

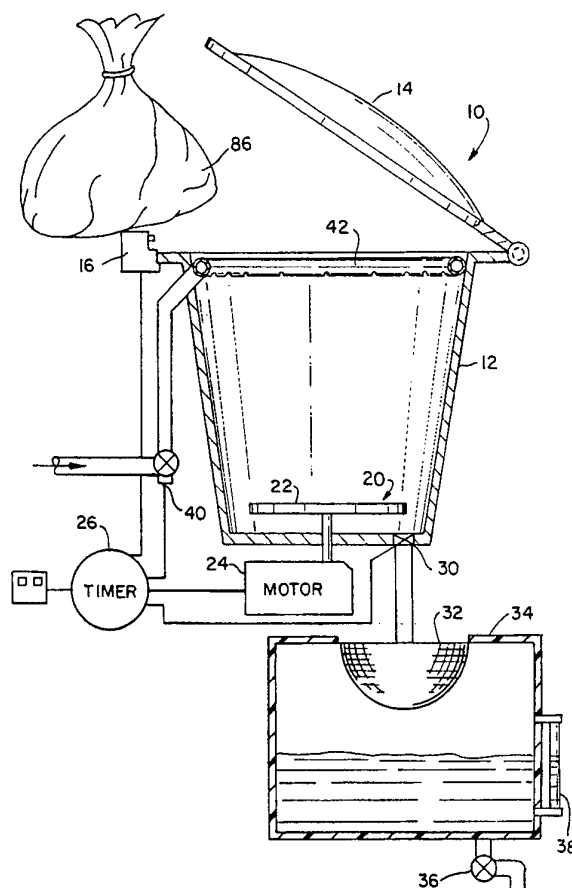
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(54) Title: MEDICAL AND BIOLOGICAL WASTE DECONTAMINATION SYSTEM

(57) Abstract

A bag (86) of medical or biological wastes is inserted into a chamber (12) that contains a grinder (20). A package (48) is placed unopened in the chamber with the wastes. A selected volume of a dilutant such as water is added to the chamber (40, 42). The chamber is closed and the grinder operated for a selected duration. The grinder grinds the packaging, disposing of the packaging and releasing liquid peracetic acid (70) and dry pH buffers (80) or permitting contained dry reagents (56, 58) such as acetylsalicylic acid and perborate to react with the dilutant, forming an anti-microbial solution with the dilutant. The grinder continues to grind the packaging and the wastes into fine particulates forming a slurry with the anti-microbial solution. The continued operation of the grinder assures that the anti-microbial solution contacts all surfaces of the waste. In this manner, the medical or biological wastes are microbially decontaminated. A color indicator (60, 78) is included with the packaging to provide a color indication as to whether the anti-microbial reaction is complete. For example, a Gentian Violet may be provided which fades to white to indicate completion of the decontamination process. Once decontaminated, the slurry is removed from the chamber and disposed of as non-contaminated waste materials. Optionally, fragrances and deodorants may be included in the package.



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MEDICAL AND BIOLOGICAL WASTE DECONTAMINATION SYSTEM

Background of the Invention

The present invention relates to the decontamination arts. It finds particular application in conjunction with the sterilizing or disinfecting of biological and medical wastes and will be described with particular reference thereto. However, it is to be appreciated that the present invention will also find application in connection with the disposal of any products having potentially harmful microorganisms.

Microbial decontamination connotes the removal of hazardous or unwanted bacteria, mold spores, and other pathogenic life forms. Disinfection connotes the absence of pathogenic life forms. Sterilization connotes the absence of all life forms, whether pathogenic or not.

Heretofore, medical waste such as used syringes, petri dishes and culture media, vials, and other equipment which has come in contact with substances which might potentially carry pathogenic organisms have been subject to elaborate and expensive waste disposal procedures. Traditionally, these wastes were incinerated at sufficiently high temperatures that the pathogenic organisms were killed. However, incinerators tend to be a source of air pollution and are being closed.

Other biological and medical wastes are sterilized in a steam autoclave. Autoclave sterilization is a relatively time consuming and expensive procedure, particularly for waste materials.

