PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61M 3/02 — A1

(11) International Publication Number: **WO 97/02058**

(43) International Publication Date: 23 January 1997 (23.01.97)

(21) International Application Number: PCT/GB96/01542

(22) International Filing Date: 27 June 1996 (27.06.96)

(30) Priority Data:
9513322.9 30 June 1995 (30.06.95) GB

(71) Applicant *(for all designated States except US)*: IATROS LIMITED [GB/GB]; Saltire Court, 20 Castle Terrace, Edinburgh EH1 2EN (GB).

(72) Inventors; and

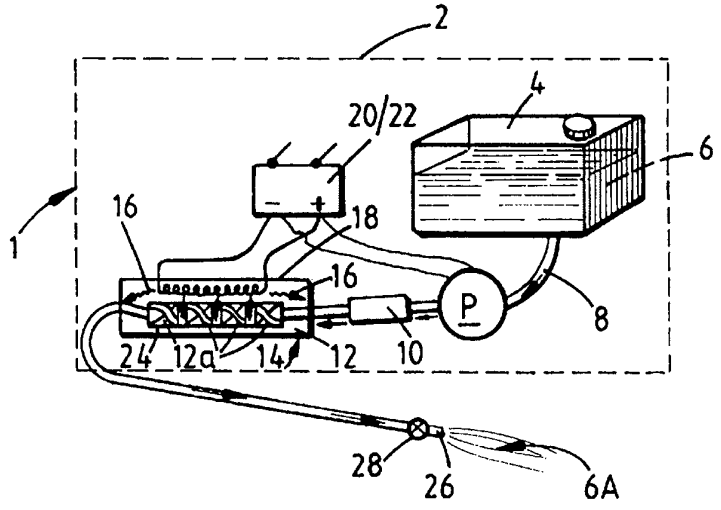
(75) Inventors/Applicants *(for US only)*: MOWAT, David, McIvor [GB/GB]; 37 Orchard Road South, Edinburgh EH4 3JA (GB). CAMERON, Ian, David [GB/GB]; 10 MacNabb Street, Dundee DD4 7EH (GB).

(74) Agents: McCALLUM, William, Potter et al.; Cruikshank & Fairweather, 19 Royal Exchange Square, Glasgow G1 3AE (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: WOUND CLEANING APPARATUS



(57) Abstract

The present invention relates to a portable wound cleaning apparatus (1) suitable for use in the cleaning and treatment of wounds. The apparatus (1) comprises a cleaning liquid inlet (4); a pump (P) for conveying liquid (6) from the inlet (4) through an irradiation passage (12) to an outlet nozzle (26). The irradiation passage (12) is enclosed within an irradiation chamber (14) for irradiation by ultraviolet radiation (16) of an effective sterilizing wavelength from an irradiation source (18). The irradiation passage (12) has a wall (24) substantially transparent to the effective sterilizing wavelength of ultraviolet radiation (16). The pump (P) for conveying the liquid (6) is provided with a flow control valve (28) for controlling delivery of cleaning liquid (6A) from the outlet nozzle (26). The pump (P) for conveying the liquid (6) and the irradiation passage (12) and the irradiation source (18) are formed and arranged so that in use of the apparatus (1), the liquid (6) is subjected to an effective sterilizing dose of irradiation (16) during transit through the irradiation passage (12) so that in use of the apparatus (1) a sterile flow of cleaning liquid (6A) may be delivered through the nozzle (26) to a wound to be cleaned.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

WOUND CLEANING APPARATUS

The present invention relates to a wound cleaning apparatus suitable for use in the cleaning and treatment of wounds.

Conventional apparatus and methods for cleaning wounds, such as those caused by ulcers, burning or infection, have included swabbing with antiseptic solution or water from specially supplied bags of sterile water, to aerosols which spray of fine mist of antiseptic solution/sterile water onto a wound. The former method using "topical water" supplied in plastics bags is clumsy and expensive. Moreover swabbing with an antiseptic is not particularly effective in cleaning wounds and is painful to patients due to the need to apply, albeit light, pressure to the wound. The latter method and apparatus because of the generally high pressure from the aerosol also results in discomfort and pain to the patient to be treated and is expensive. Moreover existing methods require a supply of sterile water which usually is not available for instance at a accident and emergency scene or in the home for use by community nurses/patients.

