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(54) **ELECTRIC DUST COLLECTOR**

(57) There is provided an electric dust collector including a trap unit that has a bottom plate on which a particle matter contained in an exhaust gas is accumulated and that is provided with a plurality of first slits in the bottom plate; and a propagation unit that has an in-

ternal space through which a microwave propagates, in which the plurality of first slits are arranged at positions overlapping the internal space in a top plan view, and the microwave propagates from the internal space to the trap unit through the plurality of first slits.

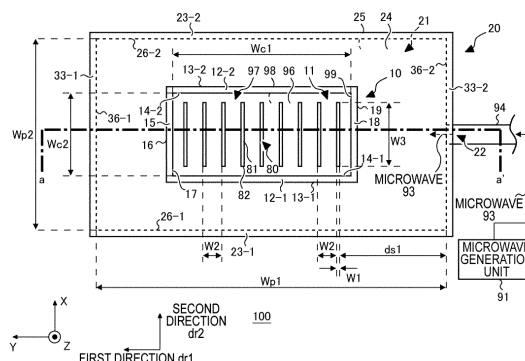


FIG. 3

Description

BACKGROUND

1. TECHNICAL FIELD

[0001] The present invention relates to an electric dust collector.

2. RELATED ART

[0002] Patent Document 1 discloses that "there is provided an electric dust collector comprising: a dust collection unit that traps charged particles; and a microwave generation unit that generates a microwave to be introduced into the dust collection unit and combusts the charged particles trapped in the dust collection unit by the microwave".

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0003] Patent Document 1: International Publication No. WO 2020/084934

TECHNICAL PROBLEM

[0004] When a particle matter contained in an exhaust gas is combusted by a microwave, it is desirable to enhance an energy efficiency of the microwave.

GENERAL DISCLOSURE

[0005] A first aspect of the present invention provides an electric dust collector. The electric dust collector includes a trap unit that has a bottom plate on which a particle matter contained in an exhaust gas is accumulated and that is provided with a plurality of first slits in the bottom plate; and a propagation unit that has an internal space through which a microwave propagates. The plurality of first slits are arranged at positions overlapping the internal space in a top plan view. The microwave propagates from the internal space to the trap unit through the plurality of first slits.

[0006] The electric dust collector may further include: a charging unit configured to charge the particle matter; and a dust collection unit configured to collect the particle matter charged by the charging unit. The trap unit may be arranged below the dust collection unit. The particle matter collected by the dust collection unit may be accumulated on the bottom plate.

[0007] The propagation unit may have a first microwave introduction port provided to be away from the plurality of first slits by a predetermined distance, in a first direction which is an in-plane direction of the bottom plate and which is a direction intersecting long sides of the plurality of first slits. The microwave may be introduced

into the internal space through the first microwave introduction port. The larger a distance from the first microwave introduction port to one first slit among the plurality of first slits in the first direction, the larger a width of each of the plurality of first slits in the first direction may be.

[0008] The propagation unit may have a first microwave introduction port provided to be away from the plurality of first slits by a predetermined distance, in a first direction which is an in-plane direction of the bottom plate and which is a direction intersecting long sides of the plurality of first slits. The microwave may be introduced into the internal space through the first microwave introduction port. The larger a distance from the first microwave introduction port to one first slit among the plurality of first slits in the first direction, the smaller an interval between one first slit and another first slit that are adjacent to each other among the plurality of first slits in the first direction may be.

[0009] The trap unit may further have a first side plate that intersects the bottom plate, faces the internal space, and is arranged to be furthest away from the first microwave introduction port in the top plan view. The first side plate may be provided with a second slit.

[0010] A width of the propagation unit in a direction intersecting the first direction may increase from the first microwave introduction port to the plurality of first slits.

[0011] The width of the propagation unit in the direction intersecting the first direction may increase, in a tapered shape, from the first microwave introduction port to the plurality of first slits.

[0012] A width of the propagation unit in a second direction intersecting the first direction, and a width of the propagation unit in a third direction which intersects the first direction and which is the third direction different from the second direction, may increase from the first microwave introduction port to the plurality of first slits.

[0013] The width of the propagation unit in the second direction intersecting the first direction, and the width of the propagation unit in the third direction which intersects the first direction and which is the third direction different from the second direction, may increase, in the tapered shape, from the first microwave introduction port to the plurality of first slits.

[0014] The propagation unit may further have: an outer side plate that faces the internal space and that extends in the first direction in the top plan view; and a second microwave introduction port provided in the outer side plate.

[0015] The propagation unit may further have: an outer bottom plate that faces the internal space and that is provided below the bottom plate; and a third microwave introduction port provided in the outer bottom plate.

[0016] A microwave introduction tube through which the microwave passes, the microwave being introduced into the internal space from an outside of the propagation unit, may be connected to the first microwave introduction port. The microwave introduction tube may have a first recess recessed in a direction intersecting a traveling

direction of the microwave. A depth of the first recess may be 1/4 of a wavelength of the microwave.

[0017] The dust collection unit may have a dust collection electrode. The dust collection electrode may have a second recess recessed in a direction intersecting a direction from the trap unit to the dust collection unit. A depth of the second recess may be 1/4 of a wavelength of the microwave.

[0018] The dust collection electrode may be provided with an opening through which the exhaust gas passes. The second recess may be arranged between the trap unit and the opening in the direction from the trap unit to the dust collection unit.

[0019] The charging unit and the dust collection unit may be provided in a pipe through which the exhaust gas passes. The trap unit may be arranged below the pipe.

[0020] The trap unit further may have a second side plate that intersects the bottom plate and faces the internal space. The plurality of first slits may be provided to extend from the bottom plate to the second side plate.

[0021] The electric dust collector may further include a covering material which is provided on an upper surface of the bottom plate and with which at least one first slit among the plurality of first slits is covered.

[0022] The covering material may be provided inside the at least one first slit.

[0023] The covering material may have a protrusion protruding in a direction from the upper surface of the bottom plate to a lower surface. The protrusion may be provided inside the first slit.

[0024] The covering material may be provided inside the first slit provided in the second side plate.

[0025] The covering material may be provided inside the second slit.

[0026] An upper surface of the covering material may be provided with a recess that corresponds to the first slit.

[0027] The covering material may be attachable to and detachable from the upper surface of the bottom plate.

[0028] The summary clause does not necessarily describe all necessary features of the embodiments of the present invention. The present invention may also be a sub-combination of the features described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is a diagram showing an example of an electric dust collector 100 according to an embodiment of the present invention.

Fig. 2 is a diagram showing an example of a block diagram of the electric dust collector 100 and an electric dust collection system 200 according to an embodiment of the present invention.

Fig. 3 is a diagram showing an example in a top plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 4 is a diagram showing an example of a cross section taken along line a-a' shown in Fig. 3.

Fig. 5 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 6 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 7 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 8 is a diagram showing an example in a side view of a vicinity of a bottom plate 11 in Fig. 7.

Fig. 9 is a diagram showing another example of the electric dust collector 100 shown in Fig. 1.

Fig. 10 is a diagram showing another example of the electric dust collector 100 shown in Fig. 1.

Fig. 11 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 12 is a diagram showing an example in a bottom plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 13 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1.

Fig. 14 is a diagram showing an example of a cross section taken along line a-a' shown in Fig. 13.

Fig. 15 is an enlarged view of a vicinity of a first microwave introduction port 22 in Fig. 3.

Fig. 16 is an enlarged view of the vicinity of the first microwave introduction port 22 in Fig. 4.

Fig. 17 is an enlarged view of an inside of a dust collection unit 40 in the electric dust collector 100 shown in Fig. 1.

Fig. 18 is an enlarged view of a dust collection electrode 41 in Fig. 17.

Fig. 19 is another enlarged view of the dust collection electrode 41 in Fig. 17.

Fig. 20 is a view showing an example of an arrangement of the electric dust collector 100.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0030] Hereinafter, the present invention will be described through embodiments of the invention, but the following embodiments do not limit the claimed invention. In addition, not all of the combinations of features described in the embodiments are essential to the solving means of the invention.