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Another technique for disposing of medical wastes is to grind the wastes with water into a slurry. Bound iodine solutions are commonly added to presumably kill pathogenic organisms. However, one of the problems with this system is providing assurance that the pathogenic organisms are killed.

In accordance with the present invention, a new and improved system for decontaminating medical waste is provided.

10

Summary of the Invention

In accordance with one aspect of the present invention, a method is provided for safely disposing of medical or biological wastes. Medical and other biological wastes are disposed in a chamber of a grinding apparatus. Two components which react in the presence of a dilutant to form an anti-microbial material are sealed in separate packets in premeasured doses. The packets containing the two or more components are put into the grinder unopened along with the medical waste. Water or other fluid is added to the grinder as necessary. The grinder grinds and mixes the medical waste, severing the sealed packets allowing the premeasured doses of the two reagents to react and form an anti-microbial solution. The grinding process completely intermixes the formed anti-microbial solution and the waste. After a selected duration sufficient for the anti-microbial solution to disinfect the waste, the grinding chamber is emptied. Because the ground waste has now been microbially decontaminated, it is no longer hazardous waste. Rather, it can be disposed of like any other waste.

In accordance with another aspect of the present invention, the components react to form a strong oxidant with a relatively short half life.

The short half life of the microbial decontaminate can be adjusted such that decontaminate

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remains active long enough to render the waste harmless but does not create a separate environmental toxin.

In accordance with another aspect of the present invention, a color indicator means is sealed in a stored compartment. The sealed compartment of the color indicator, the medical wastes, and compartments with either an anti-microbial agent or components which react to form an anti-microbial agent are inserted into a grinder with water, as necessary. The grinder is actuated to open the compartments containing the indicator and the anti-microbial agent or anti-microbial agent components. After the grinding process, the color of the ground waste slurry is checked for an indication that the waste has been microbially decontaminated.

In accordance with a more limited aspect of the present invention, the anti-microbial agent is a strong oxidant or components which react to form a strong oxidant and the indicator is Gentian Violet, which changes from violet to white under a combination of time, temperature, and acid concentration -- the three factors which contribute to microbial decontamination.

In accordance with another aspect of the present invention, a deodorizing agent or a fragrance is included in the packaged chemicals.

One advantage of the present invention is that it reliably microbially decontaminates medical and biological waste.

Another advantage of the present invention is that it prevents direct user contact with concentrated anti-microbial agents.

Another advantage of the present invention is that it reduces the potential for operator error in the sterilization of microbially decontaminated waste materials.

Still further advantages of the present invention will become apparent to those of ordinary skill in the art

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upon reading and understanding the following detailed description of the preferred embodiments.

Brief Description of the Drawings

5 The invention may take form in various components and arrangements of components and in various steps and arrangements of steps. The drawings are only for purposes of illustrating a preferred embodiment and are not to be construed as limiting the invention.

10 FIGURE 1 is a diagrammatic illustration of a waste grinding system in accordance with the present invention;

FIGURE 2 is a perspective view of a microbial decontaminant packaged for use in conjunction with the device of FIGURE 1;

15 FIGURE 3 is an alternate embodiment of packaging for the microbial decontaminant; and,

FIGURE 4 is a view in partial cross-section of yet other packaging for the microbial decontaminant and indicator.

20 Detailed Description of the Preferred Embodiments

A waste disposal system 10 includes a body portion 12 which defines an interior chamber and an openable lid 14 for selectively sealing the chamber. The lid and body portion are constructed of or are at least
25 lined with a structurally strong, relatively inert material, such as stainless steel. A latching means 16 selectively latches the lid in a fluid-tight sealed relationship with the body portion.

A grinding means 20 is disposed inside of the
30 body portion internal chamber adjacent the bottom. The grinding means 20 includes a shaft which supports a plurality of blades 22 of sufficiently hardened material to shatter and grind glass, metal cannulas, plastics, and the like. The blades are also designed to shred plastic bags
35 and other flexible light-weight plastic. A motor and gear

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box means 24 rotates the blades of the grinder means at a relatively high rate of speed. A timer means 26 is selectively actuated by the operator to cause the motor 24 to run for a selected duration. The duration is selected to be sufficient for (1) the grinding means 20 to completely grind received medical waste and (2) to cause a complete intermixing and reaction of the anti-microbial reagents. Preferably, the timer 26 is also interconnected with the latching means 16 to lock the lid latched whenever the motor is on to prevent inadvertent opening of the lid. Conversely, the latch means 16 can be interconnected with the timer 26 to cause the motor to stop immediately if the lid is opened.