It is an object of the present invention to avoid or minimise one or more of the foregoing disadvantages and to provide an apparatus that produces a flow of sterile cleaning liquid for use in the cleaning and treatment of wounds.

The present invention provides a portable wound cleaning apparatus suitable for use in the cleaning and treatment of wounds which apparatus comprises a cleaning liquid inlet means; means for conveying liquid from said inlet means through an irradiation passage means to an outlet nozzle, said irradiation passage means being enclosed within an irradiation chamber for irradiation by ultra-violet radiation of an effective sterilizing wavelength from an irradiation source, said irradiation passage means having wall means substantially transparent to said effective sterilizing wavelength of ultra-violet radiation, said means

for conveying said liquid being provided with flow control means for controlling delivery of cleaning liquid from said outlet nozzle in use of the apparatus, said means for conveying said liquid and said irradiation passage means and said irradiation source being formed and arranged so that in use of the apparatus, said liquid is subjected to an effective sterilizing dose of irradiation during transit through said irradiation passage means, whereby in use of the apparatus a sterile flow of said cleaning liquid may be delivered through said nozzle to a wound for cleaning thereof.

Thus with a portable wound cleaning apparatus according to the present invention a flow of sterile cleaning fluid suitable for the cleaning of wound in a simple and convenient manner, is made available as required in a particularly convenient and economic manner.

Various forms of irradiation passage means may be used including for example an elongate conduit routed along an extended path in proximity to the irradiation source, e.g. along a helical path (preferably with a short pitch) around the irradiation source. Desirably there is used a relatively small bore conduit e.g. having a diameter less than 2 mm preferably 1.5 to 2 mm. Most preferably though the irradiation passage means is in the form of a static mixer.

Conveniently the inlet means is connected to an on-board reservoir means, which may be removable for refilling and/or may be disposable especially where it is desired to use the apparatus with different cleaning liquids e.g. plain water or water with one or more additives such as an antiseptic (e.g. SAVLON (Trade Mark) etc.) or a local anaesthetic.

Alternatively the inlet means is adapted for coupling to an external reservoir or a mains water supply. This is generally less convenient but where a mains water supply is used, then the pressure of this may be used for conveying

the water through the apparatus to the outlet nozzle.

Where an on-board reservoir is provided for holding cleaning liquid then desirably there is included means for pumping liquid through the apparatus of the invention. Preferably there is used a conventional vane or impeller type pump driven by a electric motor. Internal batteries or means for connecting the electric motor to an external electrical power source through, for example, a domestic electrical power point may be used to provide electric power for such an electric motor. Power may also be supplied via inbuilt solar power panels. In this case the flow control means conveniently comprise pump control means formed and arranged to adjust and/or control the rate of flow of cleaning liquid pumped from the reservoir to the static mixer or other irradiation passage means and out of the outlet nozzle. The flow control means may be in the form of means for controlling the rate at which said pump operates and/or adjustable valve means between said reservoir and said outlet nozzle. Conveniently said electric power source is used also to operate said irradiation source.

Manual pump means for pumping said liquid may also be used if desired. The pump means may moreover be disposed upstream or downstream of the irradiation chamber. In one embodiment there could be used a squeezable hand pumping unit on which the delivery nozzle is mounted. It will further be appreciated that the means for pumping the liquid could simply comprise a pressurized gas supply e.g. from a compressed gas cylinder or cartridge or by using a manual pump to pressurize gas in the liquid reservoir above the liquid before and/or during use of the apparatus.

Filters to prevent debris passing from the reservoir through to the pumping means and/or the static mixer are preferably utilized.

Said outlet nozzle is preferably formed and arranged to produce a low pressure spray or flow of liquid at the outlet

nozzle in the range of 2-10 psi (1.4×10^4 - 6.8×10^4 N/m^2) for gently irrigating the wound. The pumping means and said outlet nozzle means are preferably formed and arranged to provide a fluid flow of in range of from 100 ml/min to 600 ml/min. Said fluid flow may be readily adjusted by said adjustable valve means and/or by controlling the rate at which said pump operates.

