Urine drainage bag outlet with barrier against microbial infection

The invention relates to closed system urinary drainage bags. More specifically, the invention relates to a device placed in the outlet tube for dispensing an agent for controlling and preventing the retrograde migration of pathogenic microorganisms into the urinary drainage bag.

Urine drainage bags are routinely used by post-operative patients as well as those with urological disorders. Because of injury to the spinal cord, paraplegic patients are unable to control bladder activity and consequently must use a catheter continuously.

In practice, the patient is catheterized and the catheter then connected to the drainage bag through a length of plastic tubing. The bag is normally supported below the level of the patient either from a bed rail or other support and the urine drains by gravity from the patient through the catheter, the tubing and then into a bag via a drip chamber. The bag may be emptied from time to time by means of an outlet tube which is normally closed to prevent leakage. The tube may discharge its contents into any convenient receptacle and then the outlet tube is clamped and the bag reused for the same patient.

The catheterized urinary track is one of the most common sites of hospital-acquired infection and in fact

accounts for almost thirty percent of such infections. Significant improvements in the prevention of catheter associated infection has been by use of what are known as closed sterile drainage systems. Despite these advances, still over twenty percent of patients with indwelling catheters continue to acquire urinary infections. See Garibaldi et al, New England J. Med., 291: 215-219, 1974. Urine collection bags must be emptied at frequent intervals usually at least once every shift and the removal of bacterially contaminated urine can lead to the spread of urine infection. It is even possible for a patient in the same ward or room shared with a catheterized patient to acquire the infection. In order to minimize cross-contamination, the collected urine must be maintained in sterile condition during the collection period, even when the urine has a high bacterial count when it enters the drainage bag.

Despite the use of the most careful aseptic techniques almost fifty percent of catheterized patients develop an infection when the catheter is in place for twenty-four hours and approximately ninety-eight percent or even more develop an infection of after four days of use of such catheters. This of course is quite harmful to the patient and subjects them to the risk of cystitis and life threatening septicemia. Arch. Internal Med., Vol. 110: 703-711 (1962) and Lancet, Vol. 1,310-312 (1960). The above-

(13)

noted infections occur due to many circumstances. These include prolonged use of indwelling Foley-type catheters which are often accompanied by absence of sterile insertion and maintenance techniques; having the catheter connected to clean but not sterlized drainage collection containers; and others. The presence of urinary pathogens in the container which multiply and enter the urinary tract through the ascending catheter which is a major pathway of infection is quite important. Various attempts have been made to reduce the migration of bacteria through the closed system including the bag, the drip chamber and the tubing connected to the catheter.

The patent to Jinkens et al, No. 3,332,442 employs a connector between a catheter and a urine drainage bag for preventing movement of bacteria from the bag to the patient. The three patents of Langston et al, Nos. 4,236,517; 4,193,403; and 4,241,733 show a dispensing device which releases paraformaldehyde to control the multiplication of pathogens and prevent migration in catheters. Shaffer U.S. Patent No. 4,233,263, teaches adding of hydrogen peroxide solution periodically to a urine bag for prevention of bacterial growth. Attempts have been made to provide a one way inlet valve into the urine bag to prevent upward migration. See, for example, U.S. Patent No. 3,312,221 and 4,232,677.

Other attempts have been made to treat the catheter itself with an microbicidal substance. Note

U.S. Patent No. 3,598,127 and the Shepard et al Patents Nos. 3,566,874 and 3,695,921 which relate to an antibiotic material in a hydrophilic catheter coating.

U.S. Patent No. 4,417,892 describes a method of releasing an microbicidal substance by means of a frangible capsule which is inserted into the outlet drainage tube. The capsule must be broken by a nurse or other medical personnel in order to release the active agent.

It is well known that indwelling catheterization of patients, can lead to serious infections. In normal use of the conventional urinary drainage bag, transmission of infection via the outlet drainage tube is of major concern.

The invention provides an outlet for a urine drainage bag, comprising: an outlet tube secured to the bottom part of the urine drainage bag; and a microbicidal tube housed in the outlet tube, comprising means for storing and means for releasing one or more microbicidal substances, the releasing means being a hydrophilic polymer which in response to contact with urine swells permitting the leaching out of the microbicidal substance.

