Abstract: An apparatus for cleaning and/or disinfecting a medical device such as a stethoscope or pulse oximeter comprising a housing and a replaceable cartridge configured to fit within the housing. The cartridge contains cleaning medium for cleaning said medical device. The apparatus defines an aperture configured to expose a surface of the medium to allow said medical device to be brought against said surface for cleaning. The medium is configured to advance with respect to the aperture such that different portions of the medium are exposed at the aperture.
Cleaning and/or Disinfecting Apparatus

The present invention relates to an apparatus for cleaning and/or disinfecting medical devices such as stethoscopes and pulse oximeters, and to a cartridge for such an apparatus. The present invention further relates to a method of using such an apparatus.

The medical stethoscope, for example, is used by virtually all medical doctors and many other healthcare professionals. Studies have shown that the stethoscope diaphragm (the part that usually comes into contact with the patient) is often colonised with large numbers of harmful bacteria including MRSA and *C. difficile*. Accordingly, the diaphragm may act as a source of transmission of potentially serious infections between patients causing significant morbidity and mortality.

Presently, UK hospitals advise that doctors should clean the diaphragm between patients using hand-held alcohol-soaked swabs, but this method is time consuming, cumbersome, and of questionable effectiveness. In practice this often means that the diaphragm is simply not cleaned at all. Similar advice is given regarding devices such as pulse oximeters.

What is required is an expedient and effective method to prevent the spread of infection between patients by such devices. It would be most effective if such a method was available in the same place as hand washing facilities so that all relevant cleaning could take place simultaneously. Crucially, any device performing such a function must be designed so that it does not itself become a source of infection, and being intended for use in a public health environment ease of maintenance is vitally important.

According to a first aspect of the present invention there is provided an apparatus for cleaning and/or disinfecting a medical device such as a stethoscope comprising a housing and a replaceable cartridge configured to fit within the housing. The cartridge contains cleaning medium for cleaning said medical device; and the apparatus defines an aperture configured to expose a surface of the medium to allow said medical device to be brought against said surface for cleaning. The medium is configured to advance with respect to the aperture such that different portions of the medium are exposed at the aperture.
The exposed surface of the medium may carry cleaning fluid, and the cartridge may include a reservoir of cleaning fluid configured to be expressed onto the medium such that the exposed surface of the medium carries cleaning fluid. The housing may include a first actuator configured to express cleaning fluid from the reservoir. Alternatively, the medium may be pre-impregnated with cleaning fluid. The apparatus may include a perforated plate between the reservoir and the medium, the plate being configured to disperse the fluid onto the medium. The cleaning fluid may be a disinfectant fluid, preferably alcohol.

The housing may include a second, drive actuator arranged to advance the medium with respect to the aperture such that different portions of the medium are exposed at the aperture. The cartridge may include a first reel upon which the medium is supported prior to exposure at the aperture, and/or a second reel upon which medium that has been exposed at the aperture is collected. The first reel may be located at a first end of the housing and the second reel may be located at a second end of the housing, wherein the second actuator may be located between the first and second reels. The second actuator may be configured to engage and rotate the second reel such that the medium is advanced with respect to the aperture.

The apparatus may include a sensor configured to detect a medical device being brought against the exposed surface of the medium for cleaning. The second actuator may be configured to operate a predetermined period of time after detection of a medical device being brought against the exposed surface of the medium for cleaning.

The housing may include a third actuator arranged to agitate the medium at the exposed surface. The third actuator may be configured to operate upon detection of a medical device being brought against the exposed surface of the medium for cleaning.

The cleaning medium may be in the form of a continuous web, and/or may be a non-woven fabric, preferably air-laid paper.

The housing may include a shutter arrangement configured to close the aperture, and/or may have a door configured to allow removal and replacement of the cartridge. The apparatus may be configured for attachment to a substantially vertical surface such as a wall.
There is further provided a cartridge for use with an apparatus for cleaning a medical device such as a stethoscope, the cartridge comprising a first reel upon which is supported cleaning medium for cleaning said medical device, and a second reel. The cartridge may further comprise a cartridge housing within which the first and second reels are supported.

There is yet further provided a method of cleaning a medical device such as a stethoscope comprising the steps of:

a) providing an apparatus as described above;
b) exposing a fresh surface of medium at the aperture;
c) holding the medical device against the exposed surface; and
d) agitating the exposed surface of the medium.