After the selected grinding cycle and after a selected additional duration for the anti-microbial material to operate on any microbes, the timing means 26 opens a drain valve 30, draining the slurry of ground medical waste and anti-microbial solution into a straining means 32. The straining means catches and holds the particles of glass, metal, plastic, and the like which have been ground to a fine sand-like particulate. Fluid drains through the strainer 32 into a holding tank 34. A drain valve 36 enables the holding tank 34 to be drained periodically into a drain or other liquid disposal system. Optionally, a sight glass 38 is provided which enables the fill level and the color of the liquid in the holding tank to be monitored.

The timer 26 further operates a fluid valve 40 which admits tap water or other dilutant and rinse fluids into the system. A series of spray nozzles 42 around an upper periphery of the chamber 10 spray the interior of the chamber to rinse any residue through drain valve 30 into the strainer 32 and the holding tank 34. Optionally, the valve 40 may be opened at the beginning of the cycle for a duration selected to introduce a selected volume of fluid in the chamber 10 to enable the sterilant reagents to react and provide a selected concentration anti-microbial

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solution while providing the anti-microbial solution with mobility to reach all microbes.

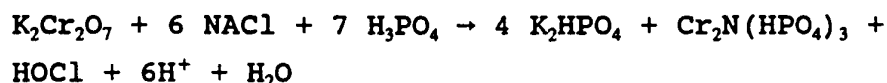
With reference to FIGURE 2, a closed package 48 holds the active reagents for making the anti-microbial solution. In the embodiment of FIGURE 2, the package includes a first closed compartment 50 and a second closed compartment 52. The compartments 50, 52 are heat sealed from a flexible plastic sheet. The first and second compartments hold metered amounts of two reagents which react in water to form the sterilant solution. If one or both of the reagents off-gas, i.e., liberate a gas, a vent 54 is provided in the associated compartment. Preferably, the vent 54 permits gas to leave the compartment but inhibits moisture from entering, e.g., a vapor check valve.

One of the reagents includes a dry acid precursor 56, preferably acetylsalicylic acid. The other reagent includes is a persalt 58, preferably a sodium or other perborate in dry form. A dry pH buffer is mixed with one of the other dry reagents. The acid precursor and persalt react in the presence of water to form sodium metaborate, peracetic acid, and salicylic acid. The volume of the dry reagents in the first and second compartments 50 and 52 and the volume of added water are coordinated such that a concentration of peracetic acid is achieved in the resultant solution sufficient to produce the desired anti-microbial effect. The pH is adjusted to control the reaction rate such that the reagents react quickly to form peracetic acid of a high concentration and a half life commensurate with the grinding cycle. A pH of 6.5 to 9.5 is preferred. The peracetic acid is a strong oxidant and aggressive anti-microbial agent. The salicylic acid and any unreacted acetylsalicylic acid have anti-microbial properties as well. Wetting agents or detergents may also be added to improve the efficacy of the anti-microbial action. Optionally, anti-corrosives may be added, if necessary, to protect the grinding means 20 and the housing 10.

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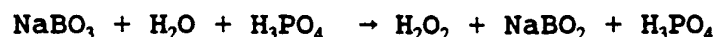
With reference to FIGURE 3, the package 50, preferably further includes a third container 60 which contains a color indicator such as Gentian Violet {4-{bis[p-(dimethylamino)phenyl]methylene} - 2,5 - cyclohexadien - 1 - ylidine}dimethylammonium chloride; hexamethylpararosaniline chloride; hexamethyl-p-rosaniline chloride. The Gentian Violet imparts a dark violet color to the slurry or solution, which violet color fades to white with a combination of time, temperature, and acid concentration. The concentration of Gentian Violet is selected such that the color fades to white if an appropriate amount of peracetic acid is generated during the grinding and any delay time before the drain valve 30 is opened.