Preferably there is used a static mixer of the interfacial surface generator type such as that sold under the POSIMIXER Trade Mark by Liquid Control Limited of United Kingdom and described in U.K. Patent Publication No. 2018609A, which document also mentions other publications relating to such mixers. Alternatively there may be used a device such as that described in our earlier U.K. Patent No. GB2200020B (though it will be appreciated that the transmission of UV through water is substantially greater than with blood so that there is significantly greater design flexibility in relation to the static mixer component). Preferably a relatively small diameter static mixer is used, desirably the POSIMIXER 1/4" (6.35 mm) model having two elements, advantageously split into forty eight (48) element sections. The static mixer may be connected to the pumping means and thereby to the reservoir by preferably flexible conduit means having a diameter of 2 to 3 mm.

Conveniently said reservoir is of a generally translucent plastics material e.g. polyvinylchloride, and/or is provided with liquid level indicator means for indicating to a user the amount of liquid remaining in the reservoir. It will be understood that the reservoir may be of any convenient size but preferably will be more or less compact to facilitate transportation between a suitable liquid source e.g. a kitchen or washroom water tap and a wound treatment location. The reservoir may be removable from the apparatus to facilitate filling and/or provided with suitable inlet means to facilitate filling thereof. Advantageously there is used a reservoir having a capacity sufficient for at least 15 secs, preferably at least 30 seconds, e.g. around 1

minute of wound irrigation. The flow rate will generally be in the range from 50 to 1000 mls per minute, preferably from 100 to 600 mls/min. Thus the reservoir will preferably have a capacity of at least 1000 cc, preferably from 500 to 1000 cc. Where the gas above the liquid in the reservoir is compressed for pumping the liquid through the system then the capacity of the reservoir is preferably increased.

Advantageously said cleaning liquid such as water may have one or more additives added thereto such as saline solution components, antiseptic, and/or local anaesthetic which helps to reduce still further any possible discomfort to patients in use of the wound cleaning apparatus of the invention.

Conveniently said irradiation source is provided by compact UVB or UVC, preferably UVC emitting fluorescent tubes e.g. type TUV 8 watt produced by Philips Lighting of United Kingdom. The effective sterilizing wavelength from said irradiation source is preferably in the region of from 200 to 300 nm, e.g. around 254 nm.

Preferably the apparatus of the invention is enclosed by a lightweight and robust aluminium or plastics housing which at least in relation to said irradiation chamber is substantially impermeable to said U.V. radiation. The inside walls of said chamber may conveniently be substantially reflective to said U.V. radiation and/or be provided with suitable reflectors e.g. aluminium foil for directing the U.V. radiation towards the static mixer.

In another respect the present invention provides a method of providing a flow of sterile cleaning fluid suitable for the cleaning of a wound comprising the steps of:- providing an apparatus according to the present invention, providing a liquid supply to said cleaning liquid inlet means, operating said means for conveying liquid through said irradiation chamber so as to subject said liquid to an effective sterilizing dose of irradiation and delivering a sterile flow of cleaning liquid through said nozzle to a wound for

cleaning thereof.

Further preferred features and advantages of the present invention will appear from the following detailed description given by way of example of some preferred embodiments illustrated with reference to the accompanying drawings in which:-

Fig. 1 is a schematic layout of a portable wound cleaning apparatus of the invention;

Fig. 2 is a block diagram of the component parts of the apparatus shown in Fig. 1; and

Fig. 3 is a sectional side view through a second embodiment of portable wound cleaning apparatus of the invention.

A portable wound cleaning apparatus, generally indicated by reference number 1, is shown in Figs. 1 and 2 and comprises a casing 2 (shown in broken line) containing a tank 4 of water 6 connected by a pipe 8 to an electric pump P and from the pump P via a filter 10 to a static mixer 12. The static mixer 12 is contained within an irradiation chamber 14 which contains also an ultra-violet light 16 source in the form of a tube 18. Both the pump P and the tube 18 are electrically connected to a power source 20 and control system 22 for powering and controlling the pump P and the U.V. tube 18.