[0031] Fig. 1 is a diagram showing an example of an electric dust collector 100 according to an embodiment of the present invention. The electric dust collector 100 includes a trap unit 10 and a propagation unit 20. The electric dust collector 100 may include a dust collection unit 40. The trap unit 10 has a bottom plate 11. The propagation unit 20 has an internal space 21 through which a microwave propagates. In the present example, the propagation unit 20 has a first microwave introduction port 22.

[0032] In the present specification, a technical matter may be described by using orthogonal coordinate axes of an X axis, a Y axis, and a Z axis. In the present specification, a plane parallel to a plate surface of the bottom plate 11 is defined as an XY plane, and a direction perpendicular to the plate surface of the bottom plate 11 is defined as a Z axis direction. The XY plane may be a horizontal plane, and the Z axis direction may be parallel to a direction of gravity. In the present specification, a predetermined direction in the XY plane is defined as an X axis direction, and a direction that is orthogonal to the X axis in the XY plane is defined as a Y axis direction.

[0033] In the present specification, a dust collection unit 40 side is referred to as an "upper" side, and a propagation unit 20 side is referred to as a "lower" side in the Z axis direction. In the present example, the Z axis direction is the direction of gravity; however, "upper" and "lower" directions are not limited to the direction of gravity. In the present specification, a top plan view refers to a case where the electric dust collector 100 is viewed in a direction from the dust collection unit 40 to the propagation unit 20, in the Z axis direction. In the present example, the trap unit 10 is arranged below the dust collection unit 40. In the present specification, a bottom plan view refers to a case where the electric dust collector 100 is viewed in a direction from the propagation unit 20 to the dust collection unit 40, in the Z axis direction. In the present specification, a side view refers to a case where the electric dust collector 100 is viewed in an XY in-plane direction.

[0034] Fig. 2 is a diagram showing an example of a block diagram of the electric dust collector 100 and an electric dust collection system 200 according to an embodiment of the present invention. In the present example, the electric dust collection system 200 includes a microwave generation unit 91, a power apparatus 92, and the electric dust collector 100. The power apparatus 92 generates an exhaust gas 30 by combusting a fuel. The power apparatus 92 is, for example, an engine. The exhaust gas 30 contains a particle matter (PM) 32. The

particle matter 32 is also referred to as black carbon. The particle matter 32 is generated by incomplete combustion of a fossil fuel. The particle matter 32 is a fine particle having carbon as a main component.

[0035] The electric dust collector 100 may include a charging unit 90. The charging unit 90 is configured to charge the particle matter 32. The charging unit 90 may generate a negative ion by a negative corona discharge. The charging unit 90 may charge the particle matter 32 with the negative ion.

[0036] The dust collection unit 40 is configured to collect the charged particle matter 32. The trap unit 10 traps particle matter 32. The particle matter 32 collected by the dust collection unit 40 is accumulated on the bottom plate 11 (refer to Fig. 1) of the trap unit 10. As shown in Fig. 1, in the present example, the trap unit 10 is arranged below the dust collection unit 40. In the present example, the particle matter 32 dropped from the dust collection unit 40 to the trap unit 10 is accumulated on the bottom plate 11.

[0037] The microwave generation unit 91 generates a microwave 93. The particle matter 32 trapped by the trap unit 10 is combusted by the microwave 93. The microwave 93 is an electromagnetic wave having a frequency of 300 MHz to a frequency of 300 GHz.

[0038] Fig. 3 is a diagram showing an example in a top plan view of the electric dust collector 100 shown in Fig. 1. In Fig. 3, the dust collection unit 40 is omitted. A microwave introduction tube 94 may be connected to the first microwave introduction port 22. In the present example, the microwave 93 that is introduced into the internal space 21 from an outside of the propagation unit 20, passes through the microwave introduction tube 94.

[0039] The bottom plate 11 has an upper surface 96 and a lower surface 98. The particle matter 32 is accumulated on the upper surface 96. The bottom plate 11 is provided with a plurality of first slits 80. In the present example, the bottom plate 11 is provided with nine first slits 80. The first slit 80 penetrates the bottom plate 11 from the upper surface 96 to the lower surface 98. The first slit 80 of the present example has a rectangular shape with a long side 81 and a short side 82.

[0040] A direction which is an in-plane direction of the bottom plate 11 and which is a direction intersecting the long side 81 of the first slit 80, is defined as a first direction dr1. In the present example, the first direction dr1 is a direction orthogonal to the long side 81, and a direction parallel to the short side 82. In the present example, the first direction dr1 is parallel to the Y axis direction. A direction which is the in-plane direction of the bottom plate 11 and which is a direction intersecting the short side 82 of the first slit 80 is defined as a second direction dr2. In the present example, the second direction dr2 is a direction orthogonal to the short side 82, and a direction parallel to the long side 81. In the present example, the second direction dr2 is parallel to the X axis direction.

[0041] In the present example, the trap unit 10 has a first side plate 15, a second side plate 12, and a third

side plate 18. In the present example, the trap unit 10 has two second side plates 12 (a second side plate 12-1 and a second side plate 12-2). The second side plate 12-1 and the second side plate 12-2 face each other across a trap space 97 (described later) in the second direction dr2.

[0042] The first side plate 15 and the third side plate 18 of the present example extend in the second direction dr2 in the top plan view. The second side plate 12 of the present example extends in the first direction dr1 in the top plan view. Among the first side plate 15, the second side plate 12, and the third side plate 18, the first side plate 15 is arranged to be furthest away from the first microwave introduction port 22 in the first direction dr1.

[0043] In the present example, the first side plate 15 includes an outer surface 16 and an inner surface 17, the second side plate 12 includes an outer surface 13 and an inner surface 14, and the third side plate 18 includes an outer surface 19 and an inner surface 99. In the present example, the trap unit 10 has the trap space 97. The trap space 97 is a space above the upper surface 96 of the bottom plate 11, and is a space surrounded by the inner surface 17, the inner surface 14, and the inner surface 99.

[0044] The first side plate 15, the second side plate 12, and the third side plate 18 may face the internal space 21. In the present example, the outer surface 16 of the first side plate 15, the outer surface 13 of the second side plate 12, and the outer surface 19 of the third side plate 18 face the internal space 21.

[0045] The first side plate 15, the second side plate 12, and the third side plate 18 may intersect the bottom plate 11. In the present example, the first side plate 15, the second side plate 12, and the third side plate 18 are orthogonal to the bottom plate 11.

[0046] In the present example, the propagation unit 20 has a top plate 24, an outer bottom plate 25, and an outer side plate 23 and an outer side plate 33. The outer bottom plate 25 is arranged below the top plate 24 in the Z axis direction, and is arranged to be away from the top plate 24. The top plate 24, the outer bottom plate 25, and the outer side plate 23 and the outer side plate 33 face the internal space 21.

[0047] In the present example, plate surfaces of the top plate 24 and the outer bottom plate 25 are arranged parallel to the XY plane. In the present example, the propagation unit 20 has two outer side plates 23 (an outer side plate 23-1 and an outer side plate 23-2). In the present example, the propagation unit 20 has two outer side plates 33 (an outer side plate 33-1 and an outer side plate 33-2). The outer side plate 23 of the present example extends in the first direction dr1 in the top plan view. The outer side plate 33 of the present example extends in the second direction dr2 in the top plan view.

[0048] The outer side plate 23 includes an inner surface 26. The outer side plate 33 includes an inner surface 36. The internal space 21 is a space which is interposed between the top plate 24 and the outer bottom plate 25

in the Z axis direction, and which is surrounded by the inner surface 26 and the inner surface 36 in the XY plane.

[0049] The bottom plate 11 and the first slit 80 are arranged at positions overlapping the internal space 21 of the propagation unit 20 in the top plan view. In the present example, the lower surface 98 of the bottom plate 11 is in direct contact with the internal space 21. In the present example, the trap space 97 of the trap unit 10 and the internal space 21 of the propagation unit 20 communicate with each other via the first slit 80.

[0050] Widths of the internal space 21 in the first direction dr1 and the second direction dr2 are defined as a width Wp1 and a width Wp2, respectively. The width Wp1 may be different from, or may be equal to the width Wp2. The width Wp1 may be 1000 mm or more and 1300 mm or less. The width Wp2 may be 50 mm or more and 500 mm or less.