The invention also provides a method of treating the outlet tube of a urinary drainage bag to prevent passage and/or growth of microorganisms comprising the insertion of a microbicidal tube inside the outlet tube, said microbicidal tube containing at least one

microbicidal substance, and means for releasing the said at least one microbicidal substance, the releasing means being a hydrophilic polymer which in contact with urine during drainage of urine swells, permitting the said at least one microbicidal substance to leach out to act upon the present microorganisms.

The invention further provides a urinary drainage system comprising a sustained time release barrier incorporated therein, said barrier comprising means for storing and means for releasing at least one microbicidal substance, wherein the releasing means is a hydrophilic polymer which in contact with urine swells, permitting the leaching out of the at least one microbicidal substance.

The invention also provides a microbicidal tube, comprising means for storing and means for releasing one or more antimicrobial substances, wherein the releasing means is a hydrophilic polymer which in contact with urine swells, permitting the leaching out of the one or more microbial substances.

In one form of device according to the invention, a microbicidal tube or plug is inserted into a section of the outlet tube. The microbicidal tube is usually made by one of three processes. 1) A porous material, such as polypropylene is impregnated with at least one microbicidal agent. It is then coated with a hydrophilic polymer which in response to contact with urine swells, causing the leaching out of the microbicidal

substance. 2) A porous material, such as high density polyethylene is impregnated with a hydrophilic polymer and at least one microbicidal agent. 3) The microbicidal tube is made by compounding and co-extruding a polymer, such as silicone, with at least one microbicidal agent, and then coated with a hydrophilic polymer. By appropriate combination of active agents, virtually all pathogens can be effectively eliminated

and prevented from entering the urinary bag and further into the catheter.

It is possible to construct devices according to the present invention that are superior in many ways to the methods and devices previously used. They are passive dispensing systems, thus eliminating the need for human participation, such as is necessary, for example, in the breaking of an antibiotic containing capsule. They are self-activating systems which respond to the presence of body fluids, in this case, urine. The microbicidal substances are released in a timed sequence for an extended period of time, thus creating an effective barrier against migration of infectious organisms into the catheter.

The microcidal tube is easy to prepare using readily available materials and microbicidal substances. The prolonged effectiveness of the device obviates the need for frequent draining of bags, thus saving on nurse's time. The passive, self-actuating release, likewise is a labour-saving aspect of the present invention. Since the need for human handling is substantially reduced, there is less of a chance for infection due to such contact.

One form of microbicidal tube constructed in accordance with the invention, and devices incorporating it, will now be described by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a urine drainage bag and showing the outlet tube in broken apart fashion;

Fig. 2 is an enlarged cross section of the outlet tube taken along the lines 2-2 of Fig. 1; and

Fig. 3 is a perspective view of a typical microcidal tube used in the outlet tube.

Referring now to the drawings, a conventional closed system urine drainage bag is shown generally at 10 and is formed by peripherally heat sealing or otherwise securing a pair of flat vinyl or PVC sheets. The bag is provided with an inlet 11 adjacent the top thereof for reception of a conventional drip chamber 12 and its associated tubing 13 which connects to a catheter which in turn is inserted in the urethral canal of the patient. An air vent and bacterial filter 14 is conventionally provided on one face of the bag.

The bag also includes a drain 15 terminating in an outlet tube or conduit 16 which may be formed of latex or any other suitable material, and which may be clamped off when not in use in a well known manner by means of the spring pinch clamp or valve 17 which is received about the outlet tube. The free end of the outlet is received in a protective housing 18 heat sealed to one face of the urine drainage bag.

Part of the outlet tube 16 houses a microcidal tube 25. The microcidal tube is typically 1½ inches (38 mm) in length, 5.5 mm in internal diameter (I.D.),

8.5 mm in outer diameter (O.D.) and is 70% void. It is hollow inside in order to permit unimpeded urine flow. Obviously, the geometry and dimension of the microcidal tube may be varied over wide limits yet still function as a microbial barrier while permitting urine flow.

