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(54) Title: METHOD OF LIMITING THE SPREAD OF NOROVIRUS WITHIN A CRUISE SHIP

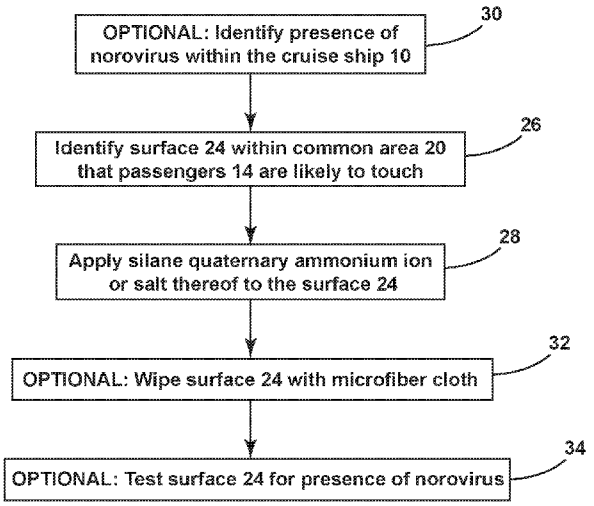


FIG. 8

(57) Abstract: A method of limiting the spread of the norovirus within a cruise ship comprising: identifying a surface within a common area of a cruise ship that passengers are likely to touch; and applying a silane quaternary ammonium ion or salt thereof to the surface. The common area can be an elevator and the surface an elevator button. The common area can be a stairway and the surface a handrail. The common area can be a casino. The common area can be a dining room. The common area can be a walkway and the surface a handrail. The silane quaternary ammonium ion or salt thereof can be 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium ion, 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride, 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium ion, or 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium chloride. Applying the silane quaternary ammonium ion or salt thereof to the surface comprises applying a solution including the silane quaternary ammonium ion or salt thereof and a solvent.

WO 2019/092563 A1

[Continued on next page]

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

METHOD OF LIMITING THE SPREAD OF NOROVIRUS WITHIN A CRUISE SHIP

BACKGROUND OF THE INVENTION

[0001] The norovirus is a virus that causes gastroenteritis. Gastroenteritis is the inflammation of the gastrointestinal tract, which includes the stomach and the small intestine. Symptoms of gastroenteritis include stomach pain, diarrhea, and vomiting. Norovirus spreads very quickly and easily, including by touching objects that have the norovirus present.

[0002] According to the United States Centers for Disease Control and Prevention (CDC), the number of outbreaks of gastroenteritis on cruise ships has increased since 2001, because of increased presence of the norovirus. The CDC even has implemented a Vessel Sanitation Program (VSP) to help cruise ships curtail outbreaks of gastroenteritis. Despite this effort, twelve cruise ships reported an outbreak of gastroenteritis caused by the norovirus in 2015. Eleven cruise ships similarly reported in 2016.

[0003] After some outbreaks, the cruise ship may undertake extensive cleaning and disinfecting. The cruise ship owners bear the cost of the cleaning and disinfecting as well as the down time.

SUMMARY OF THE INVENTION

[0004] According to an aspect of the present invention, a method of limiting the spread of norovirus within a cruise ship comprises: identifying a surface within a common area of a cruise ship that passengers are likely to touch; and applying a silane quaternary ammonium ion or salt thereof to the surface.

[0005] Embodiments of the first aspect of the invention can include any one or a combination of the following features:

- the method further comprises identifying the presence of the norovirus within the cruise ship;
- the method further comprises wiping the surface with a microfiber cloth;
- the method further comprises testing the surface for the presence of the norovirus;
- the common area is an elevator and the surface is an elevator button;

- the common area is a stairway and the surface is a handrail;
- the common area is a casino;
- the common area is a dining room;
- the common area is a walkway and the surface is a handrail;
- the silane quaternary ammonium ion or salt is 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium ion, 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride, 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium ion, or 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium chloride;
- applying a silane quaternary ammonium ion or salt thereof to the surface comprises applying, to the surface, a solution including the silane quaternary ammonium ion or salt thereof and a solvent;
- the solvent is isopropyl alcohol;
- the solution is applied via spraying the solution onto the surface with an electrostatic sprayer;
- the silane quaternary ammonium ion or salt thereof is between 0.1 percent and 10 percent by weight of the solution;
- the silane quaternary ammonium ion or salt thereof is between 0.75 percent and 5 percent by weight of the solution;
- the silane quaternary ammonium ion or salt thereof is between 1.9 percent and 2.1 percent by weight of the solution;
- the solvent is isopropyl alcohol and the isopropyl alcohol is between 30 percent to 90 percent by weight of the solution;
- the isopropyl alcohol is between 55 percent and 65 percent by weight of the solution;
- the method further comprises initially identifying the presence of the norovirus within the cruise ship, after spraying the solution onto the surface, wiping the surface with a microfiber cloth, and after wiping the surface with a microfiber cloth, waiting a preset period of time, and testing the surface for the presence of the norovirus.

[0006] These and other features, advantages, and objects of the present invention will be further understood and appreciated by those skilled in the art by reference to the following specification, claims, and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the drawings:

[0008] FIG. 1 is a perspective view of a cruise ship, illustrating numerous decks above a hull and passengers being transported over a body of water;

[0009] FIG. 2 is a perspective view of an elevator lobby common area and elevator buttons acting as surfaces which passengers are likely to touch;

[0010] FIG. 3 is a perspective view of several stairways acting as common areas and handrails acting as surfaces which passengers are likely to touch;

[0011] FIG. 4 is a perspective view of a casino acting as a common area for passengers and slot machine buttons acting as surfaces which passengers are likely to touch;

[0012] FIG. 5 is a perspective view of a dining room acting as a common area for passengers and dining table tops acting as surfaces which passengers are likely to touch;

[0013] FIG. 6 is a perspective view of a walkway common area and handrails acting as surfaces which passengers are likely to touch;

[0014] FIG. 7 is a perspective view of elevator buttons within an elevator accessible from the elevator lobby acting as surfaces which passengers are likely to touch; and

[0015] FIG. 8 is a flow chart illustrating a method of limiting the spread of norovirus within a cruise ship, including applying a quaternary ammonium ion or salt thereof to the surface of the common areas which passengers are likely to touch.