[0051] Widths of the trap space 97 in the first direction dr1 and the second direction dr2 are defined as a width Wc1 and a width Wc2, respectively. The width Wc1 may be different from, or may be equal to the width Wc2. The width Wc1 may be 800 mm or more and 1000 mm or less. The width Wc2 may be 50 mm or more and 450 mm or less.

[0052] The width Wc1 may be smaller than the width Wp1, or may be equal to the width Wp1. The width Wc2 may be smaller than the width Wp2, or may be equal to the width Wp2.

[0053] In the present example, the microwave 93 is introduced into the internal space 21 through the first microwave introduction port 22. The microwave 93 may be introduced, in the first direction dr1, at a position of the first microwave introduction port 22 in the first direction dr1. The first microwave introduction port 22 may be provided to be away from the plurality of first slits 80 by a predetermined distance in the first direction dr1. The predetermined distance is defined as a distance ds1.

[0054] It is easy for the microwave 93 introduced in the first direction dr1 to propagate radially in the internal space 21 in the XY plane in the top plan view. Therefore, by the first microwave introduction port 22 being provided to be away from the first slit 80 by the distance ds1, it is easy for the microwaves 93 to be uniform at the position of the first slit 80 in the XY plane. The fact that the microwaves 93 are uniform refers to a state in which a traveling direction of the microwave 93 is not biased toward a specific traveling direction in the XY plane direction and in the Z axis direction. The distance ds1 may be 0.2 times or more and 400 times or less of the wavelength of the microwave 93, or may be 0.4 times or more and 200 times or less.

[0055] The microwave 93 propagates from the internal space 21 to the trap space 97 of the trap unit 10 through the plurality of first slits 80. By the microwaves 93 being uniform at the position of the first slit 80 in the XY plane, it is easy for the microwave 93 to propagate evenly to the trap space 97 through the first slit 80. This makes it easy for the microwave 93 to be evenly radiated to the

particle matter 32 accumulated on the bottom plate 11, regardless of a position of the particle matter 32 on the upper surface 96. Therefore, it is easy for the particle matter 32 to be efficiently combusted by the microwave 93.

[0056] The long side 81 of the first slit 80 may be arranged in a direction intersecting the direction (the first direction dr1 in the present example) in which the microwave 93 is introduced into the internal space 21. This makes it easier for the particle matter 32 to be efficiently combusted by the microwave 93 than a case where the long side 81 is arranged in a direction parallel to the direction in which the microwave 93 is introduced.

[0057] In the present example, the microwave 93 introduced into the internal space 21 propagates radially in the internal space 21, and the radially propagated microwave 93 propagates to the trap space 97 through the plurality of first slits 80. Therefore, in the present example, the microwave 93 only needs to be introduced into the internal space 21 from one first microwave introduction port 22. Therefore, one microwave introduction tube 94 through which the microwave 93 generated by the microwave generation unit 91 passes, is needed. The microwave introduction tube 94 may be expensive. In the present example, one microwave introduction tube 94 is needed, and thus it is easier for a cost of the electric dust collection system 200 (refer to Fig. 2) to be reduced than a case where a plurality of microwave introduction tubes 94 are arranged.

[0058] A width of the first slit 80 in the first direction dr1 is defined as a width W1. The width W1 is a width of the short side 82. The width W1 may be 0.1 times or more and 40 times or less of a wavelength of the microwave 93. The width W1 may be 15 mm or more and 40 mm or less.

[0059] A width of an interval between one first slit 80 and another first slit 80 that are adjacent to each other in the first direction dr1 is defined as a width W2. In the present example, the width W2 of the interval between one first slit 80 and another first slit 80 that are adjacent to each other in the first direction dr1 is equal in all of the plurality of first slits 80. The width W2 may be 2.0 times or more and 10.0 times or less of the width W1. The width W2 may be 50 mm or more and 200 mm or less.

[0060] A width of the first slit 80 in the second direction dr2 is defined as a width W3. A width W3 is a width of the long side 81. In the present example, the width W3 of the long side 81 is equal in all of the plurality of first slits 80. The width W3 may be 1/2 or more of the wavelength of microwave 93. When the frequency of the microwave 93 is 2.45 GHz, the width W3 may be 61.3 mm or more.

[0061] Fig. 4 is a diagram showing an example of a cross section taken along line a-a' shown in Fig. 3. The a-a' line shows a YZ cross section passing through the microwave introduction tube 94, the outer side plate 33-2, the first microwave introduction port 22, the top plate 24, the outer bottom plate 25, the internal space 21, the third

side plate 18, the dust collection unit 40, the trap space 97, the first side plate 15, and the outer side plate 33-1. In Fig. 4, the dust collection unit 40 is indicated by hatching. Note that in Fig. 4, the dust collection electrode in the dust collection unit 40 is omitted. In the present example, the particle matter 32 collected in the dust collection unit 40 is dropped onto the upper surface 96 of the bottom plate 11.

[0062] An upper end of the trap unit 10 is defined as an upper end Eh. In Fig. 4, a position of the upper end Eh in the Z axis direction is indicated by a rough dashed line. In the Z axis direction, the position of the upper end Eh may match a position of an upper surface of the top plate 24 in the propagation unit 20. The trap unit 10 may be arranged inside the propagation unit 20. The lower surface 98 of the bottom plate 11 may be in direct contact with the internal space 21.

[0063] An upper surface of the outer bottom plate 25 is defined as an upper surface 27. A direction orthogonal to the first direction dr1 and the second direction dr2 is defined as a third direction dr3. In the present example, the third direction dr3 is the same as the Z axis direction.

[0064] The lower surface 98 of the bottom plate 11 may be arranged to be away from the upper surface 27 by a predetermined distance in the third direction dr3. The predetermined distance is defined as a distance ds2. As described above, it is easy for the microwave 93 introduced in the first direction dr1 to propagate radially in the internal space 21 in the XY plane in the top plan view. Therefore, by the lower surface 98 being arranged to be away from the upper surface 27 by the distance ds2, it is easy for the microwave 93 introduced into the internal space 21 to travel in a direction from the internal space 21 to the trap space 97 in the third direction dr3. In Fig. 4, the microwave 93 traveling in the direction from the internal space 21 to the trap space 97 is indicated by a dashed arrow.

[0065] The distance ds2 may be 200 times or less of the wavelength of the microwave 93, or may be 100 times or less. The distance ds may be 250 mm or less, or may be 200 mm or less.

[0066] At least a part of the dust collection unit 40 may be arranged to overlap the trap unit 10 in the Z axis direction. In the present example, a part of the dust collection unit 40 and the trap unit 10 are arranged to overlap each other in the Z axis direction between the upper surface 96 of the bottom plate 11 and the upper end Eh of the trap unit 10.

[0067] Fig. 5 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1. The first slit 80 arranged to be closest to the first microwave introduction port 22 in the first direction dr1 is defined as a first slit 80-1, and the first slit 80 arranged to be furthest away from the first microwave introduction port 22 is defined as a first slit 80-9. Widths W1 of the first slit 80-1 to the first slit 80-9 are defined as a width W1-1 to a width W1-9, respectively.

[0068] In the present example, the larger a distance

from the first microwave introduction port 22 to one first slit 80 among the plurality of first slits 80 in the first direction dr1, the larger a width of the one of the plurality of first slits 80 in the first direction dr1. That is, the width W1 increases from the first slit 80-1 to the first slit 80-9. Among the nine widths W1, the width W1-1 is the smallest and the width W1-9 is the largest. This makes it easier to suppress a loss of the microwave 93 than a case where all of the nine widths W1 are equal (that is, a case which is shown in Fig. 3).

[0069] Fig. 6 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1. In the present example, the bottom plate 11 is provided with ten first slits 80. The first slit 80 arranged to be closest to the first microwave introduction port 22 in the first direction dr1 is defined as the first slit 80-1, and the first slit 80 arranged to be furthest away from the first microwave introduction port 22 is defined as a first slit 80-10. In the present example, the width W1 (refer to Fig. 3) of each first slit 80 is equal in the ten first slits 80.