In general, the microbicidal tube is prepared by impregnating porous polymeric material with at least one microbicidal agent. Various kinds of polymeric materials can be used, but they must be crystalline and have a high melting point which will allow them to withstand exposure to body fluid temperatures without softening. Usually the tube is made by one of three methods. 1) A porous material, such as polypropylene is impregnated with at least one microbicidal agent. It is then coated with a hydrophilic polymer which in response to contact with urine swells, causing the leaching out of the microbicidal substance. 2) A porous material, such as high density polyethylene is impregnated with a hydrophilic polymer and at least one microbicidal agent. 3) The microbicidal tube is made by compounding and co-extruding a polymer, such as silicone, with at least one microbicidal agent, and then coated with a hydrophilic polymer.

Examples of hydrophilic polymers which may be used are D-3 polyethylene glycol polyurethane and Hypol 3000 polyurethane.

The solution of the additives and the polymeric material is allowed to react for a suitable length of time in the presence of solvent or solvents. The usual solvents in the preparation of the microcidal tube are ethanol and dimethyl sulfoxide. At the end of the

reaction time, the microbicidal tube is dried by conventional methods and sterilized with ethylene oxide (ETO).

The specific antimicrobial substance to be used is left to the choice of the manufacturer, however such substance must readily be compounded into polymers or adhere to the porous polymeric material which in turn will absorb the substance. The biocidal additives can be selected from a very large group of commercially available antibiotics, drugs, antiseptics, etc. Some examples of the common active agents that can be incorporated in the microcidal tube are: penicillin, tetracycline, triclosan, nalidixic acid, sulfamylon, amphotericin B, nonfloxacin, haloprogin, gentamicin, chlorhexidine, clotrimazol, tolnaftate, polymyxin, parachlorometaxylenol, pyrithione, hexachlorophene, nitrofurazone, nitrofurantoin, chlorixin and many others. Microbicidal agents may be incorporated either singly or in various combinations.

The microcidal tube may be inserted inside the outlet tube during normal manufacturing conditions and there will be no loss of the biocidal activity since the substance does not become released until it comes in contact with urine. The microcidal tube is effective for at least two weeks. During this time, it continues to release in a timed sequence, the microbicidal agents, thus creating an effective barrier against upward movement and multiplication of organisms and the

subsequent infection of the urinary tract.

The amount of drug released will depend on a number of factors, such as for example, the specific biocidal agent used, the length of time it is desired to release the drug, the dosage that is to be administered in a specific time, etc. The dosage can be controlled by varying the concentrations (or amounts) or the drug(s) and hydrophilic polymer and physical parameters such as pore size and shape of the support polymer used.

There are a number of important advantages that the microbicidal tube offers over the apparatus and methods of prior art.

Thus, the prolonged effectiveness of the microbicidal tube (two weeks at least) saves on nurses' time, for the bag need not be drained as often as it has to be, using prior art apparatus. The passive nature of the sustained drug release, activated upon contact with urine, likewise saves on the nurse's time, for there is no necessity for human participation. Moreover, this is likewise a more reliable and certain method of controlling and preventing infections then methods requiring periodic handling of apparatus. Such periodic manipulation is frequently delayed or entirely disregarded. Additionally, the less human handling that is involved, the less is there a chance for contamination from the outside, hence the decrease in an opportunity for an infection.

The following examples illustrate the invention.

Preparation of Microcidal Tube

Example 1

Batchwise compound 85% polypropylene, 10% hexachlorophene, 4% getamicin A HCl and 1% clotrimazole by weight at 196°C and, then, extrude in into a tube. A 1.0 inch (25 mm) segment of the tube is dipped into a solution of 96% ethanol and 4% D-3 polyethylene glycol polyurethane (D-3) by weight for 5 seconds, air-dried at RT for 10 minutes and oven dried at 85°C for 10 minutes.