According to a third aspect of the present invention there is further provided a device to clean and/or decontaminate and/or disinfect a stethoscope diaphragm utilising a cleaning surface that is replenished, refreshed or replaced after each use. There may be provided a cartridge for use within the previous device designed to facilitate the replenishment, refreshment or replacement of the cleaning surface.

The device may produce a combination of mechanical and chemical action. The device may be driven by mechanical activity of the user, and/or by an electric motor.

There may further be provided a cartridge housing a cleaning ribbon containing multiple vesicles of chemical cleaning fluid, designed so that direction and moment of release of said fluid may be controlled, for use in the device(s).

The device will effectively and rapidly decontaminate a stethoscope diaphragm without the cleaning surface ever being reused. The cleaning surface is replenished after a single use from a cartridge housed within the device. It combines vigorous mechanical cleaning with effective chemical decontamination via alcohol fluid. It is ideal for placement adjacent to hand washing facilities.

The cleaning surface may move with a rapid dual-directional rotating action or by a vibrating action, driven mechanically by a minimal forwards motion of the user's stethoscope being transformed into rapid circular motion via the mechanism detailed herein, or alternatively by
an electric motor, before dropping into a waste receptacle to be replaced with a fresh cleaning surface, or moving onto a waste spool. The combination of dual-modality cleaning and a constantly renewed cleaning surface differentiates this device from any other.

5 The cleaning surface is used only once before being replenished, thereby preventing the device itself becoming a source of infection. It employs dual-modality cleaning, combining an effective chemical method of decontamination with a vigorous mechanical action, ensuring efficient removal of bacterial, viral and fungal particles. Optionally, it is entirely mechanical and unpowered, reducing maintenance requirements and thereby the likelihood of devices lying redundant while awaiting replacement motors or power sources within the clinical environment.

An example of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a front perspective view of the workings of the device of a first embodiment of the invention with certain components omitted for clarity;

Figure 2 is a cross-sectional side view detailing how the cartridge containing the supply of cleaning surface interfaces with the mechanism shown in Fig 1;

Figure 3 is a cross-sectional side view that shows the detail of the cleaning ribbon of the first embodiment;

Figure 4 is a plan view of a cleaning apparatus according to a second embodiment of the present invention, with the door of the housing in an open position;

Figure 5 is a perspective view of the cleaning apparatus of Figure 4, with the housing door in a closed position;

Figure 6 is an exploded view of the cartridge and housing of the cleaning apparatus of Figures 4 and 5;

Figure 7 is a side view of a cartridge of the cleaning apparatus of Figures 4 to 6;

Figure 8 is a perspective view of the housing of the cleaning apparatus of Figures 4 to 7 with the door removed;

Figure 9 is a schematic view of a control system of the apparatus.

With reference to the first embodiment as shown in Figures 1 to 3, a stethoscope (not shown) is brought into contact with a device at contact plate 1. Depicted schematically in Fig 1, the contact plate 1 will form part of the aesthetics of the unit. The contact plate 1 has a groove
24 designed to accommodate the metal rod that projects from the inferior pole of every stethoscope diaphragm to the adjoining flexible tube that ultimately travels to the earpieces. This metal rod does not come into contact with the patient, but conveniently provides the rigidity necessary to initiate the movement required by the device. The metal rod is common to all stethoscopes.

Contact plate 1 is moved forwards by pressure from the user. Via a connecting rod 2 this forward motion partially rotates a driving cog 3. An elastic restraint 4, extending between the driving cog 3 and the base of the unit, returns the driving cog 3 to its original position at the end of the cleaning process.

The driving cog 3 interfaces with an amplifying cog 5. The amplifying cog 5 is significantly smaller than the driving cog 3, meaning that the degree of rotary movement initiated by the forwards motion of the contact plate 1 and transformed by the driving cog 3 is significantly amplified. The plane of rotation of the amplifying cog 5 is the same as that of the driving cog 3, e.g. as depicted in Fig 1.

The motion of the amplifying cog 5 is transferred via a rod 21 to a translating amplifier 6. The translating amplifier 6 rotates in the same plane as the amplifying cog 5, but interfaces with a smaller translator 11 at a 90 degree angle. Therefore, the translation amplifier 6 further amplifies the degree of rotation while the translator 11 simultaneously alters the plane of movement by 90 degrees.