[0070] A width of the interval between a first slit 80-k and a first slit 80-(k+1) that are adjacent to each other in the first direction dr1 is defined as a width W2-k. Here, the k is an integer of 1 or more and 9 or less. In the present example, the larger a distance from the first microwave introduction port 22 to one first slit 80 among the plurality of first slits 80 in the first direction dr1, the smaller an interval between one first slit 80 and another first slit 80 that are adjacent to each other among the plurality of first slits 80 in the first direction dr1. That is, in the present example, the larger the k, the smaller the width W2-k. This makes it easier to suppress a loss of the microwave 93 than a case where all of the eight widths W2 are equal (that is, a case which is shown in Fig. 3).

[0071] Fig. 7 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1. The electric dust collector 100 of the present example is different from the electric dust collector 100 shown in Fig. 3 in that a covering material 83 is further provided. In Fig. 7, the covering material 83 is indicated by hatching.

[0072] In the present example, the covering material 83 is provided on the upper surface 96 (refer to Fig. 4) of the bottom plate 11. That is, in the present example, the covering material 83 is arranged in the trap space 97. At least one first slit 80 among the plurality of first slits 80 may be covered with the covering material 83. In the present example, all of the (nine) first slits 80 are covered with the covering material 83.

[0073] The particle matter 32 (refer to Fig. 4) does not pass through the covering material 83. The microwave 93 is transmitted through the covering material 83. Transmittance and absorbance of the microwave 93 in the covering material 83 may be 90% or more and less than 10%, respectively. The covering material 83 is, for example, at least one of a heat insulating material such as glass wool, ceramic fiber, or quartz glass.

[0074] A temperature of the exhaust gas 30 (refer to

Fig. 2) discharged from the power apparatus 92 (refer to Fig. 2) may be 300°C to 400°C. Therefore, a temperature of the particle matter 32 may also be 300°C to 400°C. When the particle matter 32 is combusted by the microwave 93, the combustion may further raise the temperature. Therefore, it is preferable for a heat resistance temperature of the covering material 83 to be 800°C or higher.

[0075] Fig. 8 is a diagram showing an example in a side view of a vicinity of a bottom plate 11 in Fig. 7. Fig. 8 is a diagram of the electric dust collector 100 viewed in the X axis direction. Fig. 8 is an enlarged view of the vicinity of one first slit 80.

[0076] The upper surface and the lower surface of the covering material 83 are defined as an upper surface 87 and a lower surface 86, respectively. In the present example, the lower surface 86 of the covering material 83 is provided in direct contact with the upper surface 96 of the bottom plate 11.

[0077] The covering material 83 may be provided inside at least one first slit 80. The covering material 83 may have a protrusion 84 protruding in a direction from the upper surface 96 of the bottom plate 11 to the lower surface 98. The protrusion 84 may be provided inside the first slit 80. The fact that the protrusion 84 is provided inside the first slit 80 refers to a state in which the protrusion 84 is arranged between the upper surface 96 and the lower surface 98 in the third direction dr3. By the covering material 83 being provided inside the first slit 80, it is easy for the covering material 83 to be fixed to the upper surface 96 of the bottom plate 11.

[0078] The upper surface 87 of the covering material 83 may be provided with a recess 85 that corresponds to the first slit 80. The recess 85 is a recess provided on the upper surface 87 of the covering material 83, and is a recess, in the covering material 83, recessed in a direction from the upper surface 87 of the covering material 83 to the lower surface 86. The fact that the recess 85 corresponds to the first slit 80 refers to a state in which at least a part of the recess 85 in the first direction dr1, and at least a part of the first slit 80 in the first direction dr1 are arranged at the same position. In the present example, the entire recess 85 in the first direction dr1, and the entire first slit 80 in the first direction dr1 are arranged at the same position.

[0079] When the recess 85 is provided on the upper surface 87 of the covering material 83, it is easy for the particle matter 32 dropped onto the upper surface 87 of the covering material 83 to be accumulated on the recess 85. The recess 85 corresponds to the first slits 80, and thus it is easy for the particle matter 32 accumulated in the recess 85 to be combusted by the microwave 93 traveling through the first slits 80 in the direction from the internal space 21 to the trap space 97. Therefore, it is easier to enhance a combustion efficiency of the particle matter 32 in the electric dust collector 100 than a case where the recess 85 is not provided on the upper surface 87.

[0080] Fig. 8 shows the vicinity of one first slit 80; however, the protrusion 84 may be provided inside at least one first slit 80 among the plurality of first slits 80 shown in Fig. 7. The protrusions 84 may be provided inside all of the plurality of first slits 80. The upper surface 87 of the covering material 83 may be provided with the recess 85 that corresponds to at least one first slit 80 of the plurality of first slits 80. The upper surface 87 of the covering material 83 may be provided with a plurality of recesses 85 that respectively correspond to the plurality of first slits 80.

[0081] The covering material 83 may be attachable to and detachable from the upper surface 96 of the bottom plate 11. As described above, the covering material 83 is, for example, at least one of a heat insulating material such as glass wool, ceramic fiber, or quartz glass. In a case where the covering material 83 is, for example, a heat insulating material such as glass wool, when a pressing force is applied to the covering material 83 arranged on the upper surface 96 of the bottom plate 11 in the direction from the upper surface 96 to the lower surface 98, it is easy for a part of the covering material 83, the part of the covering material 83 being arranged above the first slit 80, to enter the inside of the first slit 80. This makes it easy for the protrusion 84 to be formed in the covering material 83, and makes it easy for recess 85 corresponding to the first slits 80 to be provided on the upper surface 87 of the covering material 83.

[0082] Fig. 9 is a diagram showing another example of the electric dust collector 100 shown in Fig. 1. Fig. 9 is an example of a case where the electric dust collector 100 shown in Fig. 1 is viewed in a direction (refer to Fig. 3) from the second side plate 12-1 to the second side plate 12-2. Note that in Fig. 9, the outer side plate 23 (refer to Fig. 3) of the propagation unit 20 is omitted. In Fig. 9, the hatching of the dust collection unit 40 shown in Fig. 4 is omitted.

[0083] In the present example, the first slit 80 is also provided in the second side plate 12. The electric dust collector 100 of the present example is different from the electric dust collector shown in Fig. 3 in this respect. The first slit 80 provided in the second side plate 12 penetrates the second side plate 12 from the outer surface 13 of the second side plate 12 to the inner surface 14 (refer to Fig. 3).

[0084] The plurality of first slits 80 may be provided to extend from the bottom plate 11 to the second side plate 12. The plurality of first slits may be provided to extend from the bottom plate 11 to the second side plate 12-1, or may be provided to extend from the bottom plate 11 to the second side plate 12-2 (refer to Fig. 3).

[0085] By the plurality of first slits 80 being also provided in the second side plate 12, it is easy for the microwave 93 (refer to Fig. 3 and Fig. 4) propagating in the internal space 21 in the second direction $dr2$ (refer to Fig. 3) to propagate to the trap space 97 through the first slit 80 provided in the second side plate 12. This makes it much easier for the particle matter 32 to be combusted

by the microwave 93 than a case where the plurality of first slits 80 are provided only in the bottom plate 11 (that is, the case in the example of Fig. 3).

[0086] When the covering material 83 is provided on the upper surface 96 of the bottom plate 11 (that is, in the case of Fig. 7), the covering material 83 may also be provided on the inner surface 14 (refer to Fig. 3) of the second side plate 12. When the covering material 83 is provided on the inner surface 14 of the second side plate 12, the covering material 83 may be provided inside the first slit 80 provided in the second side plate 12, similarly to the example shown in Fig. 8.

[0087] Fig. 10 is a diagram showing another example of the electric dust collector 100 shown in Fig. 1. Fig. 10 is an example of a case where the electric dust collector 100 shown in Fig. 1 is viewed in a direction (refer to Fig. 3) from the first side plate 15 to the third side plate 18. Note that in Fig. 10, the outer side plate 33 (refer to Fig. 3) of the propagation unit 20 is omitted. In Fig. 10, the hatching of the dust collection unit 40 shown in Fig. 4 is omitted.