Other oxidizing or antimicrobial agents can also be generated in situ, such as chlorine dioxide, chlorine, hydrogen peroxide, and mixtures thereof. More specifically, potassium chromates, sodium chloride, and phosphates may be mixed according to the following equation to produce a strong chlorine oxidant on the addition of water:



Optionally, excess dichromate and an organic corrosion inhibitor may be provided for improved buffering and corrosion inhibiting.

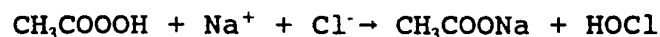
Hydrogen peroxide and an inorganic inhibitor can be generated:



Similarly, chlorine dioxide can be generated from powdered ingredients on the addition of water:



A mixed biocide system can be achieved by adding sodium chloride to the peracetic acid reaction to produce hypochlorous acid.



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Excess peracetic acid is deliberately present such that both peracetic acid and hypochlorous acid are present in the biocidal solution.

In some applications, the medical waste may contain chemicals which interfere with the reacting of the dry reagents. This is more apt to occur in medical laboratories where culture mediums and other chemicals are among the disposed wastes. In the embodiment of FIGURE 4, the package 48 includes a concentrate of the anti-microbial agent, such as peracetic acid, in a liquid form 70. More specifically, the liquid sterilant concentrate is housed in an ampule 72. For peracetic acid and other anti-microbial agents which liberate gas, a vent aperture 74 is provided. The anti-microbial liquid is housed in a carrier or common container 76 which has a second compartment for holding a color indicator reagent 88, such as the Gentian Violet, pH buffers 80, a deodorant or fragrance, corrosion inhibitors, or the like. The half life of the peracetic acid is controlled with the pH. By buffering to a new neutral pH, the efficacy of the peracetic acid peaks early for quick, effective, anti-microbial activity.

The package 48 may further include a cardboard box 82 or other shipping container. Padding or cushioning materials 84 may be impregnated with the deodorant or fragrance or other reagents. The deodorant or fragrance is released as the packaging is ground by grinder 20.

In use, a plastic bag 86 containing the biological or medical waste is placed in the chamber 12. The package 48 of the premeasured doses of anti-microbial agent are also placed in the chamber 12. The package 48 is not opened. Rather, the closed package is placed in an unopened condition within the chamber 10 to assure that the operator does not come into contact with potentially dangerous anti-microbial agents. The operator may add a preselected dose of water, e.g. a liter. The lid 14 is closed and latched. Preferably, the valve 40 is opened to meter the preselected dose of water into the chamber 12.

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The timer 26 causes the motor 24 to revolve the cutting blades 22 for a sufficient duration to assure that all the waste and the package 48 is ground to a fine pulp or slurry, e.g. about three minutes depending on the volume of the chamber 10 and the grinding efficiency of the grinding means 20. The dry reagents may be added in the form of a pellet which is ground by the grinding means. The timing means then times a duration which is selected to insure that the anti-microbial solution formed has the contents of the package 48 has an adequate time to kill all pathogenic life forms, e.g. about ten minutes. This duration can be lengthened or shortened by using higher concentrations of the anti-microbial solution or by including buffering reagents which cause the reaction which forms the solution to progress more quickly or more slowly.

The valve 30 is opened and the slurry of ground and microbially decontaminated medical waste is discharged. The granular solids are held in the strainer 32 while the liquids drain into the holding tank 34. The operator checks the color of liquid in the holding tank 34 in the sight glass 38 to determine whether the color change indicative of the completion of the decontamination process has occurred. If decontamination is complete, the drain valve 36 may be opened and the decontaminated liquid waste discharged and disposed of as any non-contaminated liquid waste would be handled. If the liquid in the sight glass shows a color which leads the operator to question whether or not the liquid was completely decontaminated, the liquid and solids may be returned to the decontamination chamber with another package 48 of the sterilant and the process repeated. Alternately, another package 48 of the sterilant material can be added to the sterilant chamber 12 with the premeasured dose of water and the grinder 20 run for a short duration to make an anti-microbial solution. The valve 30 is opened such that the anti-microbial solution is drained through the solids and strainer 32 and into the liquid in the drain tank 34 to complete the sterilization process.