In more detail the water 6 in the tank is tap water (and may optionally contain an antiseptic or local anaesthetic additive). The water 6 is pumped by the pump P through the filter 10 which removes any debris in the water. The water 6 in a stream then passes under the action of the pump P into the static mixer 12 contained in the irradiation chamber 14. The static mixer 12 is of the interfacial surface generator type and contains a plurality of elements 12a, each of which divides the stream of water 6 into substreams and then re-orients and recombines the sub-streams into a mainstream. This provides a very effective mixing of the water 6 as it passes through the mixer 12 and of the sterilization of the water 6 as it is irradiated by the U.V. light 16. The mixing ensures that a substantial

part of a body of water passing through the mixer 12 is brought into close proximity with the inside surface of the U.V. transparent walls 24 of the mixer 12 so as to be effectively sterilized by the U.V. light 16 as it exits the mixer 12. The sterilized water then pass out of the mixer through a further tube and out of the body 2 to an outlet nozzle 26. The outlet nozzle 26 may have a valve control 28 to adjust the rate of flow of sterilized liquid exiting the nozzle 26. The sterilized water 6A may be used then to treat a wound (not shown).

Fig. 3 shows a second embodiment of a portable wound cleaning apparatus according to the invention.

The wound cleaning apparatus, indicated by reference number 1a, as shown in Fig. 3, comprises a doughnut or annular shaped container 4a having a stainless steel outer wall casing 30 and a U.V. transmitting inner wall 32 of FEP (fluorinated-ethenepropene). The container 4a is mounted on a base 34 which supports a U.V. radiation source in the form of an upstanding U.V. tube 18a, around which the container 4a stands and defines an irradiation chamber 14a. An irradiation passage means in the form of a helical pipe 8a surrounds the U.V. tube 18a. The walls 24a of the helical tube 8a are transparent to the U.V. radiation 16a emitted from the U.V. tube 18a so that a liquid 6a passing through the pipe 8a may receive an effective sterilizing dose of U.V. irradiation 16a.

The container 4a contains water 6a (optionally containing an antiseptic or local anaesthetic additive) filled from a domestic tap through a filler cap 36 which seals and makes airtight the container 4a. A CO_2 gas injector 38 provides pressurized gas 40 for pressuring the container 4a and the contents thereof. When the container is pressurized water in the container is driven up a pickup pipe 42 and out through the top 44 of the container 4a and along a pipe 46 which enters the irradiation chamber 14a and is connected to the helical pipe 8a surrounding the U.V. tube 18a. The

water is irradiated by an effective sterilizing wavelength of U.V. irradiation as it passes along the helical pipe 8a and around the U.V. tube 18a and is then driven out of the top 44 of the apparatus 1a via a conduit 48 to a spray nozzle 50 for irrigating a wound with the now sterilized water 6A. Pressurized gas 40 from the container is optionally connected via a conduit 52 to the spray nozzle 50.

The top 44 of the container 4a is provided with a safety cap 52 to protect against U.V. light leakage and also to allow heat generated by the U.V. tube to escape and is described in more detail with reference to Fig. 4. The safety cap 52 comprises an outer U.V. light baffle 54 having a centre aperture 56 through which hot air 58 generated by the U.V. light 18a passes. Inside the outer light baffle 54 is a smaller heat baffle 60 spaced apart from the outer light baffle 54 and supported on support webs 62. The webs 62 and heat baffle 58 are arranged inside the cap 52 so that hot air 58 is deflected by the heat baffle 60 and passes out under the sides of the heat baffle 60 and then through the space 64 between the baffles out through the centre aperture 56 of the light baffle. The substantial overlapping of the baffles prevents any U.V. light exiting the cap 52. Furthermore the inside surfaces of the cap have a matt black non reflective coating to reduce as far as practicable the possibility of U.V. light escaping. The cap 52 has a bayonnet type fitting 66 (or other suitable means e.g. screw thread) for releasably securing the cap 52 to the container 4a and a further light baffle 68 at this connection portion. The cap 52 and the container 4a are provided with a safety interlock device (not shown - e.g. a microswitch or the like) so that in the event of the cap 52 being removed the U.V. light 18a will not operate. The underside of the cap 52 has ports 70, 72 through which the pipe 46 (not shown) connected to the helical tube 8a may pass.