[0088] In the present example, the first side plate 15 is provided with a second slit 88. The electric dust collector 100 of the present example is different from the electric dust collector shown in Fig. 3 in this respect. The second slit 88 penetrates the first side plate 15 from the outer surface 16 of the first side plate 15 to the inner surface 17 (refer to Fig. 3).

[0089] The first side plate 15 may be provided with a plurality of second slits 88. A long side of the second slit 88 may be provided to be parallel to the second direction $dr2$, or may be provided to be parallel to the third direction $dr3$. In the present example, the long side of the second slit 88 is provided to be parallel to the second direction $dr2$.

[0090] By the second slit 88 being provided in the first side plate 15, it is easy for the microwave 93 reflected on the inner surface 36-1 (refer to Fig. 3) of the propagation unit 20 to propagate to the trap space 97 through the second slit 88. This makes it much easier for the particle matter 32 to be combusted by the microwave 93 than the case where the plurality of first slits 80 are provided only in the bottom plate 11 (that is, the case in the example of Fig. 3).

[0091] When the covering material 83 is provided on the upper surface 96 of the bottom plate 11 (that is, in the case of Fig. 7), the covering material 83 may also be provided on the inner surface 17 (refer to Fig. 3) of the first side plate 15. When the covering material 83 is provided on the inner surface 17 of the first side plate 15, the covering material 83 may be provided inside the second slit 88, similarly to the example shown in Fig. 8.

[0092] Fig. 11 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1. In the electric dust collector 100 of the present example, the propagation unit 20 further has a second microwave introduction port 61 provided in the outer side plate 23. The electric dust collector 100 of the

present example is different from the electric dust collector 100 shown in Fig. 3 in this respect.

[0093] The propagation unit 20 may have a plurality of second microwave introduction ports 61. The propagation unit 20 of the present example has two second microwave introduction ports 61 (a second microwave introduction port 61-1 and a second microwave introduction port 61-2). In the present example, the outer side plate 23-1 is provided with the second microwave introduction port 61-1, and the outer side plate 23-2 is provided with the second microwave introduction port 61-2.

[0094] A microwave introduction tube 60 may be connected to the second microwave introduction port 61. In the present example, a microwave introduction tube 60-1 is connected to the second microwave introduction port 61-1, and a microwave introduction tube 60-2 is connected to the second microwave introduction port 61-2. In the present example, the microwave 93 that is introduced into the internal space 21 from the outside of the propagation unit 20, passes through the microwave introduction tube 94 and the microwave introduction tube 60.

[0095] The direction of the microwave 93 introduced into the internal space 21 through the first microwave introduction port 22, and a direction of the microwave 93 introduced into the internal space 21 through the second microwave introduction port 61 may be different from each other. In the present example, the direction of the microwave 93 introduced into the internal space 21 through the first microwave introduction port 22 is the first direction dr1. In the present example, the direction of the microwave 93 introduced into the internal space 21 through the second microwave introduction port 61-1 is the second direction dr2, and the direction of the microwave 93 introduced into the internal space 21 through the second microwave introduction port 61-2 is a direction which is parallel to the second direction dr2 and is opposite to the second direction dr2. By the direction of the microwave 93 introduced into the internal space 21 through the first microwave introduction port 22, and the direction of the microwave 93 introduced into the internal space 21 through the second microwave introduction port 61 being different from each other, it is easier for the microwaves 93 to be uniform in the internal space 21.

[0096] In the present example, it is preferable for the second side plate 12 of the trap unit 10 to be provided with the first slit 80 (refer to Fig. 9). By the microwave 93 being introduced into the internal space 21 through the second microwave introduction port 61, and the second side plate 12 being provided with the first slit 80, it is easier for the particle matter 32 trapped in the trap space 97 to be efficiently combusted.

[0097] Fig. 12 is a diagram showing an example in a bottom plan view of the electric dust collector 100 shown in Fig. 1. In the electric dust collector 100 of the present example, the propagation unit 20 further has a third microwave introduction port 63 provided in the outer bottom plate 25. The electric dust collector 100 of the present example is different from the electric dust collector 100

shown in Fig. 11 in this respect.

[0098] A microwave introduction tube 62 may be connected to the third microwave introduction port 63. In the present example, the microwave 93 that is introduced into the internal space 21 from the outside of the propagation unit 20, passes through the microwave introduction tube 94, the microwave introduction tube 60, and the microwave introduction tube 62.

[0099] A direction of the microwave 93 introduced into the internal space 21 through the third microwave introduction port 63 may be different from the direction of the microwave 93 introduced into the internal space 21 through the first microwave introduction port 22, and the direction of the microwave 93 introduced into the internal space 21 through the second microwave introduction port 61. This makes it much easier for the microwaves 93 to be uniform in the internal space 21 than those in the example shown in Fig. 11. In the present example, the direction of the microwave 93 introduced into the internal space 21 through the third microwave introduction port 63 is the third direction dr3 (refer to Fig. 4).

[0100] The third microwave introduction port 63 may be arranged at a position overlapping the bottom plate 11 of the trap unit 10 in the bottom plan view. This makes it easy for the microwave 93 introduced into the internal space 21 through the third microwave introduction port 63 to be introduced into the trap space 97. This makes it easier for the particle matter 32 trapped in the trap space 97 to be efficiently combusted.

[0101] Fig. 13 is a diagram showing another example in the top plan view of the electric dust collector 100 shown in Fig. 1. In the present example, a width of the propagation unit 20 in the direction intersecting the first direction dr1 increases from the first microwave introduction port 22 to the plurality of first slits 80. The electric dust collector 100 of the present example is different from the electric dust collector 100 shown in Fig. 11 in this respect. The direction intersecting the first direction dr1 may be a direction parallel to the long side 81 of the first slit 80. In the present example, a width of the propagation unit 20 in the second direction dr2 increases, in a tapered shape, from the first microwave introduction port 22 to the plurality of first slits 80.

[0102] Fig. 14 is a diagram showing an example of a cross section taken along line a-a' shown in Fig. 13. In the present example, a width of the propagation unit 20 in the third direction dr3 also increases from the first microwave introduction port 22 to the plurality of first slits 80. That is, in the present example, the internal space 21 from the first microwave introduction port 22 to the plurality of first slits 80 has a horn shape. Therefore, it is easy for a gain of the microwave 93 to be greater than that in the examples shown in Fig. 3 and Fig. 4.

[0103] Fig. 15 is an enlarged view of a vicinity of a first microwave introduction port 22 in Fig. 3. The microwave introduction tube 94 may have a first recess 50. The first recess 50 is recessed in a direction (in the present example, a direction from the dust collection unit 40 to the

trap unit 10) that intersects the traveling direction of the microwave 93 (in the present example, the Y axis direction).

[0104] Fig. 16 is an enlarged view of the vicinity of the first microwave introduction port 22 in Fig. 4. The first recess 50 of the present example is recessed in the direction from the dust collection unit 40 to the trap unit 10 (refer to Fig. 4). A depth of the first recess 50 is defined as a depth dp1.

[0105] The depth dp1 may be 1/4 of the wavelength of the microwave 93 (refer to Fig. 3 or the like). Thereby, the microwave 93 traveling in a direction from the microwave introduction tube 94 to the internal space 21, and the microwaves 93 traveling in a direction from the internal space 21 to the microwave introduction tube 94 cancel each other out, on an internal space 21 side further the first recess 50 in the traveling direction of the microwave 93. By the depth dp1 being 1/4 of the wavelength of the microwave 93, it is easy to enhance reflectance of the microwave 93 that is reflected in a direction from the first recess 50 to the internal space 21. This makes it easy for the particle matter 32 to be efficiently combusted in the trap unit 10. The first recess 50 may have a so-called choke structure that cancels out a traveling wave and a reflected wave of the microwave 93.

[0106] Fig. 17 is an enlarged view of an inside of a dust collection unit 40 in the electric dust collector 100 shown in Fig. 1. Note that in Fig. 17, a solid line indicating the dust collection unit 40, the trap unit 10, and the propagation unit 20 in Fig. 1 are omitted. The dust collection unit 40 may have a dust collection electrode 41. The dust collection unit 40 may have a plurality of dust collection electrodes 41. The dust collection unit 40 of the present example has seven dust collection electrodes 41 (a dust collection electrode 41-1 to a dust collection electrode 41-7).