This movement is then transmitted to a cleaning disc 7. In operation, the cleaning disc 7 will be separated from the diaphragm of the stethoscope by a cleaning ribbon 13, the specifics of which are detailed later. On initial forwards movement of the stethoscope and the contact plate 1, the cleaning disc 7 rapidly rotates in one direction. As the restraint 4 is fully stretched the forwards movement initiated by the user is halted; as the user releases pressure on the contact plate 1 the restraint 4 pulls the driving cog 3 back to its original position, operating the mechanism detailed above in reverse and producing rapid counter rotation of the cleaning disc 7 while the diaphragm of the stethoscope is still in contact with it, via the cleaning ribbon 13.
Simultaneously, the amplifying cog 5 interfaces with the diminishing cog 8. The diminishing cog 8 is larger than the amplifying cog 5, thereby diminishing the degree of rotation. It rotates in the same plane as the amplifying cog 5. The bi-directional movement of the mechanism is converted to unidirectional movement as a ratchet 9 interfaces with a cartridge driver 10. This ensures that while the cleaning disc 7 rotates in two directions, a cartridge 25 containing the cleaning ribbon 13 moves only in the required single direction. In construction, the exact degree of cartridge movement may be tuned by altering the size difference between the amplifying cog 5 and the diminishing cog 8.

As depicted in Fig 2, the cartridge driver 10 interfaces with a ribbon cog 12 to drive movement of the cleaning ribbon 13 contained within the cartridge. The cleaning ribbon 13 is housed within the cartridge by spooling around spools 14, which may produce vertical folding of the ribbon 13 e.g. as depicted in Fig 2 or alternatively by folding the cleaning ribbon 13 horizontally.

In Fig 3 the detail of the cleaning ribbon 13 may be observed. As depicted, it is composed of several 'bubbles' 23 separated by connecting areas. The cleaning disc 7 has a short, blunt ended screw bit 22 projecting anteriorly; during operation this screw bit 22 interfaces with a receptacle 15 as depicted. On initial rotation of the cleaning disc 7 the cleaning bubble 23 is rotated likewise; on subsequent counter-rotation friction between the body of the cleaning disc 7 and the posterior of the cleaning bubble 23 produces similar rotation of the bubble 23 until the screw bit 22 disengages from the receptacle 15, at which point the bubble 23 is released. At initiation of rotation the bubble 23 disengages from the body of the cleaning ribbon 13 at perforations 20, which pass circumferentially around the bubble 23 at a 90 degree angle to the plane of Fig 3.

Pressure from the screw bit 22 causes opening of a valve 16, allowing cleaning fluid stored within the reservoir 17 to flow into a potential space 18. This soaks a cleaning surface 19 with cleaning fluid (e.g. alcohol fluid such as ethanol or isopropanol, or ethoanol mixed with dodecanolic acid). This provides chemical cleaning and couples with rotation to produce dual-action cleaning. Once the cycle is completed, the bubble 23 falls into a receptacle (not shown) and the mechanism is reset via action of the elastic restraint 4.
Each cartridge contains multiple cleaning bubbles 23. Once fully spent, the cartridge is removed from a door (not shown) in the side of the unit and replaced.

In an alternative version (not shown), the cleaning disc 7 and the cartridge driver 10 are each moved by an electric motor that replaces the amplification and diminishing aspects of the mechanism detailed above, and which is initiated by a variety of means - in one version by depression of a switch or sensor mounted within the contact plate 1, in another by use of an infrared detector, and in another by a combination of means. Hence, when the user approaches the unit with a stethoscope, the same metal rod within the construction of the stethoscope initiates cleaning activity within the unit. In this motorised version the cleaning disc 7 may vibrate or agitate in a way other than a rotator action as detailed above, or alternatively it may rotate as above.

In another alternative version (not shown), the cleaning ribbon 13 may be a simple roll of fabric or paper, and may receive alcohol or other cleaning fluid from a separate reservoir within the device.