Example 2

Batchwise compound 88% polypropylene, 6% triclosan, 4% chloroxin, and 2% tolnaftate by weight at 198°C and then extrude it into a tube (5.5 mm ID/8.5 mm OD). A 1.5 inch (38 mm) segment of the tube is dipped into a solution containing 96.5% ethanol and 3.5% D-3 by weight for 5 seconds, air-dried at RT for 10 minutes and oven-dried at 52°C for 30 minutes.

Example 3

Batchwise compound 91% polythylene, 6% nalidixic acid and 3% parachlorometaxylenol by weight at 150°C to a homogenous dispersion and extrude it into a tube (6.5 mm ID/8.5 mm OD). A 1.0 inch (25 mm) segment of the tube is dipped in a solution containing 97% ethanol and 3% D-3 by weight for 5 seconds, air-dried at RT for 10 minutes and oven-dried at 78°C for 10 minutes.

Example 4

Batchwise compound 89.8% polyethylene, 8% zinc pyrithione and 2.2% tetracycline HCl by weight at 152°C to a homogenous dispersion and extrude it into a tube (6.5 mm ID/8.5 mm OD). A 1.5 inch (38 mm) segment of it is dipped in a solution of 95% ethanol and 5% D-3 by weight for 5 seconds, air-dried at RT for 10 minutes and oven-dried at 65°C for 10 minutes.

Example 5

A segment of microporous polysulfone tube is immersed in a solution of 88.8% ethanol, 7% gentamicin A HCl, 4% D-3 polyethylene glycol polyurethane and 0.2% zinc pyrithione by weight for 10 minutes. It is then air-dried at room temperature (RT) for 10 minutes and oven-dried at 70°C for 15 minutes. The concentration of gentamicin A HCl is below its saturation point and could be raised if wanted. Zinc pyrithione, an antifugal agent, is approximately at its optimum concentration. It could be replaced by the more soluble sodium pyrithione.

Example 6

A segment of microporous polysufone tube is immersed in a solution of 79.5% ethanol, 11% tetracycline HCl, 5.3% polymyxin B HCl, 3.5% D-3 polyethylene glycol polyurethane and 0.2% zinc

pyrithione by weight for 10 minutes. It is air-dried at RT for 10 minutes and oven-dried at 68°C for 20 minutes. Both tetracycline and polymyxin are below their saturation points.

Example 7

A segment of microporous high density polyethylene tube (HDPE; pore size: 50 microns) is immersed in a solution of 50% anhydrous acetone, 40% anyhydrous ethanol, 5% gentamicine HCl, and 5% parachloro-metaxylenol by weight for 5 minutes. It is air-dried at RT for 15 minutes, dipped in 96.5% ethanol, 3.5% D-3 polyethylene glycol polyurethane by weight for 5 seconds, air-dried at RT for 10 minutes and oven-dried at 70°C for 15 minutes. Concentrations of D-3, gentamicine and parachlorometaxylenol could be increased if needed.

Example 8

A segment of microporous HDPE is immersed in a solution of 73% ethanol, 10% tetracycline HCl, 10% parachlorometaxylenol, 3.8% D-3, 2% dimethyl sufoxide (DMSO), 0.6% clotrimazol and 0.6% tolnaftate by weight for 5 minutes. It is then air-dried at RT for 10 minutes, oven-dried at 55°C for 20 minutes, and air-dried at RT for 18 hours.

Example 9

A segment of HDPE tube is immersed in a solution of 41.4% DMSO, 44.6% acetone, 10% triclosan and 4.3% chloroxine by weight for 10 minutes. It is air-dried at RT for 15 minutes, dipped into 96.5% ethanol and 3.5% D-3 by weight for 5 seconds, air-dried at RT for 10 minutes and oven-dried at 55°C for 30 minutes. Concentrations of triclosan and chloroxine could be raised substantially if needed.

Example 10

A segment of microporous polypropylene tube (5.5 mm ID/8.5 mm OD; 70% void) is immersed in a solution of 83.5% anhydrous acetone, 8% chlorhexidine acetate, 5.5% triclosan and 3% Hypol 3000 polyurethane by weight for 5 minutes. It is air-dried at RT for 5 minutes, oven-dried at 52°C for 10 minutes and air-dried at RT for 18 hours. Concentrations of chlorhexidine and triclosan can be increased if needed.

