', the liquid contained within the reservoir 16 is any liquid which can be nebulised. Exemplary liquids which can be used include a saline solution of sodium chloride for when the device is used assisting with the removal of mucus and debris from the lungs, and hyaluronic acid for use in skin beauty purposes.

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CLAIMS

1. A device for nebulising a liquid, the device comprising a reservoir of liquid fluidly connected to an outlet, and
5 comprising a drive circuit electrically connectable to a piezoelectric actuator and a battery; wherein the drive circuit is actuatable to vibrate the piezoelectric actuator so that it nebulises the liquid in the reservoir such that the liquid passes through the outlet as an aerosol, wherein
10 the device is supplied as an assembly wherein the reservoir of liquid and battery are located in a cartridge detachable from a base unit comprising the drive circuit.
2. A device according to any preceding claim wherein the
15 aerosol comprises droplets of a diameter of less than 10µm.
3. A device according to any preceding claim wherein the liquid inside the reservoir is saline.
- 20 4. A device according to any preceding claim wherein the piezoelectric actuator is located in the reservoir.
5. A device according to any preceding claim wherein the cartridge is single-use and is disposable.
25
6. A device as substantially hereinbefore described with reference to the accompanying drawings.



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/055317

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M11/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, BIOSIS, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 202 289 114 U (YIXIANG DENG) 4 July 2012 (2012-07-04)	1-3,5,6
Y	abstract; claims 1-6; figures 1-3 -----	4
Y	WO 97/31721 A1 (MEDIX LTD [GB]; HOPKINS ANDREW DAVID [GB]) 4 September 1997 (1997-09-04) abstract; figure 1 -----	4
A	WO 2010/129994 A1 (UNIV MONASH [AU]; FRIEND JAMES [AU]; YEO LESLIE [AU]; MORTON DAVID [AU]) 18 November 2010 (2010-11-18) figure 1 -----	1-6
A	US 2003/216683 A1 (SHEKALIM AVRAHAM [IL]) 20 November 2003 (2003-11-20) abstract; figure 4 -----	1-6



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
CN 202289114	U	04-07-2012	NONE	
WO 9731721	A1	04-09-1997	AU 2223197 A	16-09-1997
			CA 2219341 A1	04-09-1997
			EP 0833695 A1	08-04-1998
			JP H11504567 A	27-04-1999
			WO 9731721 A1	04-09-1997
WO 2010129994	A1	18-11-2010	AU 2010246904 A1	01-12-2011
			CN 102458684 A	16-05-2012
			EP 2459319 A1	06-06-2012
			JP 5860395 B2	16-02-2016
			JP 2012525944 A	25-10-2012
			JP 2016000209 A	07-01-2016
			US 2012187209 A1	26-07-2012
			WO 2010129994 A1	18-11-2010
US 2003216683	A1	20-11-2003	CA 2527512 A1	09-12-2004
			EP 1638639 A2	29-03-2006
			US 2003216683 A1	20-11-2003
			WO 2004105827 A2	09-12-2004