DETAILED DESCRIPTION

[0016] Referring now to FIGS. 1-7, a cruise ship 10 includes a hull 12 configured to float on, and transport passengers 14 over, a body of water 16. The cruise ship 10 further includes one or more decks 18 within and/or above the hull 12.

[0017] The cruise ship 10 further includes one or more common areas 20, which are areas that the passengers 14 are allowed to access, on the one or more decks 18. The common areas 20 include, without limitation, an elevator lobby 20a (see FIG. 2) with elevators 22 transporting passengers 14 between the one or more decks 18, stairways

20b (see FIG. 3) on which passengers 14 can move between the one or more decks 18, a casino 20c (see FIG. 4), a dining room 20d (see FIG. 5), and a walkway 20e upon which passengers 14 walk (see FIG. 6), among other areas. The common areas 20 include surfaces 24 that the passengers 14 are likely to touch with their hands and thus constitute surfaces 24 where the norovirus can transfer from passenger 14 to passenger 14. Examples of such surfaces 24 in the common areas 20 that passengers 14 are likely to touch, include, without limitation: elevator buttons 24a in the elevator lobby 20a (see FIG. 2) and in the elevators 22 (see FIG. 7); handrails 24b for the stairways 20b (see FIG. 3); slot machine screens 24c, buttons 24d, and levers 24e, gaming table tops 24f, and seatbacks 24g in the casino 20c (see FIG. 4); railings 24h, seatbacks 24g, dining table tops 24i, and place settings 24j in the dining room 20d (see FIG. 5); and handrails 24b in the walkway 20e (see FIG. 6).

[0018] Referring now to FIG. 8, at step 26, a method of limiting the spread of norovirus within the cruise ship 10 comprises identifying a surface 24 within a common area 20 of a cruise ship 10 that passengers 14 are likely to touch. Examples of such surfaces 24 in such common areas 20 are provided above. A common area 20 could include any area to which many or all of the passengers 14 have access.

[0019] The method further includes, at step 28, applying a silane quaternary ammonium ion or salt thereof to the surfaces 24. Preferred silane quaternary ammonium ions or salts thereof include 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium ion, 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride, 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium ion, or 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium chloride.

[0020] Applying the silane quaternary ammonium ion or salt thereof to the surface can made by applying, to the surface 24, a solution including the silane quaternary ammonium ion or salt thereof and a solvent. The solvent can be isopropyl alcohol, among others. The silane quaternary ammonium ion or salt thereof can comprise between 0.1 percent and 10 percent by weight of the solution. More preferably, the silane quaternary ammonium ion or salt thereof can comprise between 0.75 percent and 5 percent by weight of the solution. Even more preferably, the silane quaternary ammonium ion or salt thereof can comprise between 1.9 percent and 2.1 percent by weight of the solution. As for the isopropyl alcohol, the isopropyl alcohol can comprise

between 30 percent to 90 percent by weight of the solution. More preferably, the isopropyl alcohol can comprise between 55 percent and 65 percent by weight of the solution. An example preferable solution comprises (by weight) 60.0 percent isopropyl alcohol, 2.02 percent 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride, and 34.19 percent deionized water.

[0021] The solution can be applied via spraying the solution containing the silane quaternary ammonium ion or salt thereof and the solvent with an electrostatic sprayer. Alternatively, the solution can be applied with a wipe soaked with the solvent, a spray bottle containing the solvent, and other means.

[0022] Quaternary ammonium compounds are generally thought to be ineffective in destroying non-enveloped viruses. The norovirus is a non-enveloped virus. Surprisingly, testing performed pursuant to ASTM E1053 has shown that a solution including 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride as the active ingredient was an effective virucidal solution against a norovirus-like virus. Because of difficulties in propagating norovirus, surrogate viruses which are able to be propagated in cell cultures have been discovered and used for testing purposes. The virus selected for the test was Bacteriophage MS2, which is a virus that infects *Escherichia coli*, and is an accepted surrogate virus for norovirus. Like norovirus, Bacteriophage MS2 is a non-enveloped virus.

[0023] For the testing, Petri dish carriers (a sufficient number for both test and control) were presented. The test Petri dish carriers were then sprayed five times with the solution including 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride as the active ingredient. The test Petri dish carriers were sprayed at a distance of between eight and ten inches and at an angle of 45 degrees. The solution was shaken before being sprayed. The test Petri dish carries with the solution applied thereon were then allowed to dry for fifty-eight minutes. The control Petri dish carriers were not sprayed with the solution including 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride as the active ingredient.

[0024] Both the test and control Petri dish carriers were then inoculated with the Bacteriophage MS2 virus. Specifically, the carriers were inoculated with 0.2 ml of the virus, which was spread of the entire surface area of the carrier (10-in^2). At time zero,

the PFU/Carrier for the control carrier was measured at 9.25E+ 06. The carriers were then held for twenty-four hours.

[0025] Both the test and control carriers were neutralized and the level of the Bacteriophage MS2 virus remaining in each was determined. After the 24 hours holding time, the PFU/Carrier for the control carrier was 1.43E+ 06, and the PFU/Carrier for the test carrier was 2.95E+ 04. Thus, the $\log_{10}$ reduction compared to time zero was 0.81 for the control and 2.50 for the test (the carrier sprayed with the solution containing 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride as the active ingredient). The percent reduction compared to time zero was 84.6 percent for the control and 99.7 percent for the test. The $\log_{10}$ reduction for the test compared to the control was 1.68. The percent reduction for the test compared to the control was 97.9 percent. This testing surprisingly demonstrated that the solution containing 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride as the active ingredient satisfied the criteria for passing ASTM E1053, because a greater than 3-$\log_{10}$ reduction was observed in the test carrier compared to the control carrier.