[0107] The dust collection electrode 41 may have a plate shape. In the present example, a plate surface of the dust collection electrode 41 with the plate shape is arranged to be parallel to the XZ plane. The dust collection electrode 41 may be provided with a plurality of openings 42 through which the exhaust gas 30 passes. The opening 42 penetrates the plate surface in a thickness direction (the Y axis direction) of the dust collection electrode 41 with the plate shape. In the present example, the exhaust gas 30 passes through the inside of the dust collection unit 40 in a direction intersecting the plate surface of the dust collection electrode 41. In the present example, the exhaust gas 30 passes through the inside of the dust collection unit in a direction from the dust collection electrode 41-1 to the dust collection electrode 41-7.

[0108] One of the dust collection electrodes 41 that are adjacent to each other may be connected to a power supply 43, and the other may be grounded. In the present example, the dust collection electrode 41-1, the dust collection electrode 41-3, the dust collection electrode 41-5, and the dust collection electrode 41-7 are connected to

the power supply 43, and the dust collection electrode 41-2, the dust collection electrode 41-4, and the dust collection electrode 41-6 are grounded. The charged particle matter 32 (refer to Fig. 4) is collected by the grounded dust collection electrode 41 by a potential difference which is generated between the dust collection electrodes 41 that are adjacent to each other. In the present example, the collected particle matter 32 is dropped into the trap unit 10.

[0109] The dust collection electrode 41 may have a second recess 44. In the present example, the second recess 44 is provided to be recessed in the thickness direction of the plate surface of the dust collection electrode 41 with the plate shape. The second recess 44 is recessed in a direction (the Y axis direction in the present example) intersecting a direction (the Z axis direction in the present example) from the trap unit 10 to the dust collection unit 40.

[0110] Fig. 18 is an enlarged view of a dust collection electrode 41 in Fig. 17. Fig. 18 is a drawing of one dust collection electrode 41 viewed in the thickness direction of the plate surface. The second recess 44 may have a rectangular shape having a long side 45 and a short side 46 when the dust collection electrode 41 is viewed in the thickness direction of the plate surface. The long side 45 of the second recess 44 may intersect the direction (the Z axis direction in the present example) from the trap unit 10 to the dust collection unit 40. In the present example, the long side 45 is orthogonal to the direction from the trap unit 10 to the dust collection unit 40. The second recess 44 may be arranged between the trap unit 10 and the opening 42 in the direction from the trap unit 10 to the dust collection unit 40.

[0111] Fig. 19 is another enlarged view of the dust collection electrode 41 in Fig. 17. Fig. 19 is a drawing of one dust collection electrode 41 viewed in a direction parallel to the plate surface. The second recess 44 of the present example is recessed in the thickness direction of the plate surface when the dust collection electrode 41 is viewed in the direction parallel to the plate surface. A depth of the second recess 44 from the plate surface is defined as a depth dp2.

[0112] The depth dp2 may be 1/4 of the wavelength of the microwave 93 (refer to Fig. 3 or the like). Thereby, the microwave 93 traveling in the direction from the trap unit 10 to the dust collection unit 40, and the microwave 93 traveling in the direction from the dust collection unit 40 to the trap unit 10 cancel each other out, above the second recess 44. By the depth dp2 being 1/4 of the wavelength of the microwave 93, it is easy to enhance the reflectance of the microwave 93 that is reflected in a direction from the second recess 44 to the trap unit 10. This makes it easy for the particle matter 32 to be efficiently combusted in the trap unit 10.

[0113] As described above, the second recess 44 may be arranged between the trap unit 10 and the opening 42 in the direction from the trap unit 10 to the dust collection unit 40. This makes it difficult for the microwave

93 to travel to an opening 42 side further than the second recess 44. The second recess 44 may have a so-called choke structure that cancels out a traveling wave and a reflected wave of the microwave 93.

[0114] Fig. 20 is a view showing an example of an arrangement of the electric dust collector 100. The exhaust gas 30 discharged by the power apparatus 92 passes through a pipe 110. The charging unit 90 and the dust collection unit 40 may be provided in the pipe 110 through which the exhaust gas 30 passes. The charging unit 90 and the dust collection unit 40 may be provided in a flow path of the exhaust gas 30 inside the pipe 110. In Fig. 20, a range of the electric dust collector 100 is indicated by a frame of a dash dotted line. The charging unit 90 may be provided upstream of the flow path of the exhaust gas 30 further than the dust collection unit 40 in the pipe 110. Thereby, the particle matter 32 charged by the charging unit 90 is collected by the dust collection unit 40.

[0115] The trap unit 10 may be arranged below the pipe 110. The propagation unit 20 may be arranged below the pipe 110. The particle matter 32 may be combusted outside the pipe 110 by the microwave 93 (refer to Fig. 3).

[0116] While the embodiments of the present invention have been described, the technical scope of the invention is not limited to the above described embodiments. It is apparent to persons skilled in the art that various alterations and improvements can be added to the above-described embodiments. It is also apparent from the scope of the claims that the embodiments added with such alterations or improvements can be included in the technical scope of the invention.

[0117] The operations, procedures, steps, and stages of each process performed by an apparatus, system, program, and method shown in the claims, embodiments, or diagrams can be performed in any order as long as the order is not indicated by "prior to," "before," or the like and as long as the output from a previous process is not used in a later process. Even if the process flow is described using phrases such as "first" or "next" in the claims, embodiments, or diagrams, it does not necessarily mean that the process must be performed in this order.

EXPLANATION OF REFERENCES

[0118] 10: trap unit, 11: bottom plate, 12: side plate, 13: outer surface, 14: inner surface, 15: side plate, 16: outer surface, 17: inner surface, 18: side plate, 19: outer surface, 20: propagation unit, 21: internal space, 22: first microwave introduction port, 23: outer side plate, 24: top plate, 25: outer bottom plate, 26: inner surface, 27: upper surface, 30: exhaust gas, 32: particle matter, 33: outer side plate, 36: inner surface, 40: dust collection unit, 41: dust collection electrode, 42: opening, 43: power supply, 44: second recess, 45: long side, 46: short side, 50: first recess, 60: microwave introduction tube, 61: second microwave introduction port, 62: microwave introduction tube, 63: third microwave introduction port, 80: first slit, 81: long side, 82: short side, 83: covering material, 84:

protrusion, 86: lower surface, 87: upper surface, 88: second slit, 90: charging unit, 91: microwave generation unit, 92: power apparatus, 93: microwave, 94: microwave introduction tube, 96: upper surface, 97: trap space, 98: lower surface, 99: inner surface, 100: electric dust collector, 110: pipe, 200: electric dust collection system.

Claims

1. An electric dust collector comprising:

a trap unit that has a bottom plate on which a particle matter contained in an exhaust gas is accumulated and that is provided with a plurality of first slits in the bottom plate; and
a propagation unit that has an internal space through which a microwave propagates, wherein
the plurality of first slits are arranged at positions overlapping the internal space in a top plan view, and
the microwave propagates from the internal space to the trap unit through the plurality of first slits.

2. The electric dust collector according to claim 1, further comprising:

a charging unit configured to charge the particle matter; and
a dust collection unit configured to collect the particle matter charged by the charging unit, wherein
the trap unit is arranged below the dust collection unit, and
the particle matter collected by the dust collection unit is accumulated on the bottom plate.

3. The electric dust collector according to claim 2, wherein

the propagation unit has a first microwave introduction port provided to be away from the plurality of first slits by a predetermined distance, in a first direction which is an in-plane direction of the bottom plate and which is a direction intersecting long sides of the plurality of first slits, the microwave is introduced into the internal space through the first microwave introduction port, and
the larger a distance from the first microwave introduction port to one first slit among the plurality of first slits in the first direction, the larger a width of each of the plurality of first slits in the first direction.