A second embodiment of the present invention shown in Figures 4 to 9 is an example of the version described in the preceding paragraph. An apparatus for cleaning medical devices such as stethoscopes is indicated generally at 100. The apparatus 100 has a housing 102 that defines a cavity 103, within which is contained a replaceable cartridge 104. The cartridge 104 contains cleaning media 136 against which medical devices can be cleaned, utilising similar principles to the first embodiment.

The cartridge 104 contains consumable material that will be used up during operation of the apparatus 100. The housing 102 contains actuating means for controlling operation of the apparatus 100. Various parts of the housing 102 engage parts of the cartridge 104 upon fitting of the cartridge 104, and operate the cartridge 104 through this engagement (see below). Once the consumable material within the cartridge 104 has been finished, the cartridge 104 is removed, and replaced with a new cartridge 104.

In this embodiment, the housing 102 is generally cuboid, with rounded edges, and has a front face 106, an upper end 108, a lower end 110 and sides 112. One of the sides 112 comprises a
hinged door 114, which may be opened primarily to allow access to the cartridge cavity 103 for removal of the cartridge 104.

The front face 106 defines a circular aperture 116 which provides access to the cartridge 104 for a medical device to be cleaned. The housing 102 includes a shutter arrangement 118 on the inside of the front face 106 (e.g. as shown in Figure 7) that may be used to close the aperture 116. The shutter arrangement 118 has a grooved frame 120 that defines an aperture 122 which corresponds to the housing aperture 116, and a shutter 124 that is held within the frame 120. The shutter 124 is movable between a fully open position where the aperture 116 is accessible, and a closed position, where the aperture 116 is fully closed. The shutter 124 is shown in Figure 4 in a partially open position. The shutter 124 is moved between these positions by a motor 180 (see Figure 9) or other actuator. In alternative embodiments the shutter 124 may be moved manually. When closed, the shutter arrangement 118 inhibits the ingress of contaminants into the apparatus 100. In alternative embodiments there is no shutter arrangement.

The housing 102 further has a protruding central portion 160 within the cavity 103 (e.g. as shown in Figure 8) that includes various actuators used to operate the apparatus 100, as well as a controller for controlling operation.

Figure 5 shows the housing 102 with the door 114 in an open position, displaying the cartridge 104 in position within the housing 102. The cartridge 104 is shown without the housing 102 in Figure 7. Internal components of the cartridge 104 are shown in broken lines.

The cartridge 104 has a cartridge housing 126 having a front face 127, a rounded upper end 128, a rounded lower end 130 and parallel first 132 and second 134 sides. The cartridge housing 126 defines a recess 135 in the first side 132. The recess 135 corresponds to the central portion 160, which extends into the recess 135 when the cartridge 104 is fitted within the housing 102. The actuators within the central portion 160 engage with the components of the cartridge 104, as will be described in further detail below.

The housing 126 contains the cleaning medium 136. In this embodiment, the cleaning medium 136 is in the form of a web of material 138, preferably non-woven material such as air-laid paper, or some other paper or fabric capable of fluid retention.
The web 138 is initially wound around a first reel 140. An end (not shown) of the web 138 extending from the first reel 140 is attached to a second reel 142, so that winding the second reel 142 results in the web 138 being gradually transferred from the first reel 140 to the second reel 142. The reels 140, 142 are rotatably supported by respective tubular, open ended axles 144, 146 extending between the parallel sides 132, 134. The first reel 140 is at the upper end 128, supported by the first axle 144, while the second reel 142 is at the lower end 130, supported by the second axle 146. Each axle 144, 146 defines a bore 148 extending through the cartridge housing 126.

The web 138 is arranged in the cartridge 104 to pass from the first reel 140 and through an upper slot 150 defined by the front face 127 of the housing 126 to the exterior of the cartridge 104. The web 138 returns to the interior of the cartridge 104 through a lower slot 152 defined by the front face 127, extending to the second reel 142. The surface of a portion 154 of the web 138 is thus exposed. When the cartridge 104 is fitted within the housing 102 as shown in Figure 4 the surface 154 is accessible to a user through the aperture 116. The surface 154 is stretched over two pins 155 that extend across the cavity 103 parallel to the front face 106, and is backed by a backing plate 157. In use, a user holds a stethoscope diaphragm to the surface 154 against the backing plate 157.

