

## STERILANT SYSTEM WITH MULTI-COMPARTMENT DISPENSER

### BACKGROUND

#### 5 a. Field of the Invention

The present invention relates to a sterilant system and method for sterilising surfaces.

#### b. Related Art

10 Two-part sterilising solutions are used in applications where the active sterilising ingredient is unstable over time. The solution is therefore prepared in situ shortly before it is to be used. A particularly important sterilising agent is chlorine dioxide ( $\text{ClO}_2$ ), which may be formed from mixtures of various reagents including: chlorite and acid; chlorate, peroxide and acid; and chlorite, hypochlorite, and a suitable  
15 buffer. Chlorine dioxide has excellent sterilising and bactericidal properties, and oral ingestion in man and animals has been shown to be relatively safe.

WO 2006/079822 describes a two part sterilant system having two reagents, each of which is put up in an aqueous medium in its own container. The aqueous media  
20 contain a foam promoter, and actuation of a single trigger dispenses each part as a foam. Mixing of the foams allows the reagents to react together to form a sterilant such as  $\text{ClO}_2$  in situ.

The effectiveness of two-part sterilant systems in conventional trigger sprayers  
25 can be reduced if the spray action does not result in the delivery of an identical volume of each reagent medium, resulting in an excess of one reagent in the mixture. Delivery of different volumes is particularly likely to result when the dispensed media are of different viscosities.

### 30 SUMMARY OF THE INVENTION

Aspects of the invention are specified in the independent claims. Preferred features are specified in the dependent claims.

The invention allows plural volumes of fluid to be evenly pumped as equal volumes from two or more sources irrespective of differences in viscosity.

- 5 Another advantage of the invention over conventional multi-component fluid pumps is that it ensures clean delivery of each fluid. Prior art sterilant apparatuses typically have pistons and require use of silicone oil or a similar lubricant. Such lubricants can contaminate the fluids being pumped. In the present invention, silicone and other lubricants are not required, and the fluids being pumped are
- 10 isolated from contact with the pump member.

solution together may be employed in the multi-part system. A practical limit of up to about 10 dispensing tubes and associated containers is envisaged; for example 4-6 tubes, or for particularly complex systems, 7-9 tubes.

5 Referring now to Figure 9, an embodiment of a multi-part sterilant system 12 is illustrated. This system is similar to the system of Figures 6-8, but includes a third part 52 in a third container 54, with a third dispensing tube 58. Equal volumes of each part 4,8,52 are simultaneously dispensed when the trigger 24 is squeezed, via respective nozzles 36a,b,c. The first part and the second part may include  
10 reagents which react when mixed to provide an oxidising sterilant composition, for example  $\text{ClO}_2$ , and the third part may include additional components which may not be stable to long term exposure to either or both of the reagents. In this example, the third part comprises an alcohol, notably isopropanol, which provides additional antiseptic functionality. Other alcohols, or mixtures of alcohols, may be  
15 used.

To increase the proportion of alcohol, or other desired component, in the dispensed mixture, it will be appreciated that additional dispensing tubes may be used. For example, a fourth dispensing tube may be used, and both the third and  
20 fourth dispensing tubes may be used to dispense alcohol, providing up to 50% alcohol in the final mixture without alcohol being present in the first part or the second part. A fifth dispensing tube permits up to 60% alcohol to be dispensed, and use of 10 tubes permits up to 80% alcohol to be dispensed. When a plurality of dispensing tubes are used to dispense the same component, for example  
25 alcohol, this component may optionally be provided in fewer containers than the number of dispensing tubes for the component. For example, a single container may be used, in which two or more dispensing tubes are disposed. For efficiency, the volume of such a container is preferably increased in proportion to the number of associated dispensing tubes so that each container is emptied after the same  
30 number of operations of the trigger.

Each container 6,10, 54 may be provided with a vent tube to connect the top of the container's interior to atmosphere to allow pressure equalisation within the

operated by the action of a user's foot on a footpad 64 which is return-biased by a spring 66. A spring-loaded catch 68 on the end of the foot pad pushes the pump ratchet to turn the pump member. The containers 6,8 are removable and replaceable, and are connected to tubes in the peristaltic pump member 22 by a connector 70 on the containers and a corresponding connector 72 on the pump member. The pump head 20 receives pumped fluids via a supply hose 58. In this embodiment, the supply hose 58 is detachable from the footpad and connectable via a hose plug 60 and hose socket 62. The hose 58 may be detached for replacement or clearing of the pump head 20.

In the embodiment of Figure 17, an alternative hand-operated trigger lever 74 is used to drive the peristaltic pump head 22.

The invention allows plural volumes of reagents to be evenly pumped as equal volumes from two or more sources irrespective of differences in viscosity, to form a sterilising composition.