[0026] The method can optionally further include, at step 30, identifying the presence of the norovirus within the cruise ship 10. Applying a silane quaternary ammonium ion or salt thereof to the surface 24 set forth above, to limit the spread of the norovirus within a cruise ship 10, can be performed either before the presence of the norovirus has been identified (as a preventative measure) or after the presence of norovirus has been identified (as a consequential measure to limit the spread of the norovirus and to reduce the amount of norovirus within the cruise ship to acceptable levels). The presence of the norovirus can be identified, for example, after an outbreak of sickness on the cruise ship 10. Documenting the existence of gastroenteritis among numerous passengers 14 of the cruise ship can give rise to the assumed identification of the norovirus within the cruise ship 10.

[0027] The method can optionally further include, at step 32, wiping the surface 24 with a microfiber cloth. If the solution including the silane quaternary ammonium ion or salt thereof has been applied to the surface 24 via spraying, then beads of the solution may develop on the surface 24. Wiping the surface 24 with a microfiber cloth spreads the solution and therefore the silane quaternary ammonium ion or salt thereof over the surface 24 more uniformly.

[0028] The method can optionally further include, at step 34, testing the surface 24 for the presence of the norovirus. After the solution including the silane quaternary ammonium ion or salt thereof has been applied to the surface 24, and after waiting a preset time (such as 24 hours), the surface 24 can be tested for the presence of the norovirus. Such testing can confirm that the silane quaternary ammonium ion or salt thereof applied to the surface 24 has effectively eliminated the norovirus from the surface 24. Alternatively, such testing can confirm whether another application of the silane quaternary ammonium ion or salt thereof to the surface 24 may be required to effectively eliminate the norovirus from the surface 24.

CLAIM(S)

The invention claimed is:

1. A method of limiting the spread of norovirus within a cruise ship comprising:

identifying a surface within a common area of a cruise ship that passengers are likely to touch; and

applying a silane quaternary ammonium ion or salt thereof to the surface.

2. The method of claim 1 further comprising:

identifying presence of norovirus within the cruise ship.

3. The method of any one of claims 1 or 2 further comprising:

wiping the surface with a microfiber cloth.

4. The method of any one of claims 1-3 further comprising:

testing the surface for presence of the norovirus.

5. The method of any one of claims 1-4, wherein the common area is an elevator and the surface is an elevator button.

6. The method of any one of claims 1-4, wherein the common area is a stairway and the surface is a handrail.

7. The method of any one of claims 1-4, wherein the common area is a casino.

8. The method of any one of claims 1-4, wherein the common area is a dining room.

9. The method of any one of claims 1-4, wherein the common area is a walkway and the surface is a handrail.

10. The method of any one of claims 1-9, wherein the silane quaternary ammonium ion or salt is 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium ion, 3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride, 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium ion, or 3-(trihydroxysilyl)propyldimethyloctadecyl ammonium chloride.

11. The method of claim 10, wherein applying a silane quaternary ammonium ion or salt thereof to the surface comprises:

applying, to the surface, a solution comprising: the silane quaternary ammonium ion or salt thereof; and a solvent.

12. The method of claim 11, wherein the solvent is isopropyl alcohol.

13. The method of any one of claims 11-12, wherein the solution is applied via spraying the solution onto the surface with an electrostatic sprayer.

14. The method of any one of claims 11-13 wherein the silane quaternary ammonium ion or salt thereof is between 0.1 percent and 10 percent by weight of the solution.

15. The method of any one of claims 11-14, wherein the silane quaternary ammonium ion or salt thereof is between 0.75 percent and 5 percent by weight of the solution.

16. The method of any one of claims 11-15, wherein the silane quaternary ammonium ion or salt thereof is between 1.9 percent and 2.1 percent by weight of the solution.

17. The method of any one of claims 11-16, wherein the solvent is isopropyl alcohol and the isopropyl alcohol is between 30 percent to 90 percent by weight of the solution.

18. The method of any one of claims 11-17, wherein the isopropyl alcohol is between 55 percent and 65 percent by weight of the solution.

19. The method of any one of claims 1-9,

wherein applying a silane quaternary ammonium ion or salt thereof to the surface comprises:

applying, via spraying onto the surface with an electrostatic sprayer, a solution comprising:

between 0.1 percent and 10 percent by weight

3-(trimethoxysilyl)propyldimethyloctadecyl ammonium ion or

3-(trimethoxysilyl)propyldimethyloctadecyl ammonium chloride; and

between 30 percent to 90 percent by weight isopropyl alcohol.

20. The method of claim 19 further comprising:

initially identifying presence of norovirus within the cruise ship;

after spraying the solution onto the surface, wiping the surface with a microfiber cloth; and

after wiping the surface with a microfiber cloth, waiting a preset period of time, and testing the surface for the presence of the norovirus;

wherein, the common area is one of an elevator, a stairway, a casino, a dining room, or a walkway.