The cartridge 104 contains a reservoir 156 holding a cleaning, preferably disinfectant, fluid 158 (e.g. alcohol fluid such as ethanol or isopropanol, or ethoanol mixed with dodecanoic acid). The fluid 158 is dispersed over the surface 154 immediately prior to use for improved cleaning by a first actuator 162 (see Figure 9) within the central portion 160 of the housing 102. In this embodiment the first actuator is a peristaltic pump 162 that acts on a flexible pipe (not shown) that extends between the reservoir 156 and the surface 154, connecting with the reservoir 156 through an aperture 164 on the upper side of the central portion 160 and a corresponding aperture (not shown) in the reservoir 156. Advantageously, the fluid 158 does not therefore contact the moving parts of the pump 162. In alternative embodiments, other types of pump or other actuators may be used. The reservoir 156 may have a pierceable membrane or a valve to prevent leakage of the fluid 158 that is opened by a suitable feature of the housing 102, e.g. a rim of the aperture 164, upon fitting of the cartridge 104.
Upon operation of the pump 162 a predetermined amount of fluid 158 is expressed onto the surface 154 via a conduit (not shown) and through apertures 159 in the backing plate 157. Fluid 158 is dispersed onto the web 138 through a diffusing plate 161 (see Figure 6) which diffuses the fluid 158 so that an increased surface area of fluid 158 is provided for cleaning. The web 138 absorbs the fluid 158 so that it seeps through to the exposed surface 154. Means for chemical cleaning, or disinfecting, of the stethoscope is thus provided.

In alternative embodiments, the web 138 is pre-impregnated with cleaning fluid, and no reservoir is provided.

The cartridge 104 is supported within the housing 102 by upper 165 and lower 166 locating pins (see Figure 8), which extend within the cavity 103 proximal and parallel to the front face 106. The pins 165, 166 extend part way through the bores 148. The door 114 comprises further locating pins 167, 168 (see Figure 4), which extend part way through the bores 148 when the door 114 is closed, further supporting the cartridge 104.

The lower pin 166 has at its base a housing 170 for a second actuator, a drive motor 172 (see Figure 9) arranged to extend through the pin 166 to drive the second reel 142, thereby spooling the web 138 from the first reel 140 to the second reel 142. Turning of the first reel 140 on the axle 144 is frictionally or resiliently inhibited in order to keep the web 138 taut between the reels 140, 142, for example by biasing of the reel 140 against the cartridge housing 126. In alternative embodiments, other actuators may be used.

The central portion 160 further includes a third actuator 174 (see Figure 9) configured to agitate the backing plate 157 so that the surface 154 is agitated, in order to facilitate mechanical cleaning of the stethoscope. In this embodiment the third actuator 174 is a motor with an eccentric drive that oscillates the backing plate 157 via a cam and follower. In alternative embodiments the third actuator 174 may be a linear motor, or other suitable types of actuator.

The central portion 160 includes in this embodiment a battery (not shown) used to power the actuators 162, 172, 174, sensor 176 and control system 178. In alternative embodiments other power sources may be used.
The apparatus 100 includes a sensor 176 (see Figure 9) configured to detect the presence of a stethoscope at the cleaning surface 154. In this embodiment, the sensor 176 detects pressure on the backing plate 157. In other embodiments, a light sensor or Hall effect sensor may be used to detect the presence of the stethoscope at the aperture 116, or some other aspect. The sensor 176 signals a control system 178 (e.g. a microprocessor controller suitably programmed) situated within the central portion 160. The control system 178 controls the actuators 162, 172, 174, so that, in use, the apparatus 100 operates as follows.

The user holds a stethoscope up to the apparatus 100. The shutter 124 is opened by the control system 160 via the motor 180, making the aperture 116 accessible. The shutter 124 may be opened following detection of the stethoscope by a sensor such as an infra red sensor in the housing 102. Alternatively a command may be given to the control system 116 to open the shutter 124, e.g. by pressing a button on the housing.

The user holds the stethoscope so that its diaphragm contacts the surface 154, pushing the surface 154 onto the backing plate 157. The sensor 176 detects the presence of the stethoscope. The control system 178 operates the pump 162 to supply fluid 158 to the surface 154, and the third actuator 174 to agitate the backing plate 157. Fluid 158 disperses through the diffusing plate 161 and soaks through the web 138 to the surface 154, and so to the diaphragm, disinfecting the diaphragm. Agitation of the backing plate 157 assists disinfection, and causes mechanical cleaning of the diaphragm, removing contaminants.