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Having thus described the preferred embodiment,
the invention is now claimed to be:

1. A method of decontaminating medical or
biological wastes, the method comprising:

placing medical wastes in a chamber containing a
grinder;

5 placing a closed package which holds a
premeasured dose of at least one of (i) an anti-microbial
concentrate and (ii) dry reagents which react in water
unopened in the chamber;

adding a dilutant to the chamber;

10 grinding the wastes and the package in the
chamber (i) releasing the anti-microbial concentrate or
reagents into the dilutant, (ii) grinding the wastes and
the package to a slurry, and (iii) mixing an anti-microbial
solution with the dilutant, and (iv) intermixing the anti-
15 microbial solution with all surfaces of the slurry, the
anti-microbial solution having a sufficient strength to
kill all pathogenic microorganisms in the waste.

2. The method as set forth in claim 1 wherein
the package includes a first compartment holding liquid
peracetic acid and a second compartment holding dry
buffers.

3. The method as set forth in claim 1 wherein
the package includes at least a first compartment which
holds the anti-microbial concentrate and a second sealed
compartment which holds a color indicator, the color
5 indicator providing an initial color to the anti-microbial
solution which changes color to indicate a completeness of
the microbial decontamination procedure.

4. The method as set forth in claim 2 wherein
the color indicator includes Gentian Violet.

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5. The method as set forth in claim 3 further including monitoring a color of the slurry to check for the completeness of microbial decontamination.

6. The method as set forth in claim 1 wherein the package includes a first sealed compartment which holds a first dry reagent and a second sealed compartment holds a second dry reagent, the first and second dry reagents
5 reacting in the presence of the dilutant to form the anti-microbial solution.

7. The method as set forth in claim 6 wherein the package further includes a third sealed compartment, the third sealed compartment containing a color indicator which changes color to indicate a completeness of microbial
5 decontamination.

8. The method as set forth in claim 7 wherein the first dry reagent includes an acid precursor and the second dry reagent includes a persalt, during the grinding step, the acid precursor and persalt reacting in the
5 dilutant to form a strong oxidant.

9. The method as set forth in claim 8 wherein the acid precursor includes acetylsalicylic acid and the persalt includes a perborate, the acetylsalicylic acid and perborate reacting during the grinding step to form
5 peracetic acid and salicylic acid.

10. A system for disposing of medical or biological wastes, the system comprising:

a chamber holding a grinding means, a selected volume of a dilutant, medical or biological waste to be
5 disposed, and a closed package containing at least one of (i) an anti-microbial concentrate and (ii) reagents which react in the presence of the dilutant to form an anti-microbial solution;

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10 a control means for controlling the grinder means
such that the grinder means (i) grinds the wastes and the
package into a slurry, (ii) intermixes the sterilant
concentrate or reagents with the dilutant to form the anti-
microbial solution, and (iii) intermixes the anti-microbial
solution with all surfaces of the slurry microbially
15 decontaminating the waste.

11. The method as set forth in claim 10 wherein
the package includes a first compartment holding liquid
peracetic acid and a second compartment holding dry
buffers.

12. The system as set forth in claim 11 wherein
the closed package further includes a third compartment,
the third sealed compartment holding a fragrance.

13. The system as set forth in claim 10 wherein
the closed package includes at least a first compartment
which holds the anti-microbial concentrate and a second
sealed compartment which holds a color indicator, the color
5 indicator providing an initial color to the anti-microbial
solution which changes color to indicate a completeness of
microbial decontamination.

14. The system as set forth in claim 10 wherein
the closed package includes a first compartment which holds
a first dry reagent and the second compartment holds a
second dry reagent, the first and second dry reagents
5 reacting in the presence of the dilutant to form the anti-
microbial solution.

15. The system as set forth in claim 14 wherein
the package further includes a third compartment, the third
sealed compartment holding a color indicator which changes
color to indicate a completeness of the microbial
5 decontamination process.

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16. The system as set forth in claim 14 wherein the acid precursor includes acetylsalicylic acid and the persalt includes a perborate, the acetylsalicylic acid and perborate reacting during the grinding step to form
5 peracetic acid.