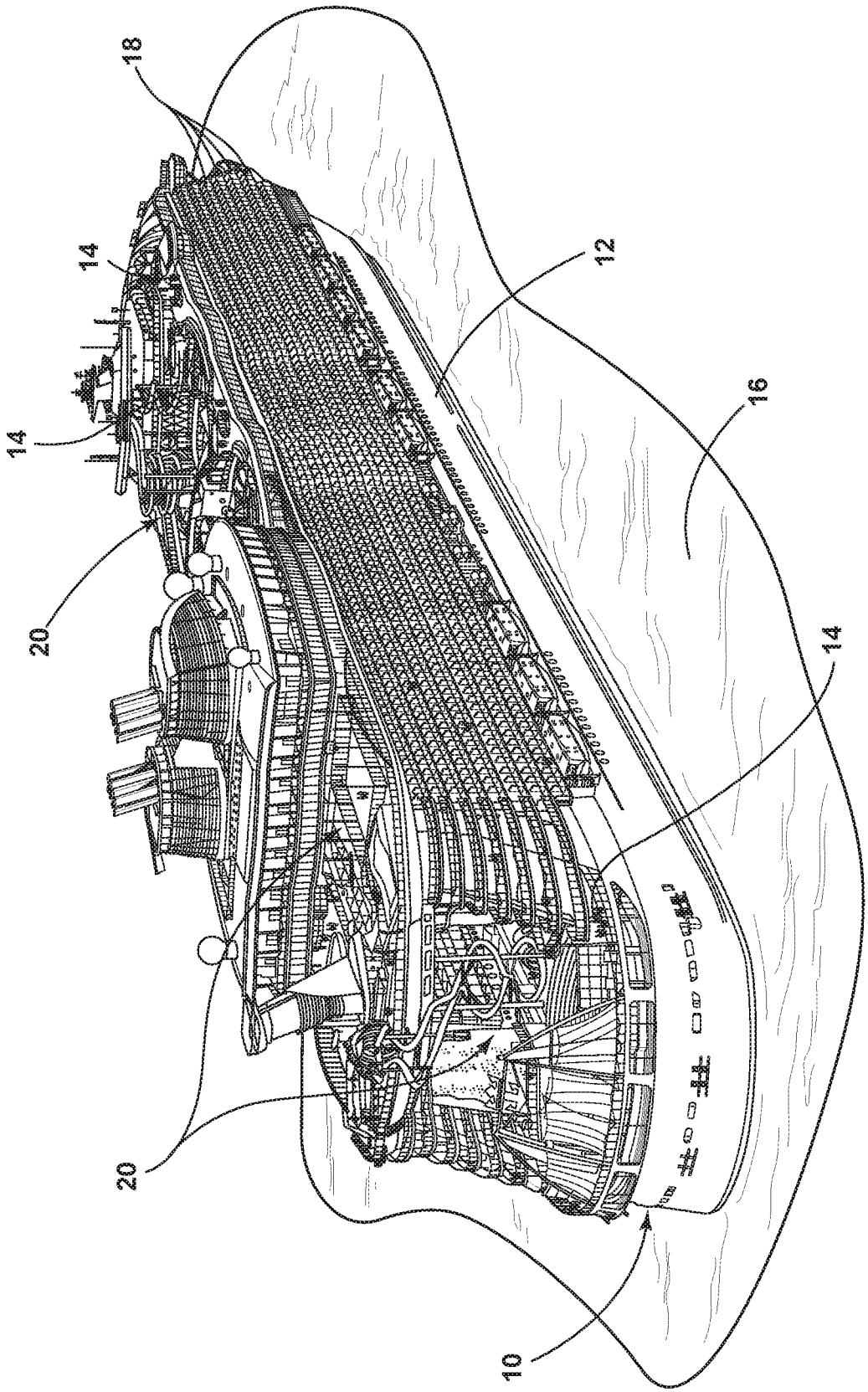


FIG. 1

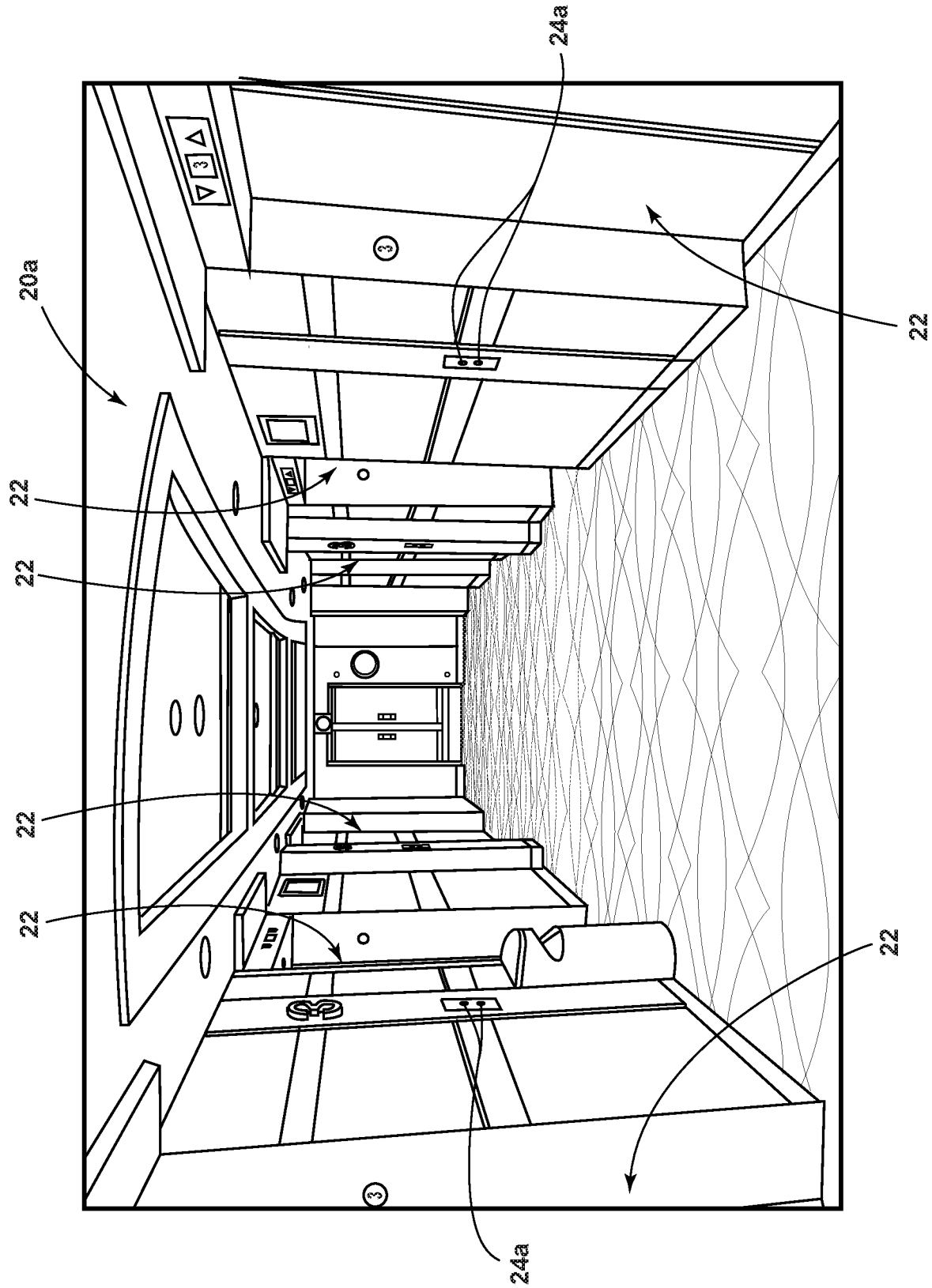


FIG. 2

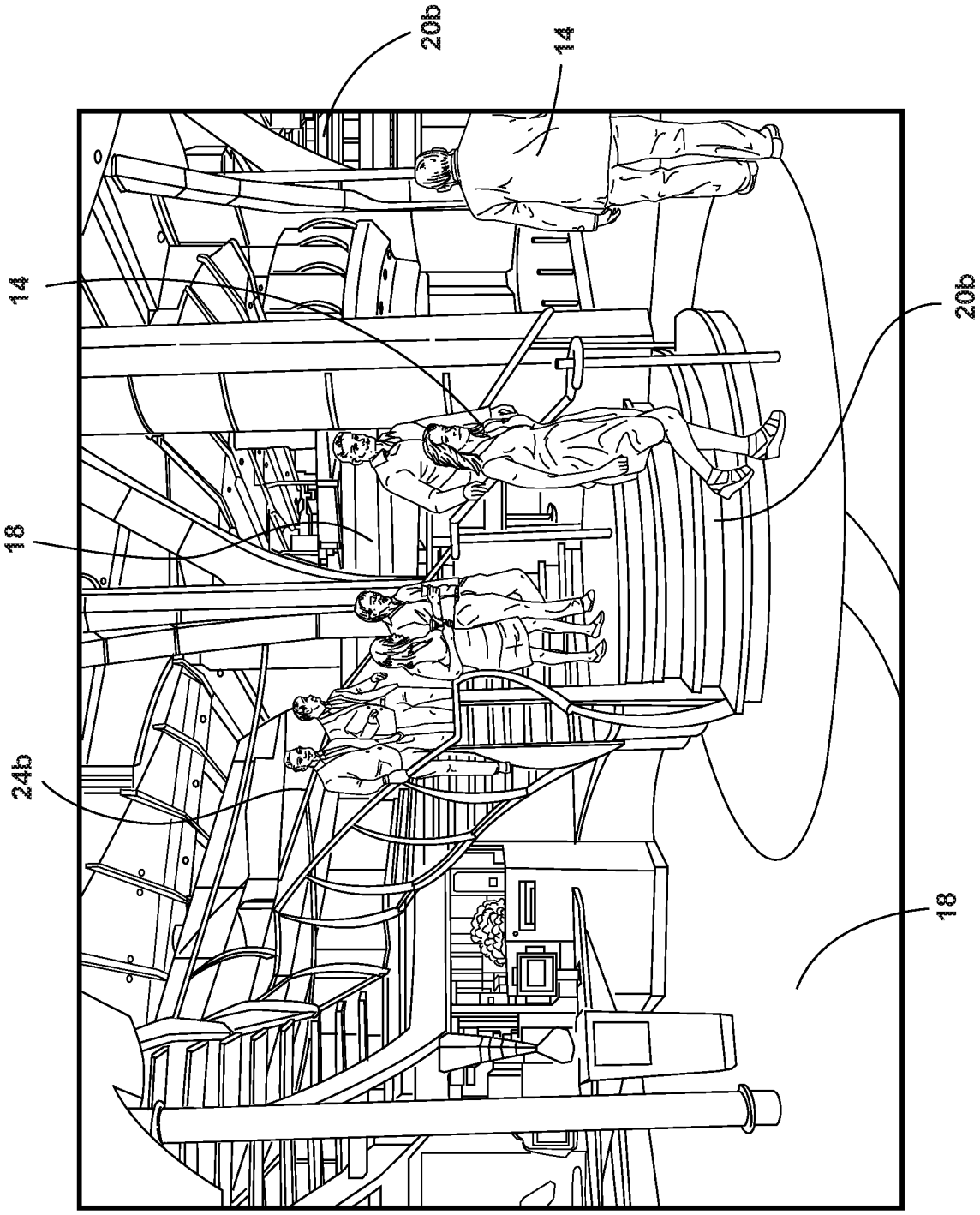


FIG. 3

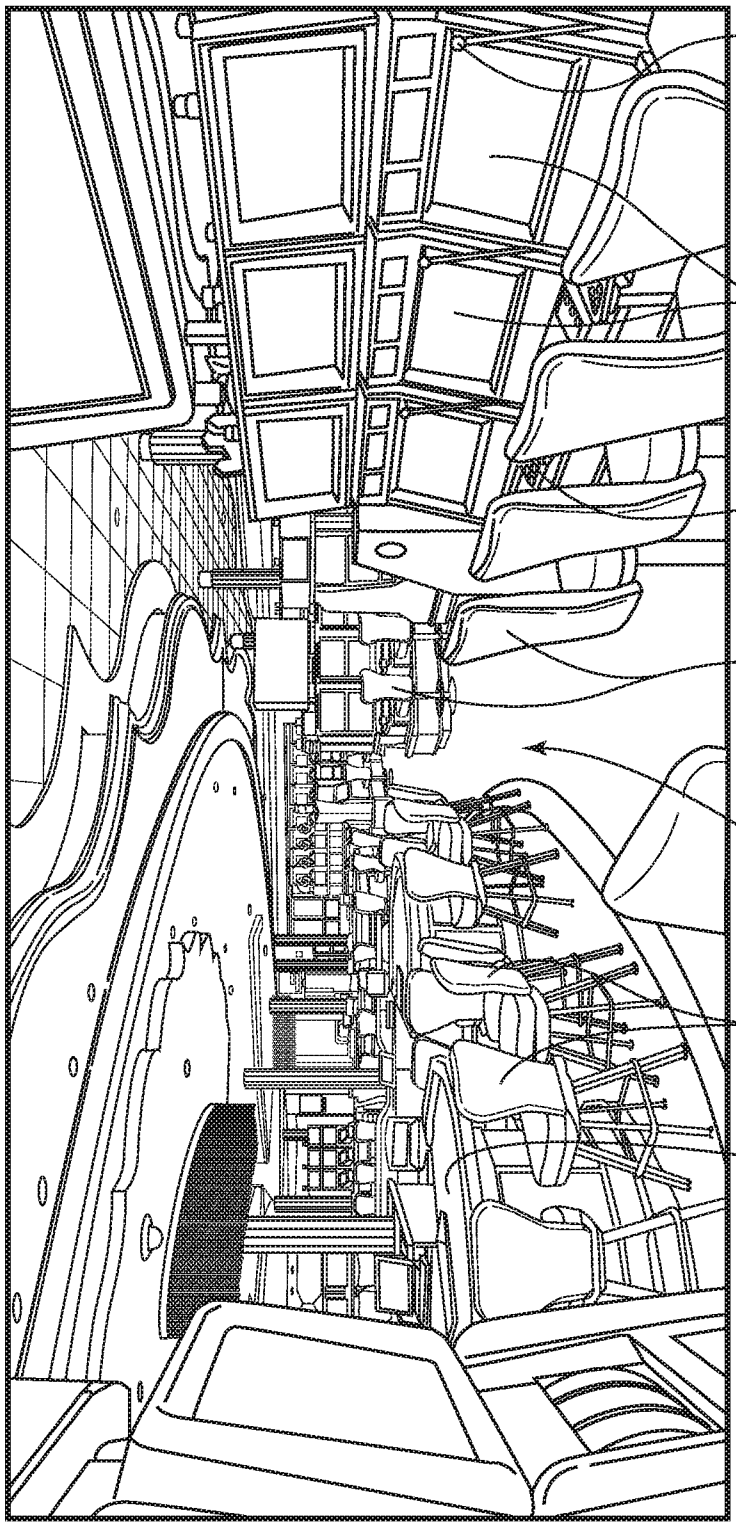


FIG. 4

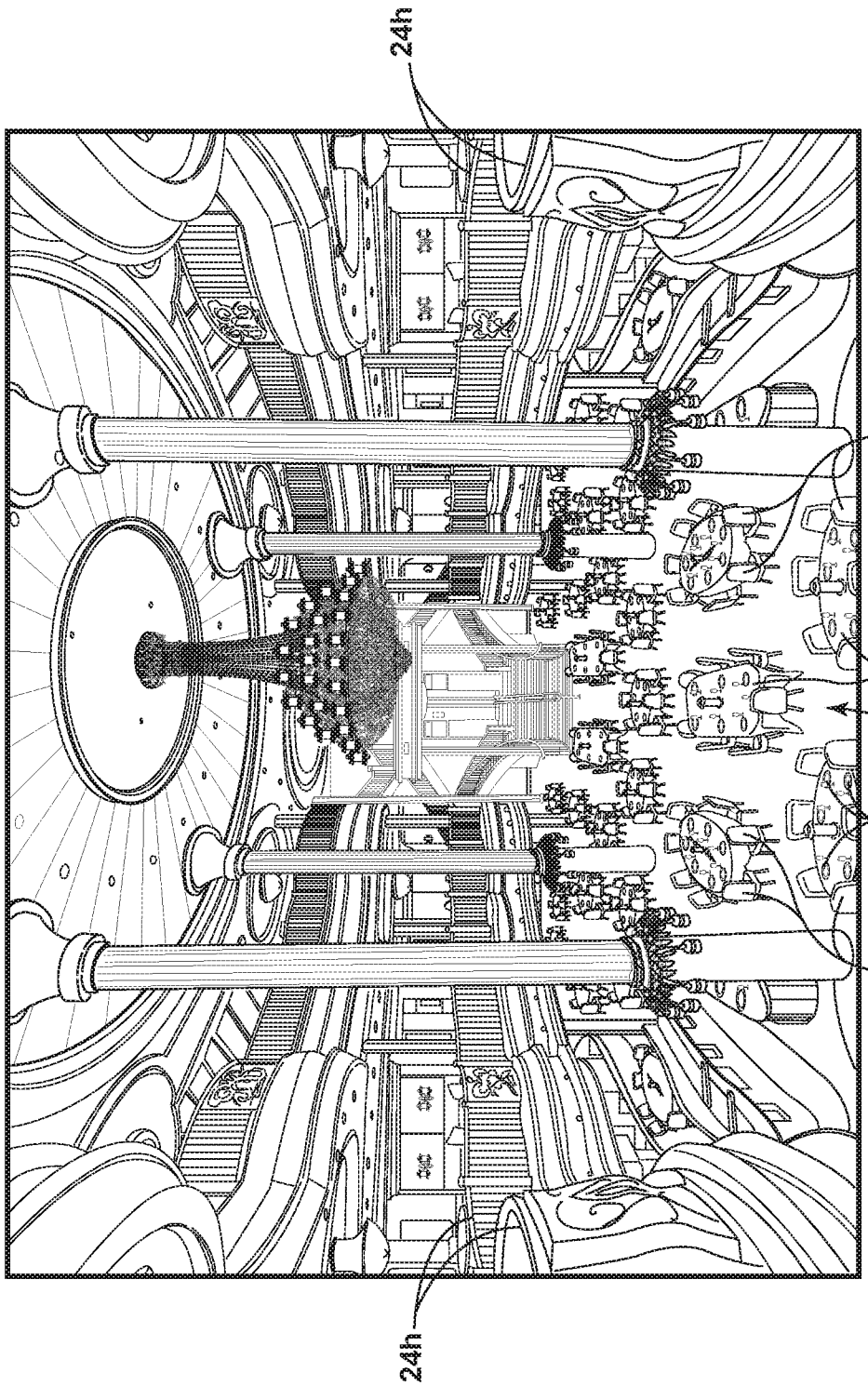


FIG. 5

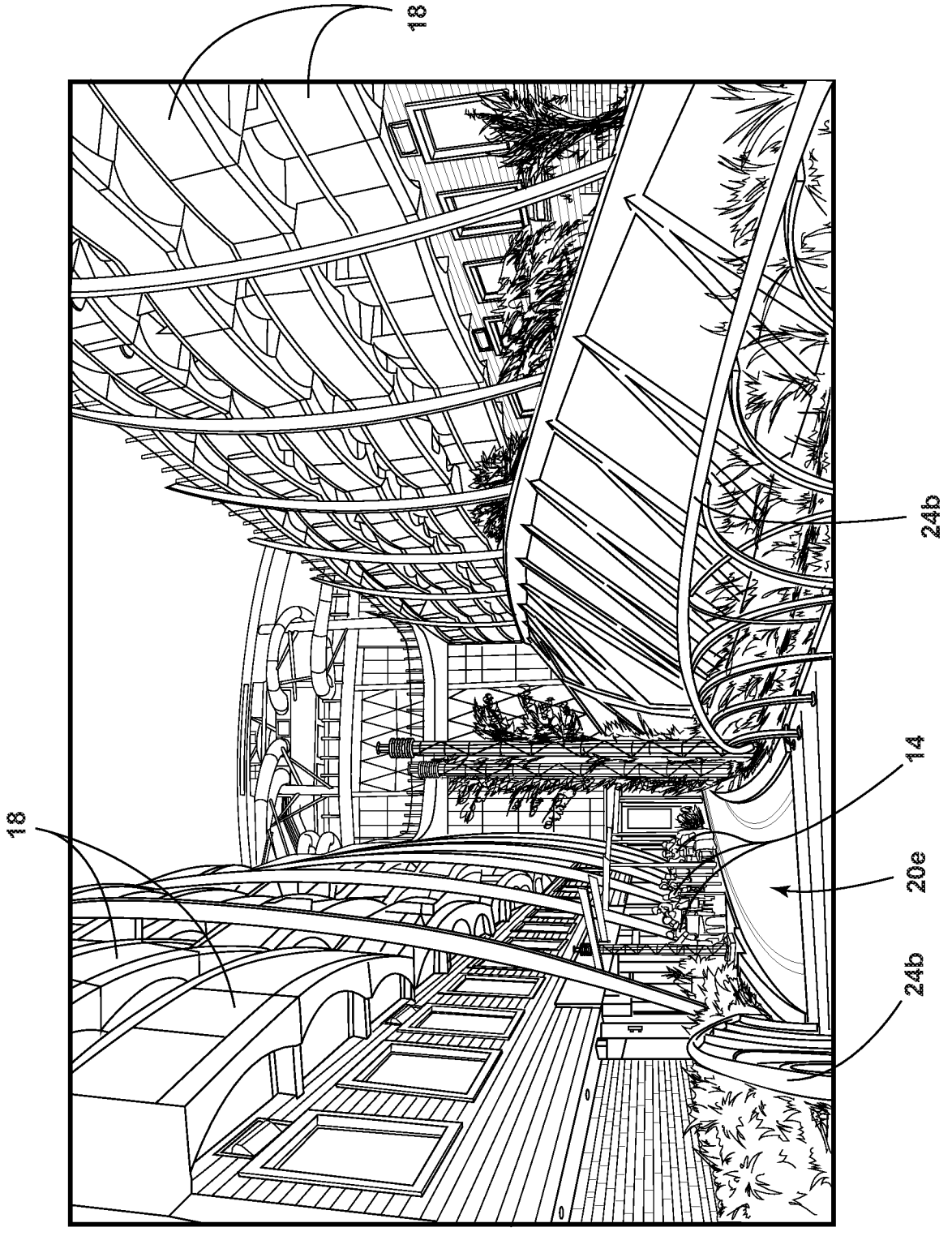


FIG. 6

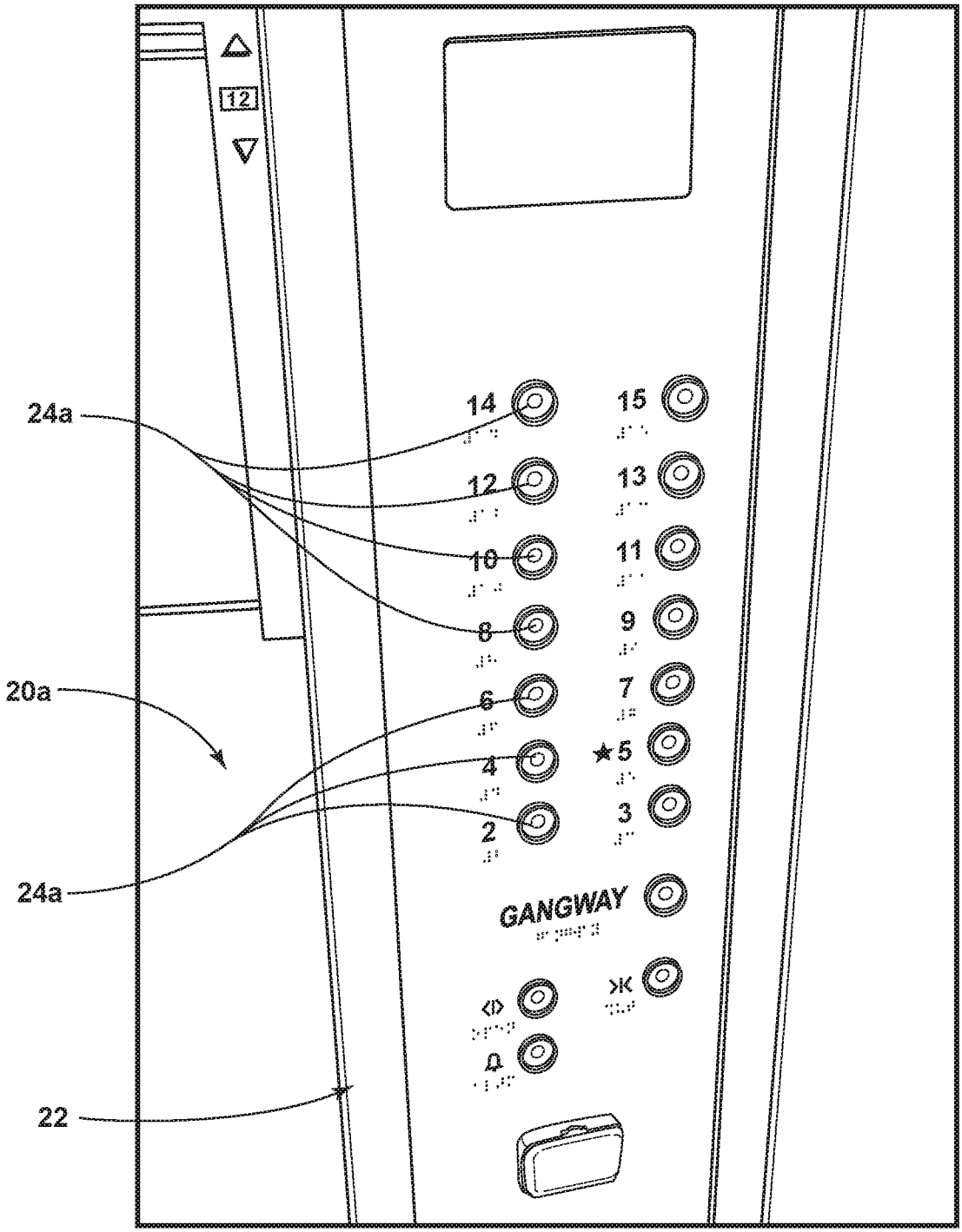


FIG. 7

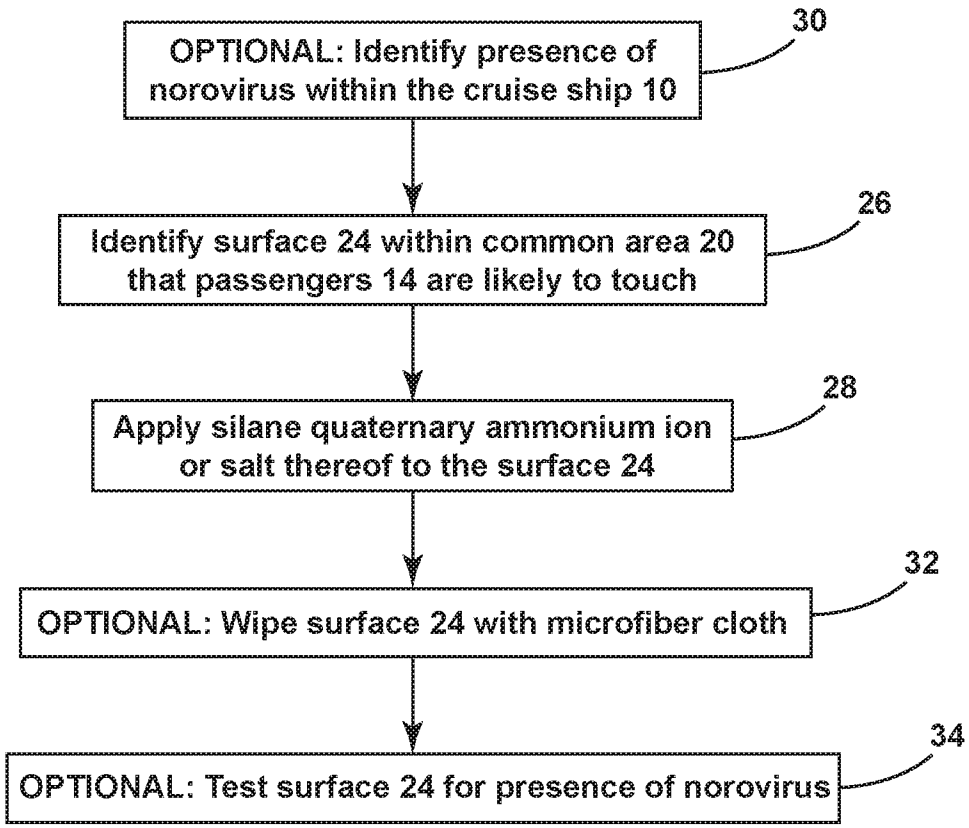

OPTIONAL: Identify presence of norovirus within the cruise ship 10
30