Another advantage of the invention over conventional multi-component fluid pumps is that it ensures clean delivery of each reagent fluid. Prior art sterilant apparatuses typically have pistons and require use of silicone oil or a similar lubricant. Such lubricants can contaminate the fluids being pumped. In the present invention, silicone and other lubricants are not required, and the fluids being pumped are isolated from contact with the pump member.

Although the invention has been described with particular reference to a disposable sterilant system, it will be understood that it is not limited to this embodiment. Instead of a finger-operated trigger, the peristaltic pump member may be actuated by a motorised trigger. The trigger may be manually operated by a user, or may be operated automatically in response to a proximity sensor detecting when an object is brought sufficiently close to the nozzle or nozzles. Such embodiments may include a counter-top dispenser, an automatic wall-mounted dispenser, and a personal (body-mounted) dispenser.

## CLAIMS

1. A multi-part sterilant system comprising:
  - a first part comprising a first reagent in a carrier medium in a first container;
  - 5 a second part comprising a second reagent in a carrier medium in a second container;
  - wherein the first reagent and the second reagent will react to provide a sterilising composition when the first part is mixed with the second part;
  - a pump head having a peristaltic pump member;
  - 10 the first container having a first-part dispensing tube extending from its interior and disposed through the pump head;
  - the second container having a second-part dispensing tube extending from its interior and disposed through the pump head;
  - wherein the peristaltic pump member when actuated acts on both the first-
  - 15 part dispensing tube and the second-part dispensing tube so as simultaneously to pump substantially equal volumes of the first part and the second part.
2. A system according to claim 1, wherein the peristaltic pump member is driven by a ratchet member provided with a plurality of ratchet surfaces which are  
20 engageable by a pawl.
3. A system according to claim 2, wherein the peristaltic pump member is provided with 4-30 ratchet surfaces, preferably 4-20 ratchet surfaces.
- 25 4. A system according to any preceding claim, wherein the system is incorporated in one of a counter top dispenser, an automatic wall-mounted dispenser, a foot-operated dispenser, a hand-operated dispenser, and a personal, body-mounted, dispenser.
- 30 5. A system according to any preceding claim, which has from two to 10 dispensing tubes.
6. A system according to any preceding claim, further comprising:

a third part comprising a fluid in a third container;  
the third container having a third dispensing tube extending from its interior  
and disposed through the pump head;

5 wherein the peristaltic pump member when actuated acts on the first-part  
dispensing tube, the second-part dispensing tube and the third dispensing tube so  
as simultaneously to pump substantially equal volumes of the first part, the second  
part and the third part.

7. A system according to claim 6, wherein the first reagent and the second  
10 reagent will react when mixed to produce an oxidising sterilant composition, and  
wherein the third part comprises an alcohol or mixture of alcohols.

8. A system according to any preceding claim, wherein the first container and  
the second container are collapsible.

15 9. A system according to any preceding claim, wherein at least two first-part  
dispensing tubes and at least two second-part dispensing tubes are provided for  
dispensing, respectively, the first part and the second part.

20 10. A system according to any preceding claim, wherein the first reagent and  
the second reagent react to produce chlorine dioxide when the first part is mixed  
with the second part.

25 11. A system according to any preceding claim, wherein the first container and  
the second container are permanently secured to the pump head so that they are  
not refillable.

12. A system according to any of claims 1-10, wherein each container is  
provided in a housing which is releasably secured to the pump head.

30 13. A system according to claim 12, wherein each container is collapsible and  
is secured to a collar member, the collar member having, for each container, an  
opening which is aligned with an opening of the container to receive a

corresponding dispensing tube when the pump head is attached to the housing.

14. A system according to claim 13, wherein the open end of each container has a neck portion and a lip, and wherein each opening in the collar member is dimensioned to support the lip of a container and has a slot portion which extends to an edge of the collar member for slidably receiving the neck portion of a container.

15. A refill component for the system of claim 14, comprising  
a first part comprising a first reagent in a carrier medium in a first collapsible container;  
a second part comprising a second reagent in a carrier medium in a second container;  
wherein the first reagent and the second reagent will react to provide a sterilising composition when the first part is mixed with the second part;  
each container being secured to a collar member, the collar member having, for each container, an opening which is aligned with an opening of the container to receive a corresponding dispensing tube from a pump head.

16. A refill component according to claim 15, wherein the open end of each container has a neck portion and a lip, and wherein each opening in the collar member is dimensioned to support the lip of a container and has a slot portion which extends to an edge of the collar member for slidably receiving the neck portion of a container.