It will be appreciated that various modifications may be made to the abovedescribed embodiment without departing from

the scope of the present invention. Thus for example the gas injector, (such as that used for home beer making and sold by the Boots company of Nottingham, U.K.) may be connected to the container through a safety release valve designed to release excess pressure from the container when it reaches a predetermined level e.g. 15 psi. (103.4 kN/m^2) A gas injector need not be used and a simple manually operated (e.g. hand) pump formed and arranged to pressurize the container may be used.

The helical pipe 8a may have a twin bore - one for water and one for air - each having a diameter of from 1.5 to 2 mm and formed and arranged such that the water bore is supplied from water in the container and the air bore is supplied from the compressed air in the container. It will be appreciated that this arrangement can supply sterilized water only, sterilized air only or a combination thereof such as an atomised water spray from a suitable spray nozzle.

The spray nozzle may be of the type used by dentists for oral hygiene purposes. A preferred spray nozzle is one of the type sold under the MICRON Trade Mark and marketed by Wright Dental Ltd. of Dundee, Scotland, U.K.

The helical tube may be formed and arranged to be disposable and/or interchangable with other helical tubes for use with the apparatus of the invention where, for example, different solutions of water and water additives are required. Moreover there may be provided a disposable reservoir bag formed and arranged for fitting into the container. Such bags may contain ready mixed but unsterilized liquid such as water only; water/SAVLON (Trade Mark) mixtures; saline solutions; anaesthetic solutions for subsequent sterilization by the apparatus of the invention.

In yet a further embodiment of the invention (not shown) the gas injector may be dispensed with and the apparatus connected directly to the domestic water supply via a tap

such that the pressure for the apparatus is supplied by the water mains pressure.

CLAIMS

1. A portable wound cleaning apparatus (1) suitable for use in the cleaning and treatment of wounds which apparatus (1) comprises a cleaning liquid inlet means (4); means (P) for conveying liquid (6) from said inlet means (4) through an irradiation passage means (12) to an outlet nozzle (26), said irradiation passage means (12) being enclosed within an irradiation chamber (14) for irradiation by ultra-violet radiation (16) of an effective sterilizing wavelength from an irradiation source (18), said irradiation passage means (12) having wall means (24) substantially transparent to said effective sterilizing wavelength of ultra-violet radiation (16), said means (P)for conveying said liquid (6) being provided with flow control means (28) for controlling delivery of cleaning liquid (6A) from said outlet nozzle (26) in use of the apparatus (1), said means (P)for conveying said liquid (6) and said irradiation passage means (12) and said irradiation source (18) being formed and arranged so that in use of the apparatus, said liquid (6) is subjected to an effective sterilizing dose of irradiation (16) during transit through said irradiation passage means (12), whereby in use of the apparatus (1) a sterile flow of said cleaning liquid (6A) may be delivered through said nozzle (26) to a wound for cleaning thereof.

2. An apparatus according to claim 1 wherein said irradiation passage means (12) comprises an elongate relatively small bore conduit (8a) routed along on extended path in proximity to said irradiation source (18).

3. An apparatus according to claim 2 wherein said conduit (8a) is routed along a short pitch helical path routed around said irradiation source (18).

4. An apparatus according to any one of claims 1 to 3 wherein said irradiation passage means is in the form of a static mixer (12).

5. An apparatus according to claim 4 wherein said static

mixer (12) is of the interfacial surface generator type.

6. An apparatus according to any one of claims 1 to 5 wherein said inlet means is connected to an on board reservoir means (4).

7. An apparatus according to any one of claims 1 to 5 wherein said inlet means (4) is adapted for coupling to a water supply tap.

8. An apparatus according to any one of claims 1 to 7 wherein said means for conveying liquid (6) is in the form of an electric pump (P).

9. An apparatus according to claim 8 wherein said pump (P) is connected to an on board electrical power source.

10. An apparatus according to claim 8 wherein said pump (P) is provided with means for connecting with a mains power supply.

11. An apparatus according to any one of claims claim 8 to 10 wherein said flow control means comprises pump control means (22) formed and arranged to adjust and/or control the rate of flow of cleaning liquid (6).

12. An apparatus according to any one of claims 1 to 7 wherein said means for conveying liquid are selected from the group comprising:- manual pump means; pressurized gas supply means; and pressurized liquid supply means.