The third actuator 174 ceases to operate upon removal of the stethoscope from the surface 154. In alternative embodiments the third actuator 174 is operated for a predetermined length of time, based on the predicted time taken to clean the stethoscope.

Once cleaning of the stethoscope has taken place, the control system 178 activates the drive motor 172 to advance the web 138 so that a fresh portion of the web 138 is exposed at the aperture 116. Alternatively, a fresh portion of the web 138 may be exposed upon detection of a stethoscope prior to cleaning, or both prior to and after cleaning.

The housing 102 has a rear face including mounting points (not shown) whereby the housing 102 may be attached to a wall or other surface for convenience of use.
There are multiple advantages to the cleaning apparatus of this embodiment. The apparatus 100 provides quick, effective cleaning. Both mechanical and chemical cleaning are provided, and are carried out simultaneously. The apparatus 100 may be conveniently situated on a wall or other surface, for example near hand washing facilities or at an entrance to a ward.

The replaceable cartridge 104 allows the apparatus 100 to be replenished quickly and easily. The closed reservoir and the shutter arrangement inhibit the build up of germs on or in the apparatus 100 itself, reducing the possibility of the apparatus 100 becoming a source of infection.

In alternative embodiments (not shown) the web 138 may be advanced by manual activation of the second reel 142, e.g. by a handle extending from the housing.

Stethoscopes may be fitted with a radio frequency ID tag (RFID tag), barcode, QR code, or other suitable machine readable identifier and the device may be provided with a corresponding reader so that each stethoscope may be identified by the apparatus 100, and a log kept of stethoscopes cleaned by the apparatus 100.

The apparatus 100 may give an indication of when the web 138 is close to being finished, e.g. by flashing a light or emitting an alarm sound.

The apparatus 100 can be used to clean other medical devices, such as pulse oximeters, laryngoscope blades or specula, and may be adapted for use with such devices, e.g. to have a rotating or reciprocating protrusion in place of the backing plate 157 to correspond with a pulse oximeter.
Claims

1. An apparatus for cleaning and/or disinfecting a medical device such as a stethoscope or pulse oximeter comprising a housing and a replaceable cartridge configured to fit within the housing;

   the cartridge containing cleaning medium for cleaning said medical device; and the apparatus defining an aperture configured to expose a surface of the medium to allow said medical device to be brought against said surface for cleaning;

   wherein the medium is configured to advance with respect to the aperture such that different portions of the medium are exposed at the aperture.

2. An apparatus according to claim 1 wherein the exposed surface of the medium carries cleaning fluid.

3. An apparatus according to claim 1 or claim 2 having a mechanism to express cleaning fluid onto the medium.

4. An apparatus according to claim 2 or claim 3 wherein the cartridge includes a reservoir of cleaning fluid configured to be expressed onto the medium such that the exposed surface of the medium carries cleaning fluid.

5. An apparatus according to claim 4 wherein the housing includes a first actuator configured to express cleaning fluid from the reservoir.

6. An apparatus according to claim 4 or claim 5 including a dispersal plate between the reservoir and the medium, the plate being configured to disperse the fluid onto the medium.

7. An apparatus according to claim 2 wherein the medium is pre-impregnated with cleaning fluid.

8. An apparatus according to any one of claims 2 to 7 wherein the cleaning fluid is a disinfectant fluid, preferably alcohol.
9. An apparatus according to any preceding claim wherein the housing includes a second, drive actuator arranged to advance the medium with respect to the aperture such that successive portions of the medium are exposed at the aperture.

10. An apparatus according to any preceding claim wherein the cartridge includes a first reel upon which the medium is supported prior to exposure at the aperture.

11. An apparatus according to any preceding claim wherein the cartridge includes a second reel upon which medium that has been exposed at the aperture is collected.

12. An apparatus according to claim 11 when dependent upon claims 9 and 10 wherein the first reel is located at a first end of the housing and the second reel is located at a second end of the housing, and wherein the second actuator is located between the first and second reels.

13. An apparatus according to any one of claims 10 to 12 when dependent upon claim 9 wherein the second actuator is configured to engage and rotate the second reel such that the medium is advanced with respect to the aperture.