Example 11

A segment of microporous polypropylene tube is immersed in a solution containing 50% ethanol, 33% chloroform, 11% hexachlorophene, 3.8% D-3, 1% nalidixic acid, 0.6% clotrimazole and 0.6% tolnaftate by weight for 10 minutes. It is air-dried at RT for 10 minutes and oven-dried at 72°C for 25 minutes. Concentrations of clotrimazole and tolnaftate are substantially below

their saturation points in the solvent system.

Example 12

A segment of microporous polypropylene tube is immersed in a solution of 46.2% ethanol, 22% DMSO, 11% parachlorometaxylenol, 11% dichlorhexidine diacetate, 4.8% water, 4.0% D-3 and 1.0% nitrofurazone by weight for 10 minutes. It is air-dried at RT for 10 minutes, oven-dried at 68 C for 10 minutes and air-dried at RT for 18 hours. The concentration of parachlorometaxylenol could be increased if needed.

Example 13

A segment of microporous polypropylene tube is immersed in a solution containing 84% ethanol, 7.5% hexachlorophane, 5% D-3, 2.5% DMSO, 0.7% H_2O, 0.25% clotrimazole and 0.05% aminacrine by weight for 10 minutes. It is air-dried at RT for 10 minutes, oven-dried at 78°C for 20 minutes and air-dried at RT for 18 hours.

Example 14

A segment of microporous polypropylene tube is immersed in a solution of 50.5% ethanol, 31% acetone, 10% hexachlorophene, 4.3% D-3, 2.5% DMSO, 1% clotrimazole and 0.5% H_2O by weight for 10 minutes. It is air-dried at RT for 10 minutes, oven-dried at 78°C for 20 minutes, and air-dried at RT for 18 hours.

Example 15

A segment of microporous polypropylene tube is immersed in a solution containing 44.1% ethanol, 31% DMSO, 11% triclosan, 9% hexachlorophene, 3.4% D-3, 1.0% clotrimazole, and 0.5% nitrofurazone by weight for 10 minutes. It is air-dried at RT for 15 minutes, oven-dried at 52°C for 30 minutes and air-dried at RT for 18 hours. Concentration of triclosan, hexachlorophene and clotrimazole could be increased if needed.

The foregoing preparations of microbicidal tubes were effective in maintaining sterility for 17 to 21 days upon exposure to urine.

* C L M S *

What we claim is:-

1. An outlet for a urine drainage bag, comprising: an outlet tube secured to the bottom part of the urine drainage bag; and a microbicidal tube housed in the outlet tube, comprising means for storing and means for releasing one or more microbicidal substances, the releasing means being a hydrophilic polymer which in response to contact with urine swells permitting the leaching out of the microbicidal substance.

2. An outlet according to claim 1, wherein the means of storing the microbicidal substance/s is a porous polypropylene material.

3. An outlet according to claim 1 or claim 2, wherein the hydrophilic polymer is D-3 polyethylene glycol polyurethane.

4. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are hexachlorophene, gentamycin and clotrimazol.

5. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are triclosan, chloroxin and tolnaftate.

6. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are nalidixic acid and parachlorometaxylenol.

7. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are zinc pyrithione and tetracycline.

8. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are gentamicin and zinc pyrithione.

9. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are tetracycline polymyxin and zinc pyrithione.

10. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are gentamycin and parachlorometaxylenol.

11. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are tetracycline, parachlorometaxylenol, clotrimazol and tolnaftate.

12. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are triclosan and chloroxin.

13. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are chlorhexidine and triclosan.

14. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are chloroform, hexachlorophene, nalidixic acid, clotrimazol and tolnaftate.

15. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are parachlorometaxylenol, chlorhexidine and nitrofurazone.

16. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are hexachloro-

phene, clotrimazol and aminacrine.

17. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are hexachlorophene and clotrimazol.

18. An outlet according to any one of claims 1 to 3, wherein the microbicidal substances are triclosan, hexachlorophene, clotrimazole and nitrofurazan.