4. The electric dust collector according to claim 2,

wherein

the propagation unit has a first microwave introduction port provided to be away from the plurality of first slits by a predetermined distance, in a first direction which is an in-plane direction of the bottom plate and which is a direction intersecting long sides of the plurality of first slits, the microwave is introduced into the internal space through the first microwave introduction port, and

the larger a distance from the first microwave introduction port to one first slit among the plurality of first slits in the first direction, the smaller an interval between one first slit and another first slit that are adjacent to each other among the plurality of first slits in the first direction.

5. The electric dust collector according to claim 3 or 4, wherein

the trap unit further has a first side plate that intersects the bottom plate, faces the internal space, and is arranged to be furthest away from the first microwave introduction port in the top plan view, and
the first side plate is provided with a second slit.

6. The electric dust collector according to any one of claims 3 to 5, wherein
a width of the propagation unit in a direction intersecting the first direction increases from the first microwave introduction port to the plurality of first slits.

7. The electric dust collector according to any one of claims 3 to 6, wherein
the propagation unit further has:

an outer side plate that faces the internal space and that extends in the first direction in the top plan view; and
a second microwave introduction port provided in the outer side plate.

8. The electric dust collector according to any one of claims 3 to 7, wherein
the propagation unit further has:

an outer bottom plate that faces the internal space and that is provided below the bottom plate; and
a third microwave introduction port provided in the outer bottom plate.

9. The electric dust collector according to any one of claims 3 to 8, wherein

a microwave introduction tube through which the

microwave passes, the microwave being introduced into the internal space from an outside of the propagation unit, is connected to the first microwave introduction port,

the microwave introduction tube has a first recess recessed in a direction intersecting a traveling direction of the microwave, and
a depth of the first recess is 1/4 of a wavelength of the microwave.

10. The electric dust collector according to any one of claims 2 to 9, wherein

the dust collection unit has a dust collection electrode,
the dust collection electrode has a second recess recessed in a direction intersecting a direction from the trap unit to the dust collection unit, and
a depth of the second recess is 1/4 of a wavelength of the microwave.

11. The electric dust collector according to any one of claims 2 to 10, wherein

the charging unit and the dust collection unit are provided in a pipe through which the exhaust gas passes, and
the trap unit is arranged below the pipe.

12. The electric dust collector according to any one of claims 1 to 11, wherein

the trap unit further has a second side plate that intersects the bottom plate and faces the internal space, and
the plurality of first slits are provided to extend from the bottom plate to the second side plate.

13. The electric dust collector according to any one of claims 1 to 12, further comprising:
a covering material which is provided on an upper surface of the bottom plate and with which at least one first slit among the plurality of first slits is covered.

14. The electric dust collector according to claim 13, wherein
the covering material is provided inside the at least one first slit.

15. The electric dust collector according to claim 14, wherein
an upper surface of the covering material is provided with a recess that corresponds to the first slit.

16. The electric dust collector according to any one of claims 13 to 15, wherein
the covering material is attachable to and detachable

from the upper surface of the bottom plate.

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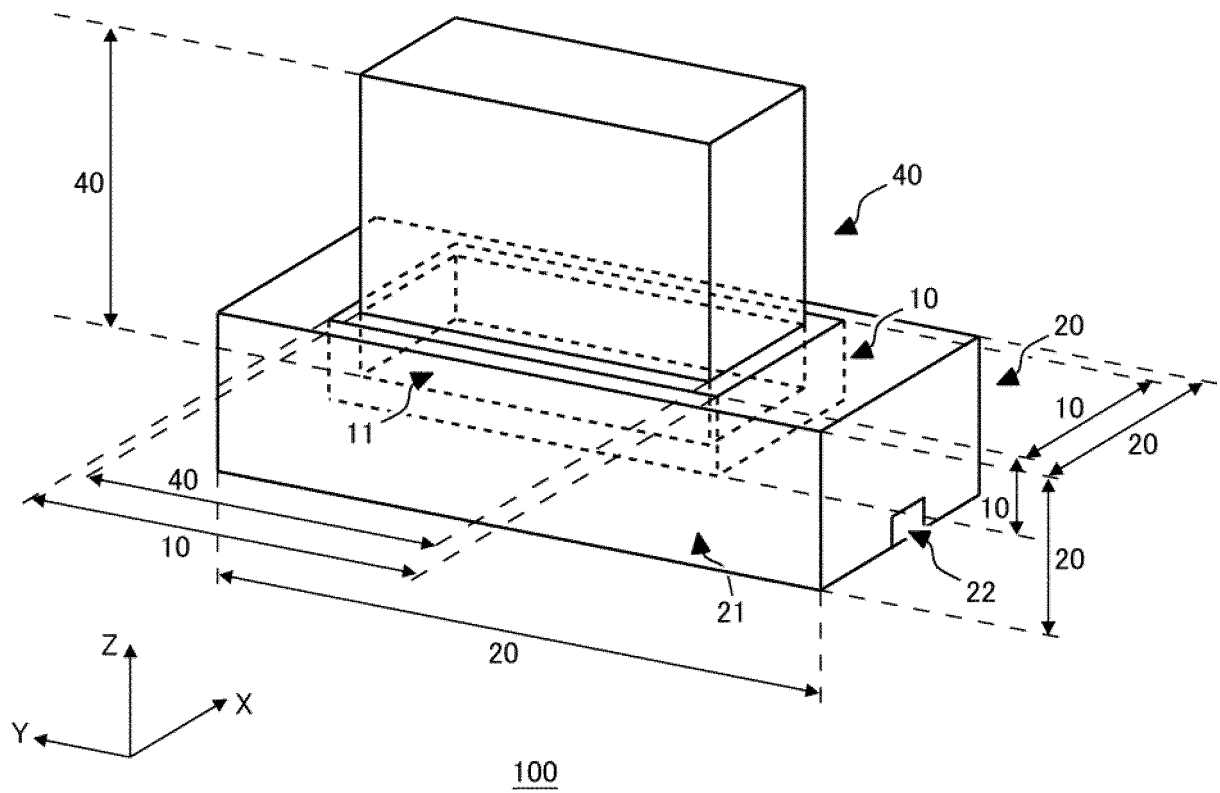