13. An apparatus according to any one of claims 1 to 12 wherein said irradiation source (18) produces U.V. radiation (16) in the wavelength range from 200 to 300 nm.

14. An apparatus according to any one of claims 1 to 13 wherein said irradiation chamber (14) is enclosed by a housing (30) which is substantially impermeable to said U.V. radiation (16).

15. An apparatus according to claim 14 wherein said housing (30) is provided with an arrangement of overlapping baffle means (54, 60) formed and arranged to permit venting of heat generated by said irradiation source and preventing any U.V. light exiting said housing (30).

16. A method of providing a flow of sterile cleaning fluid suitable for the cleaning of a wound comprising the steps of:- providing an apparatus (1) according to claim 1, providing a liquid supply to said cleaning liquid inlet means (4), operating said means for conveying liquid through said irradiation chamber (14) so as to subject said liquid to an effective sterilizing dose of irradiation and delivering a sterile flow of cleaning liquid through said nozzle (26) to a wound for cleaning thereof.

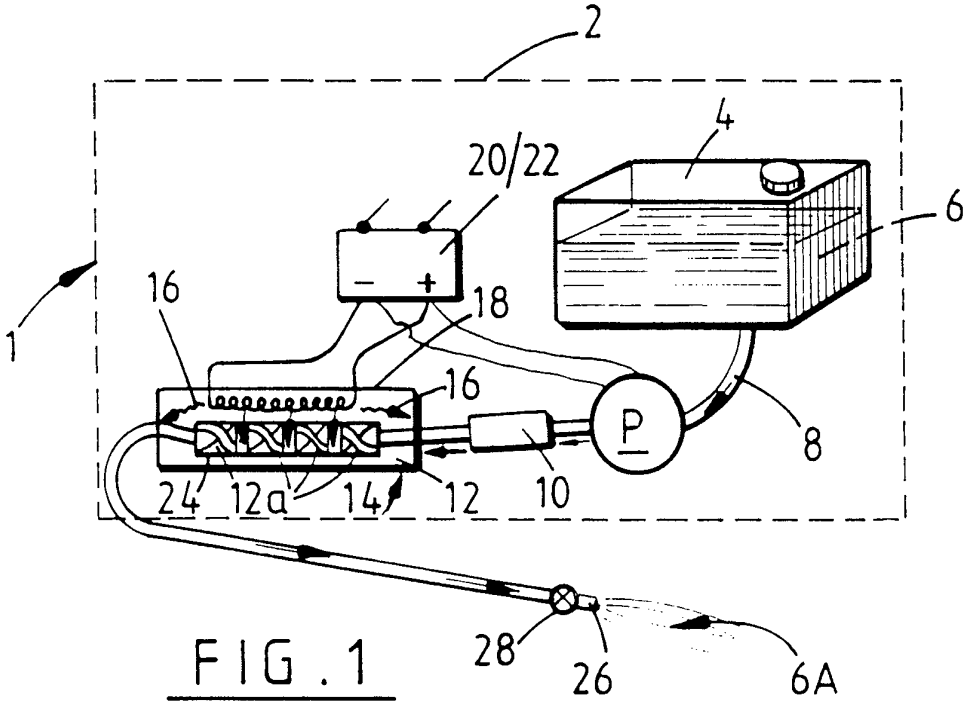

2
4
20/22
6
1
16
18
16
P
8
24
12a
14
12
10
28
26
6A

FIG. 1

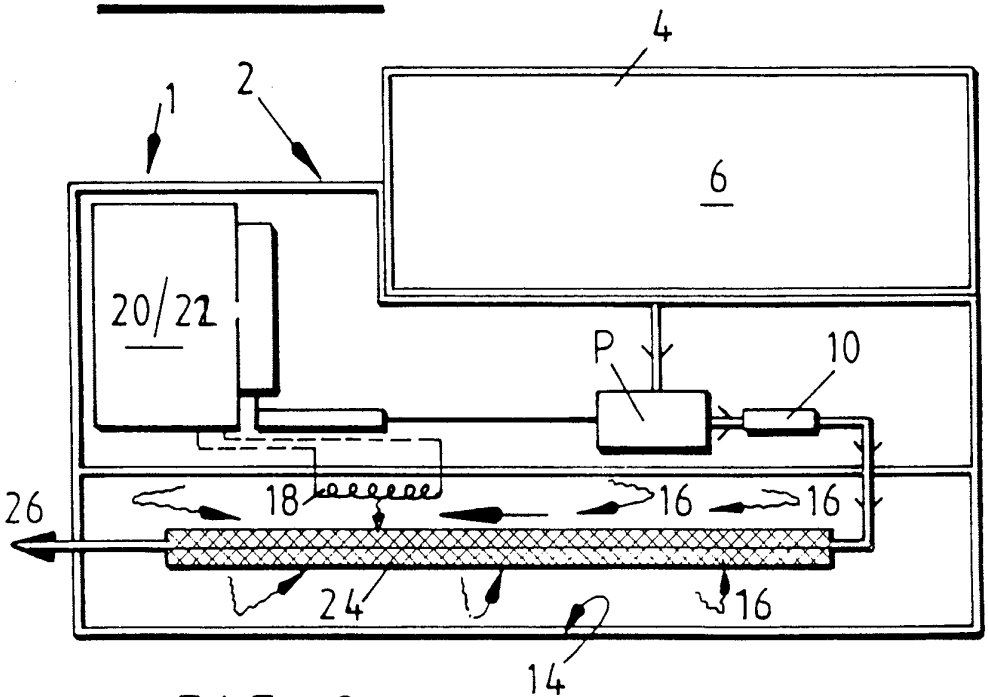

4
1
2
6
20/22
P
10
26
18
16
16
24
16
14

FIG. 2

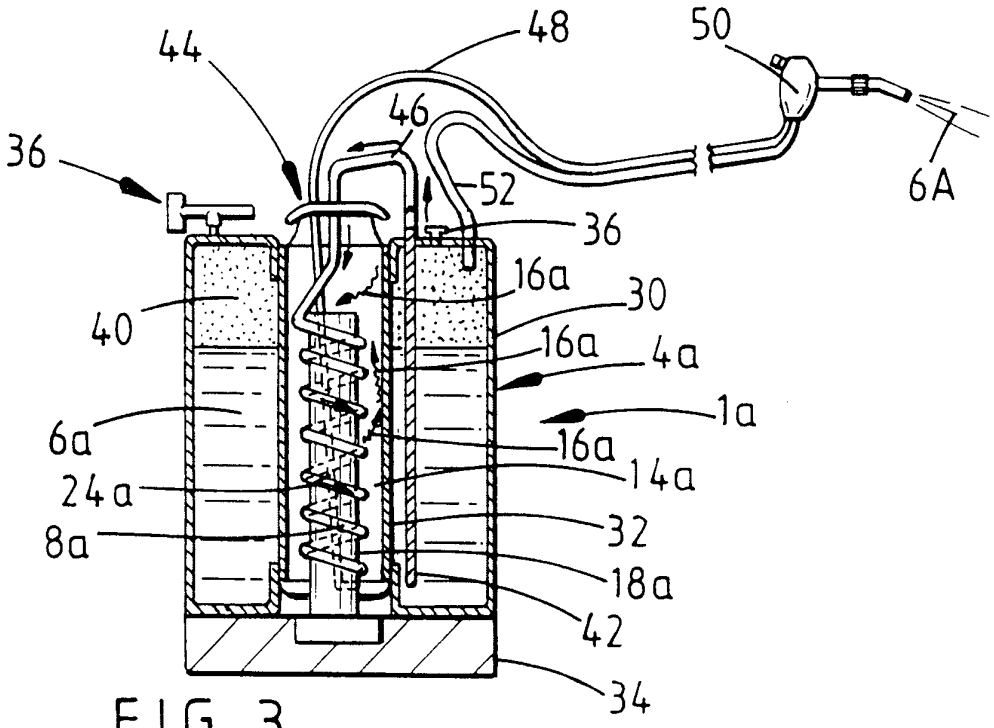

48
50
44
46
36
52
6A
36
16a
30
40
16a
4a
1a
6a
16a
14a
24a
32
8a
18a
42
34

FIG. 3

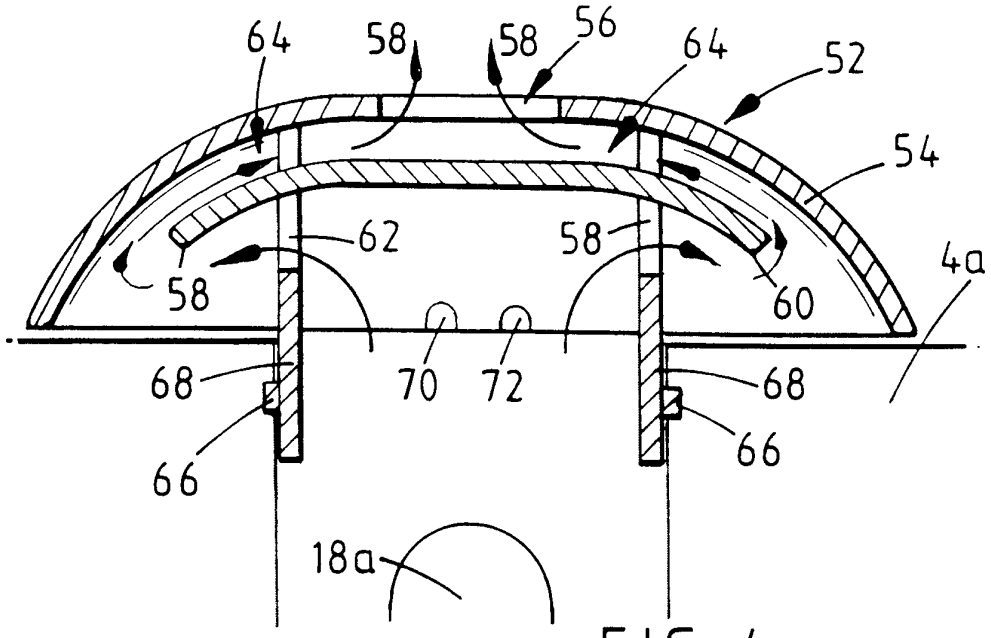

64
58
58
56
64
52
54
62
58
58
4a
60
68
70
72
68
66
66
18a

FIG. 4

INTERNATIONAL SEARCH REPORT

Int. onal Application No
PCT/GB 96/01542

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61M3/02

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)
IPC 6 A61M A61L A61C

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE,A,28 36 532 (SCHEICHER HANS) 28 February 1980 see page 13, paragraph 3 see page 25, paragraph 2 - page 26, paragraph 1; figures 6-8	1,2,6, 12-14,16 2-5,8-11
Y	GB,A,1 212 633 (KELLER) 18 November 1970 see page 2, line 60 - line 65; claim 1; figure 2A	2-5
Y	US,A,4 416 628 (CAMMACK MICHAEL A ET AL) 22 November 1983 see column 6, line 61 - column 7, line 8; claim 1	8-11
A	EP,A,0 350 459 (CASTELLINI SPA) 10 January 1990	

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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	Date of mailing of the international search report
21 October 1996	24.10.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Villeneuve, J-M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int .onal Application No
PCT/GB 96/01542

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 278 078 (SMITH WILLIAM E) 14 July 1981	

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ɔnal Application No
PCT/GB 96/01542

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A-2836532	28-02-80	AT-T-	10432	15-12-84
		WO-A-	8000413	20-03-80
		EP-A-	0019622	10-12-80
GB-A-1212633	18-11-70	CH-A-	477825	15-09-69
		DE-A-	1916540	13-11-69
US-A-4416628	22-11-83	US-A-	4302186	24-11-81
		AT-T-	4625	15-09-83
		CA-A-	1204007	06-05-86
		CA-C-	1215879	30-12-86
		CA-C-	1215880	30-12-86
		EP-A-	0029636	03-06-81
		JP-A-	4212346	03-08-92
		JP-C-	1680813	13-07-92
		JP-B-	3047856	22-07-91
		JP-A-	56075150	22-06-81
		US-A-	4337040	29-06-82
EP-A-0350459	10-01-90	JP-A-	2071736	12-03-90
US-A-4278078	14-07-81	NONE		