19. A method of treating the outlet tube of a urinary drainage bag to prevent passage and/or growth of microorganisms comprising the insertion of a microbicidal tube inside the outlet tube, said microbicidal tube containing at least one microbicidal substance, and means for releasing the said at least one microbicidal substance, the releasing means being a hydrophilic polymer which in contact with urine during drainage of urine swells, permitting the said at least one microbicidal substance to leach out to act upon the present microorganisms.

20. A urinary drainage system comprising a sustained time release barrier incorporated therein, said barrier comprising means for storing and means for releasing at least one microbicidal substance, wherein the releasing means is a hydrophilic polymer which in contact with urine swells, permitting the leaching out of the at least one microbicidal substance.

21. A urinary drainage system according to claim 20, wherein the means of storing the microbicidal substance/s is a porous polypropylene material.

22. A urinary drainage system according to claim 20 or claim 21, wherein the hydrophilic polymer is D-3 polyethylene glycol polyurethane.

23. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are hexachlorophene, gentamycin and clotrimazole.

24. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are triclosan, chloroxin and tolnaftate.

25. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are nalidixic acid and parachlorometaxylenol.

26. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are zinc pyrithione and tetracycline.

27. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are gentamycin and zinc pyrithione.

28. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are tetracycline, polymyxin and zinc pyrithione.

29. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are gentamycin and parachlorometaxylenol.

30. A urinary drainage system according to any

* C L M S *

one of claims 20 to 22, wherein the microbicidal substances are tetracycline, parachlorometaxylenol, clotrimazol and tolnaftate.

31. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are triclosan and chloroxin.

32. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are chlordexidine and triclosan.

33. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are chloroform, hexachlorophene, nalidixic acid, clotrimazol and tolnaftate.

34. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are parachlorometaxylenol, chlorhexidine and nitrofurazone.

35. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are hexachlorophene, clotrimazol and aminacrine.

36. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are hexachlorophene, and clotrimazol.

37. A urinary drainage system according to any one of claims 20 to 22, wherein the microbicidal substances are triclosan, hexachlorophene, clotrimazole and nitrofurazone.

38. A microbicidal tube, comprising means for storing and means for releasing one or more microbicidal substances, wherein the releasing means is a hydrophilic polymer which in contact with urine swells, permitting the leaching out of the one or more microbicidal substances.

39. A microbicidal tube according to claim 38, wherein the means of storing the microbicidal substance/s is a porous polypropylene material.

40. A microbicidal tube according to claim 38 or claim 39, wherein the hydrophilic polymer is D-3 polyethylene glycol polyurethane.

41. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are hexachlorophene, gentamycin and clotrimazol.

42. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are triclosan, chloroxin and tolnaftate.

43. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are nalidixic acid and parachlorometaxylenol.

44. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are zinc pyrithione and tetracycline.

45. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are gentamycin and zinc pyrithione.

46. A microbicidal tube according to any one of

* C L M S *

claims 38 to 40, wherein the microbicidal substances are tetracycline, polymyxin and zinc pyrithione.

47. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are gentamycin and parachlorometaxylenol.

48. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are tetracycline, parachlorometaxylenol, clotrimazol and tolnaftate.

49. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are triclosan and chloroxin.

50. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are chlorhexidine and triclosan.

51. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are chloroform, hexachlorophene, nalidixic acid, clotrimazol and tolnaftate.

52. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are parachlorometaxylenol, chlorhexidine and nitrofurazone.

53. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are hexachlorophene, clotrimazol and aminacrine.

54. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances

are hexachlorophene and clotrimazol.

55. A microbicidal tube according to any one of claims 38 to 40, wherein the microbicidal substances are triclosan, hexachlorophene, clotrimazole and nitrofurazan.

56. A microbicidal tube substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

57. A microbicidal tube substantially as described in any of the examples.

58. An outlet as claimed in claim 1, including a microbicidal tube as claimed in any one of claims 38 to 57.

59. A urinary drainage system as claimed in claim 20, including an outlet as claimed in any one of claims 1 to 18 or a microbicidal tube as claimed in any one of claims 38 to 57.

60. A urinary drainage system substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.