14. An apparatus according to any preceding claim including a sensor configured to detect a medical device being brought against the exposed surface of the medium for cleaning.

15. An apparatus according to claim 3 when dependent upon any one of claims 9 to 13 wherein the second actuator is configured to operate a predetermined period of time after detection of a medical device being brought against the exposed surface of the medium for cleaning.

16. An apparatus according to any preceding claim wherein the housing includes a third actuator arranged to agitate the medium at the exposed surface.

17. An apparatus according to claim 16 when dependent upon claim 14 or claim 15 wherein the third actuator is configured to operate upon detection of a medical device being brought against the exposed surface of the medium for cleaning.
18. An apparatus according to any preceding claim wherein the cleaning medium is in the form of a continuous web.

19. An apparatus according to any preceding claim wherein the cleaning medium is a non-woven fabric, preferably air-laid paper.

20. An apparatus according to any preceding claim wherein the housing includes a shutter arrangement configured to close the aperture.

21. An apparatus according to any preceding claim wherein the housing has a door configured to allow removal and replacement of the cartridge.

22. An apparatus according to any preceding claim configured for attachment to a substantially vertical surface such as a wall.

23. A cartridge for use with an apparatus for cleaning a medical device such as a stethoscope, the cartridge comprising a first reel upon which is supported cleaning medium for cleaning said medical device, and a second reel.

24. A cartridge according to claim 23 further comprising a cartridge housing within which the first and second reels are supported.

25. A method of cleaning a medical device such as a stethoscope or pulse oximeter comprising the steps of:
   a) providing an apparatus according to any of claims 1 to 22;
   b) exposing a fresh surface of medium at the aperture;
   c) holding the medical device against the exposed surface; and
   d) agitating the exposed surface of the medium.

26. A device to clean and/or decontaminate and/or disinfect a stethoscope diaphragm or pulse oximeter utilising a cleaning surface that is replenished, refreshed or replaced after each use.
27. A cartridge for use in the device according to claim 26 designed to facilitate the replenishment, refreshment or replacement of the cleaning surface.

28. A device according to claim 26 or claim 27 that produces a combination of mechanical and chemical action.

29. A cartridge housing a cleaning ribbon containing multiple vesicles of chemical cleaning fluid, designed so that direction and moment of release of said fluid may be controlled.

30. An apparatus substantially as described herein and/or with reference to the accompanying drawings.
INTERNATIONAL SEARCH REPORT

PCT/GB2011/051387

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B19/00

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

ADD.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>col umns 5-10; claims 1-5; figures 1-6</td>
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<td>X</td>
<td>US 5 865 551 A ( LALLI ANTHONY [US] ET AL) 2 February 1999 (1999-02-02)</td>
<td>1-5, 7, 9, 25,30</td>
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"X" 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 document or the existence of a prior invention or for 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

"Y" 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.

"A" document member of the same patent family

Date of the actual completion of the international search: 27 September 2011

Date of mailing of the international search report: 30/11/2011

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040;
Fax: (+31-70) 340-3018

Authorized officer:
Chopi naud, Marjorie
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<td><strong>US 3 556 667 A (KAUFMAN JACK W)</strong>&lt;br&gt;19 January 1971 (1971-01-19) columns 4-6; figures 1-2</td>
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**INTERNATIONAL SEARCH REPORT**

**Box No. II**  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☑ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III**  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

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   see additional sheet
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1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☑ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

   1-22, 25, 30

**Remark on Protest**

- ☑ The additional search fees were accompanied by the applicant’s protest and, where applicable, the payment of a protest fee.
- ☑ The additional search fees were accompanied by the applicant’s protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☑ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-22, 25, 30

   Apparatus comprising a housing and a replaceable cartridge containing a cleaning medium. The apparatus comprising an aperture through which the cleaning medium can be advanced and corresponding method of use.

2. claims: 23, 24

   Cartridge comprising a first reel upon which is supported cleaning medium for cleaning a medical device and a second reel and method of using it.

3. claims: 26-28

   Device utilising a cleaning surface that is replenished, refreshed or replaced after each use.

4. claim: 29

   Cartridge comprising a ribbon having a plurality of vesicles of cleaning fluid adapted to be released so that direction and moment of release of said fluid can be controlled.
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