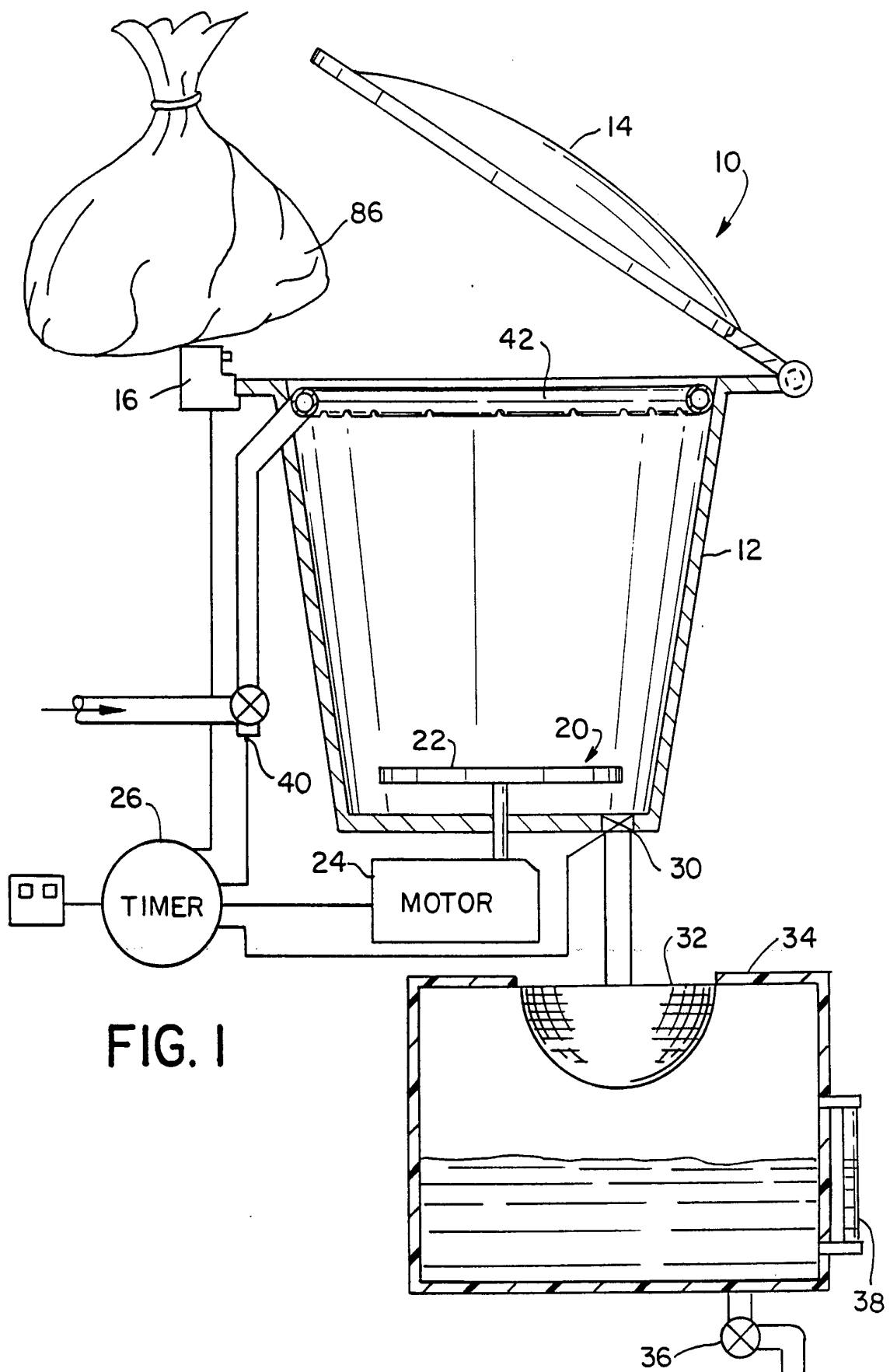
17. The system as set forth in claim 10 further including:

a drain means controlled by the control means for draining the microbially decontaminated slurry from the
5 chamber after the grinding step;

a straining means for separating solids and liquids of the slurry; and

a holding tank for holding separated liquids.