## STERILANT SYSTEM WITH MULTI-COMPARTMENT DISPENSER

### BACKGROUND

#### a. Field of the Invention

5 The present invention relates to a sterilant system.

#### b. Related Art

Two-part sterilising solutions are used in applications where the active sterilising ingredient is unstable over time. The solution is therefore prepared in situ shortly  
10 before it is to be used. A particularly important sterilising agent is chlorine dioxide ( $\text{ClO}_2$ ), which may be formed from mixtures of various reagents including: chlorite and acid; chlorate, peroxide and acid; and chlorite, hypochlorite, and a suitable buffer. Chlorine dioxide has excellent sterilising and bactericidal properties, and oral ingestion in man and animals has been shown to be relatively safe.

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WO 2006/079822 describes a two part sterilant system having two reagents, each of which is put up in an aqueous medium in its own container. The aqueous media contain a foam promoter, and actuation of a single trigger dispenses each part as a foam. Mixing of the foams allows the reagents to react together to form a  
20 sterilant such as  $\text{ClO}_2$  in situ.

CN 201537558U shows a two part sterilant system in a bottle with a trigger sprayer pump head. The bottle has a first part in a first compartment and a second part in a second compartment. Each compartment has a dip tube that connects  
25 with a mixing compartment in the pump head. Operation of the trigger first draws each part into the mixing compartment where they produce a sterilant containing  $\text{ClO}_2$  and then dispenses the sterilant through a nozzle.

EP 1 889 665 discloses a powered sprayer head which eliminates the need for  
30 repeatedly squeezing a sprayer lever manually, which can be tiresome.

US 6,193,058 discloses a system for dispensing premeasured quantities of concentrated materials.

The effectiveness of two-part sterilant systems in conventional trigger sprayers can be reduced if the spray action does not result in the delivery of an identical volume of each reagent medium, resulting in an excess of one reagent in the mixture. Delivery of different volumes is particularly likely to result when the dispensed media are of different viscosities.

#### SUMMARY OF THE INVENTION

According to the invention there is provided a multi-part sterilant system as specified in claim 1. Preferred features are specified in the dependent claims.

The invention allows plural volumes of fluid to be evenly pumped as equal volumes from two or more sources irrespective of differences in viscosity.

Another advantage of the invention over conventional multi-component fluid pumps is that it ensures clean delivery of each fluid. Prior art sterilant apparatuses typically have pistons and require use of silicone oil or a similar lubricant. Such lubricants can contaminate the fluids being pumped. In the present invention, silicone and other lubricants are not required, and the fluids being pumped are isolated from contact with the pump member.

solution together may be employed in the multi-part system. A practical limit of up to about 10 dispensing tubes and associated containers is envisaged; for example 4-6 tubes, or for particularly complex systems, 7-9 tubes.

5 Referring now to Figure 9, an embodiment of a multi-part sterilant system 12 is illustrated. This system is similar to the system of Figures 6-8, but includes a third part 52 in a third container 54, with a third dispensing tube 56. Equal volumes of each part 4,8,52 are simultaneously dispensed when the trigger 24 is squeezed, via respective nozzles 36a,b,c. The first part and the second part may include  
10 reagents which react when mixed to provide an oxidising sterilant composition, for example  $\text{ClO}_2$ , and the third part may include additional components which may not be stable to long term exposure to either or both of the reagents. In this example, the third part comprises an alcohol, notably isopropanol, which provides additional antiseptic functionality. Other alcohols, or mixtures of alcohols, may be  
15 used.

To increase the proportion of alcohol, or other desired component, in the dispensed mixture, it will be appreciated that additional dispensing tubes may be used. For example, a fourth dispensing tube may be used, and both the third and  
20 fourth dispensing tubes may be used to dispense alcohol, providing up to 50% alcohol in the final mixture without alcohol being present in the first part or the second part. A fifth dispensing tube permits up to 60% alcohol to be dispensed, and use of 10 tubes permits up to 80% alcohol to be dispensed. When a plurality of dispensing tubes are used to dispense the same component, for example  
25 alcohol, this component may optionally be provided in fewer containers than the number of dispensing tubes for the component. For example, a single container may be used, in which two or more dispensing tubes are disposed. For efficiency, the volume of such a container is preferably increased in proportion to the number of associated dispensing tubes so that each container is emptied after the same  
30 number of operations of the trigger.

Each container 6,10, 54 may be provided with a vent tube to connect the top of the container's interior to atmosphere to allow pressure equalisation within the

operated by the action of a user's foot on a footpad 65 which is return-biased by a spring 67. A spring-loaded catch 69 on the end of the foot pad pushes the pump ratchet to turn the pump member. The containers 6,8 are removable and replaceable, and are connected to tubes in the peristaltic pump member 22 by a  
5 connector 71 on the containers and a corresponding connector 73 on the pump member. The pump head 20 receives pumped fluids via a supply hose 59. In this embodiment, the supply hose 59 is detachable from the footpad and connectable via a hose plug 61 and hose socket 63. The hose 59 may be detached for replacement or cleaning of the pump head 20.