Identify surface 24 within common area 20 that passengers 14 are likely to touch
26
Apply silane quaternary ammonium ion or salt thereof to the surface 24
28
OPTIONAL: Wipe surface 24 with microfiber cloth
32
OPTIONAL: Test surface 24 for presence of norovirus
34

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 2018/058595

A. CLASSIFICATION OF SUBJECT MATTER

A61L 2/16 *(2006.01)*
A61L 101/46 (2006.01)
A61L 101/32 (2006.01)

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)

A61L 2/16, 9/14, 101/32, 101/46

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 practicable, search terms used)

PatSearch, esp@cenet, USPTO, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Guide to marine sanitation - Third Edition, World Health Organization (Руководство по судовой санитарии - Третье издание, Всемирная организация Здравоохранения), 2013, pages 90, 147-149	1-3
Y	WO 2016/130837 A1 (ALLIED BIOSCIENCE, INC.) 18.08.2016, claims, abstract, paragraphs [0008], [00012]-[00017], [00020]-[00026], [00042], [00043], [00046], [00081], [00094]	1-3
A	RU 2540478 C1 (OBSCHESTVO S OGRANICHENNOY OTVETSTVENNOSTIYU "URALSKIY TSENTR NANOTEKHNOLOGIY") 10.02.2015	1-3

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 December 2018 (03.12.2018)	24 January 2019 (24.01.2019)

Name and mailing address of the ISA/RU:
Federal Institute of Industrial Property,
Berezhkovskaya nab., 30-1, Moscow, G-59,
GSP-3, Russia, 125993
Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 2018/058595

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 2599004 C1 (FEDERALNOE GOSUDARSTVENNOE BYUDZHETNOE UCHREZHDENIE "48 TSENTRALNY NAUCHNO-ISSLEDOVATELSKIY INSTITUT" MINISTERSTVA OBORONY ROSSIYSKOY FEDERATSII) 10.10.2016	1-3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 2018/058595

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.: 4-20
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:

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 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.:

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.