18. The system as set forth in claim 17 further including a rinsing means for selectively spraying a rinse fluid inside the chamber for selectively rinsing slurry residue through the drain means to the straining means.



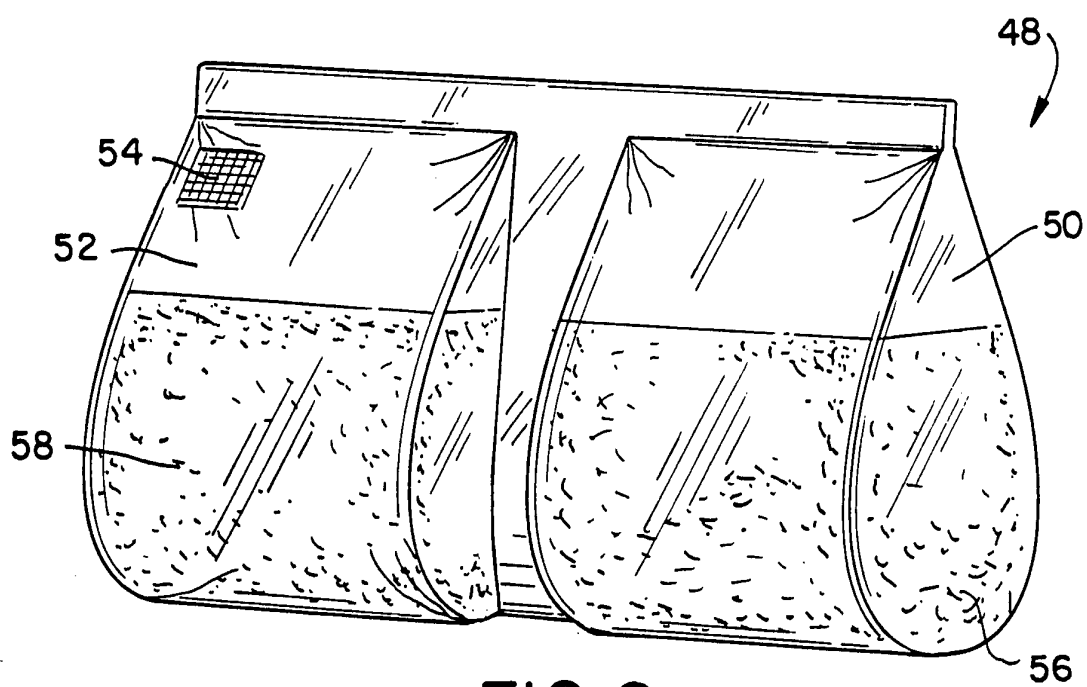


FIG. 2

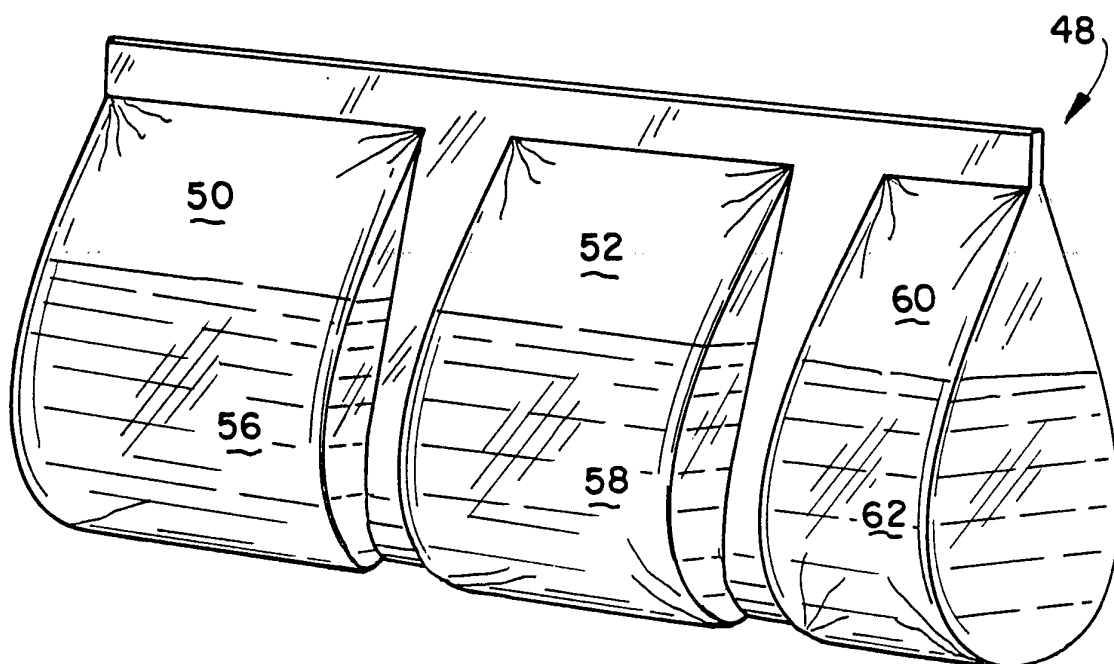


FIG. 3

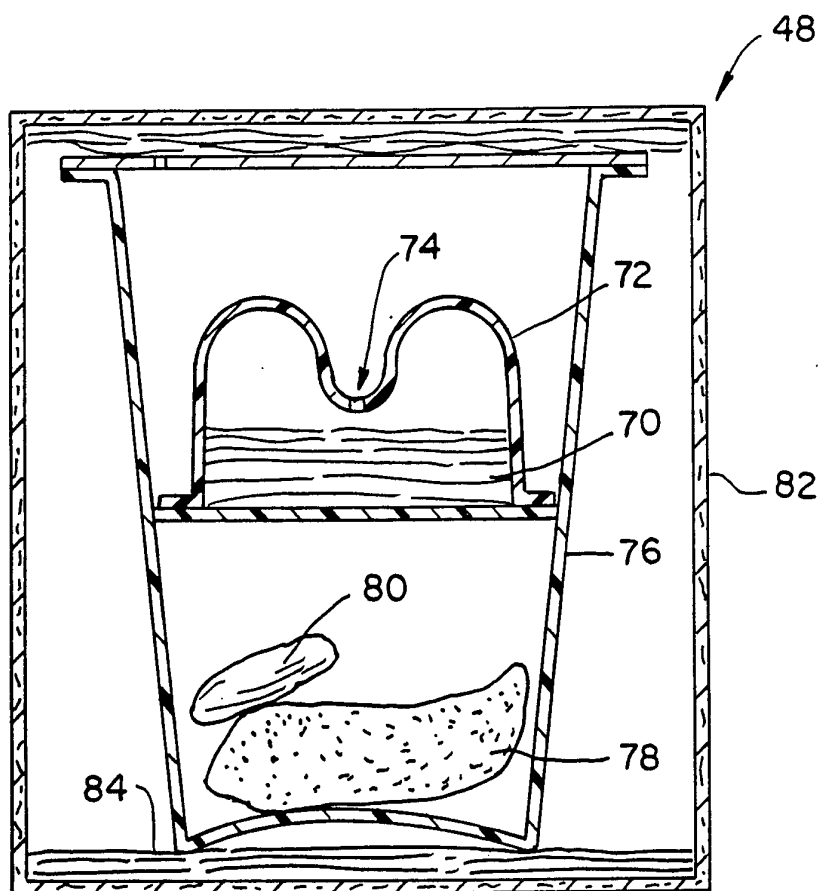


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 94/01832

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A61L11/00 A61L2/16

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 5 A61L

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	EP,A,0 455 326 (WINFIELD) 6 November 1991 see column 2, line 29 - column 3, line 14 see column 6, line 26 - column 7, line 18 ---	1,3,5
X	US,A,5 089 228 (MEIJER R.S.) 18 February 1992 see claims 1-6 ---	1,3,5
X	EP,A,0 510 277 (WINFIELD) 28 October 1992 see column 4, line 53 - column 5, line 58 ---	1
A	EP,A,0 315 106 (MOLTENI) 10 May 1989 -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

21 June 1994

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 94/01832

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0455326	06-11-91	US-A- 5190725	02-03-93
US-A-5089228	18-02-92	NONE	
EP-A-0510277	28-10-92	US-A- 5190725	02-03-93
EP-A-0315106	10-05-89	DE-A- 3872487	06-08-92