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In the embodiment of Figure 17, an alternative hand-operated trigger lever 75 is used to drive the peristaltic pump head 22.

The invention allows plural volumes of reagents to be evenly pumped as equal  
15 volumes from two or more sources irrespective of differences in viscosity, to form a sterilising composition.

Another advantage of the invention over conventional multi-component fluid pumps is that it ensures clean delivery of each reagent fluid. Prior art sterilant  
20 apparatuses typically have pistons and require use of silicone oil or a similar lubricant. Such lubricants can contaminate the fluids being pumped. In the present invention, silicone and other lubricants are not required, and the fluids being pumped are isolated from contact with the pump member.

25 Although the invention has been described with particular reference to a disposable sterilant system, it will be understood that it is not limited to this embodiment. Instead of a finger-operated trigger, the peristaltic pump member may be actuated by a motorised trigger. The trigger may be manually operated by a user, or may be operated automatically in response to a proximity sensor  
30 detecting when an object is brought sufficiently close to the nozzle or nozzles. Such embodiments may include a counter-top dispenser, an automatic wall-mounted dispenser, and a personal (body-mounted) dispenser.

## CLAIMS

1. A multi-part sterilant system (12) comprising:
  - a first part (4) comprising a first reagent in a carrier medium in a first  
5 container (6,66,80);
  - a second part (8) comprising a second reagent in a carrier medium in a second container (10,68);
  - wherein the first reagent and the second reagent will react to provide a sterilising composition when the first part (4) is mixed with the second part (8);
  - 10 characterised by:
    - a pump head (20) having a peristaltic pump member (22);
    - the first container (6,66) having a first-part dispensing tube (16) extending from its interior and disposed through the pump head (20);
    - the second container (10,68) having a second-part dispensing tube (18)  
15 extending from its interior and disposed through the pump head (20);
    - wherein the peristaltic pump member (22) when actuated acts on both the first-part dispensing tube (16) and the second-part dispensing tube (18) so as simultaneously to pump equal volumes of the first part (4) and the second part (8).
- 20 2. A system (12) according to claim 1, further comprising a pawl (28) and a ratchet member (40) for driving the peristaltic pump member (22), the ratchet member (40) provided with a plurality of ratchet surfaces (30) which are engageable by the pawl (28).
- 25 3. A system (12) according to claim 2, wherein the peristaltic pump member (22) is provided with 4-30 ratchet surfaces (30), preferably 4-20 ratchet surfaces (30).
4. A system (12) according to any preceding claim, wherein the system is  
30 incorporated in one of a counter top dispenser, an automatic wall-mounted dispenser, a foot-operated dispenser, a hand-operated dispenser, and a personal, body-mounted, dispenser.

5. A system (12) according to any preceding claim, which has from two to 10 dispensing tubes.
6. A system (12) according to any preceding claim, further comprising:  
5 a third part (52) comprising a fluid in a third container (54,70);  
the third container (54,70) having a third dispensing tube (56) extending from its interior and disposed through the pump head (20);  
wherein the peristaltic pump member (22) when actuated acts on the first-part dispensing tube (16), the second-part dispensing tube (18) and the third  
10 dispensing tube (56) so as simultaneously to pump equal volumes of the first part (4), the second part (8) and the third part (52).
7. A system (12) according to claim 6, wherein the first reagent and the second reagent will react when mixed to produce an oxidising sterilant  
15 composition, and wherein the third part (54) comprises an alcohol or mixture of alcohols.
8. A system (12) according to any preceding claim, wherein the first container (66) and the second container (68) are collapsible.  
20
9. A system (12) according to any preceding claim, wherein at least two first-part dispensing tubes (16) and at least two second-part dispensing tubes (18) are provided for dispensing, respectively, the first part (4) and the second part (8).
- 25 10. A system (12) according to any preceding claim, wherein the first reagent and the second reagent react to produce chlorine dioxide when the first part (4) is mixed with the second part (8).
11. A system (12) according to any preceding claim, wherein the first container  
30 (6) and the second container (10) are permanently secured to the pump head (20) so that they are not refillable.
12. A system (12) according to any of claims 1-10, wherein each container

(6,10,54,66,68,70,80) is provided in a housing (38) which is releasably secured to the pump head (20).

13. A system (12) according to claim 12, wherein each container (66,68,70,80)  
5 is collapsible and is secured to a collar member (64,78), the collar member (64,78) having, for each container (66,68,70), an opening (72) which is aligned with an opening of the container to receive a corresponding dispensing tube (16,18,56) when the pump head (20) is attached to the housing (38).

10 14. A system (12) according to claim 13, wherein the open end of each container (80) has a neck portion (84) and a lip (86), and wherein each opening in the collar member (78) is dimensioned to support the lip (86) of a container and has a slot portion (82) which extends to an edge of the collar member (78) for slidably receiving the neck portion (84) of a container.

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