FIG.1

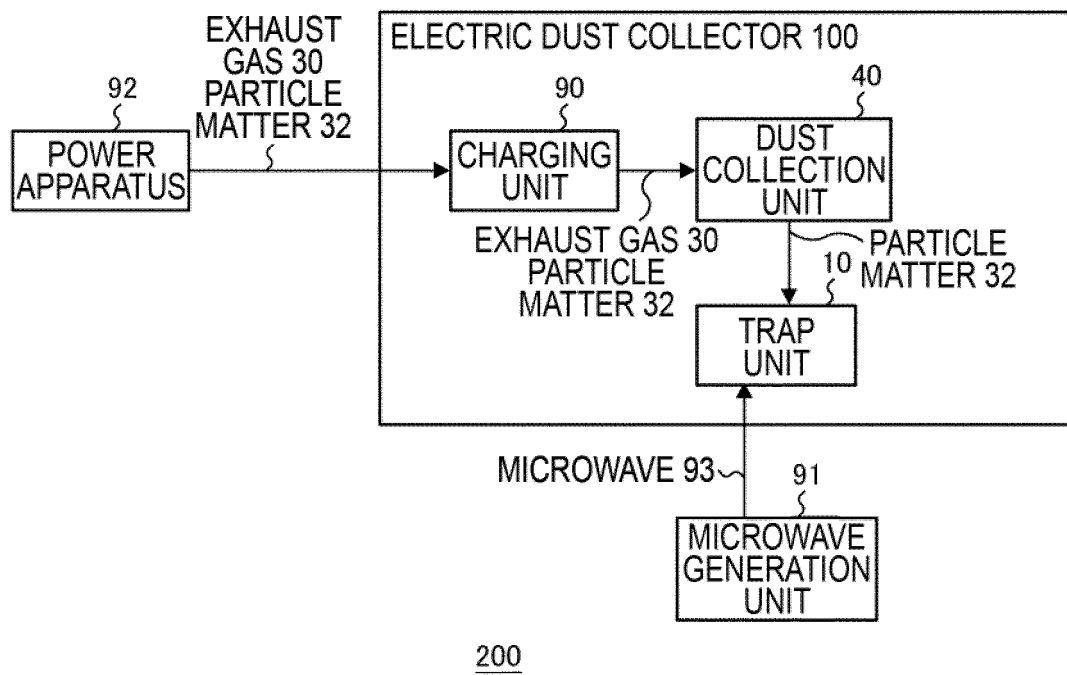


FIG.2

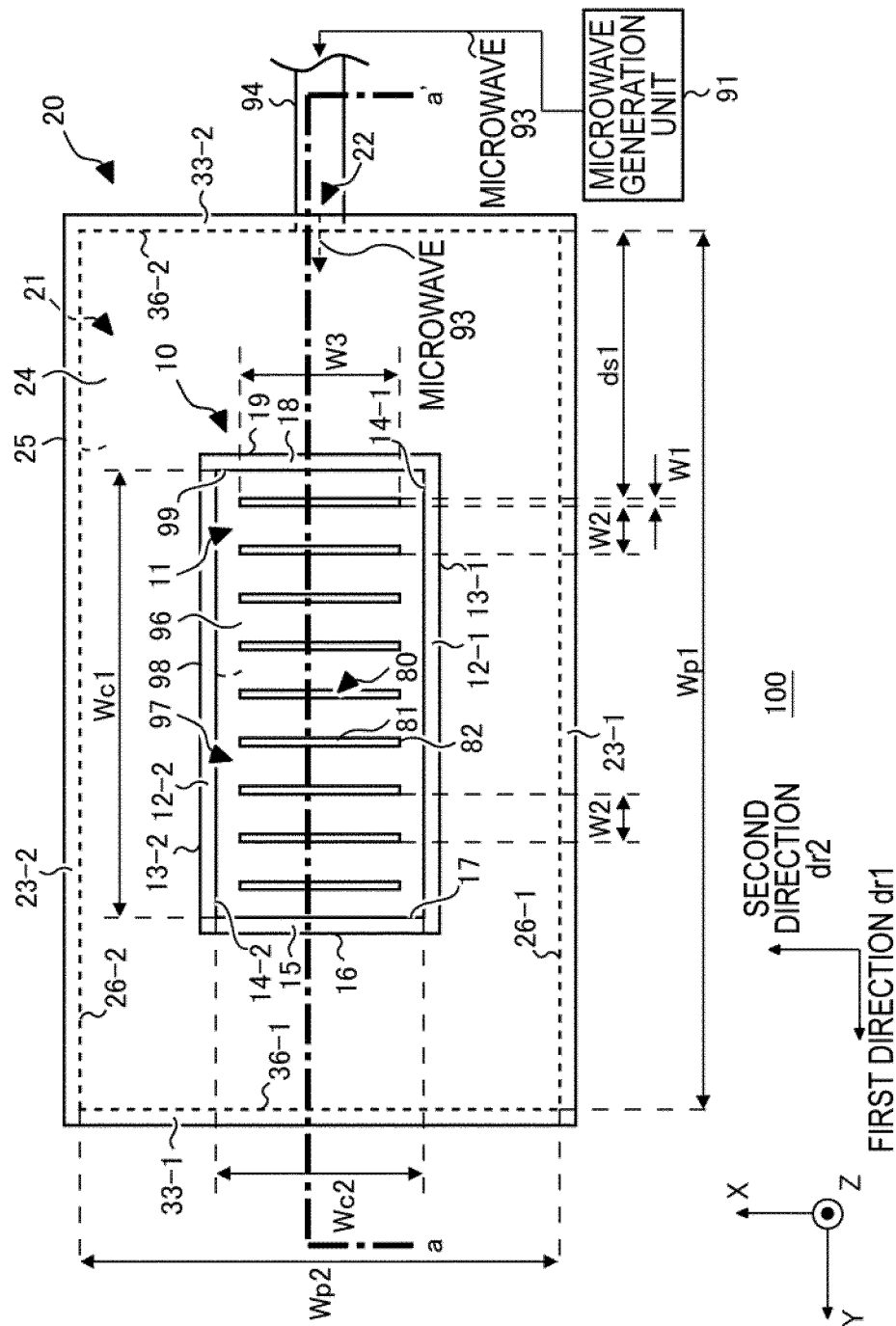


FIG. 3

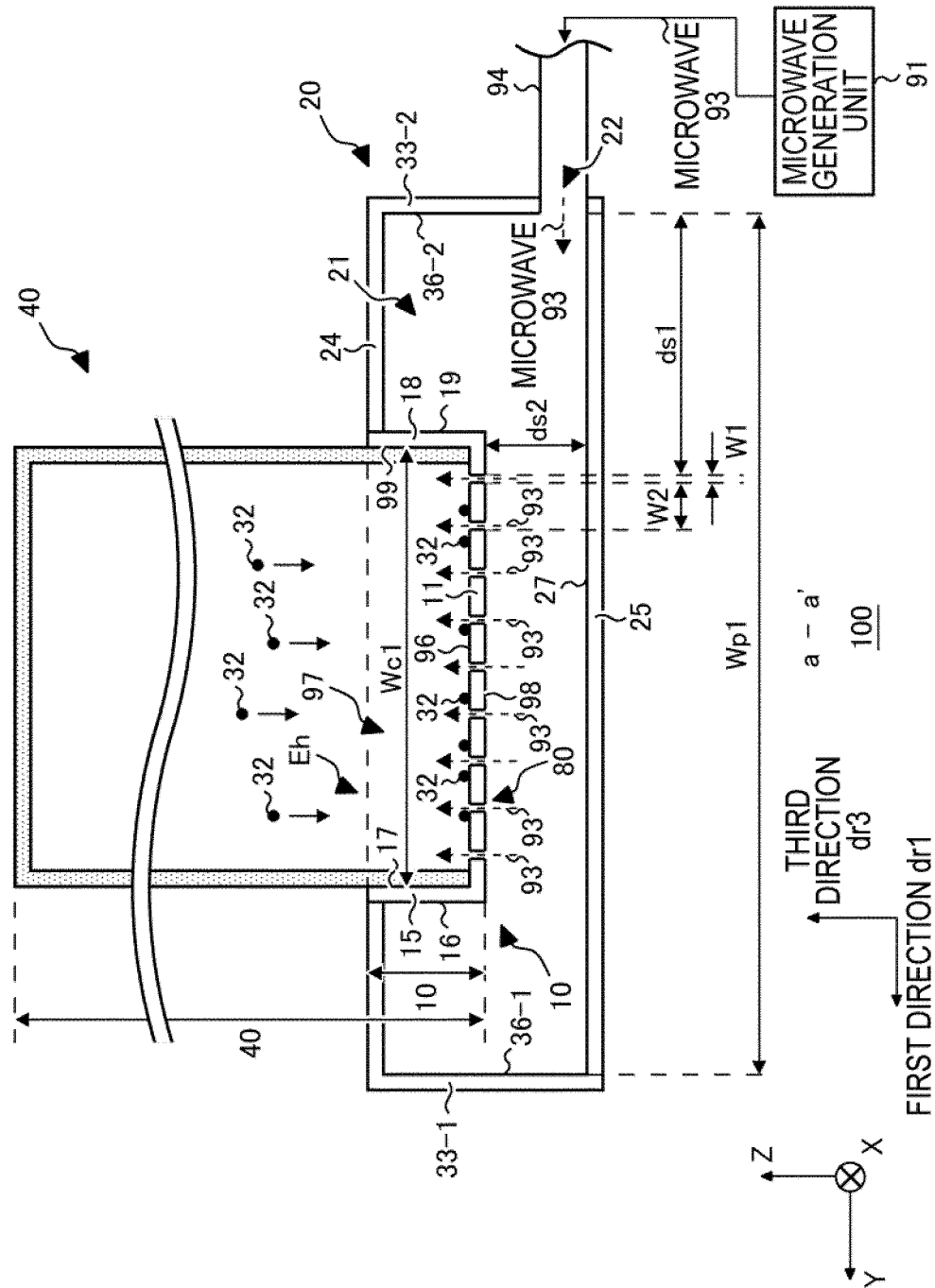


FIG. 4

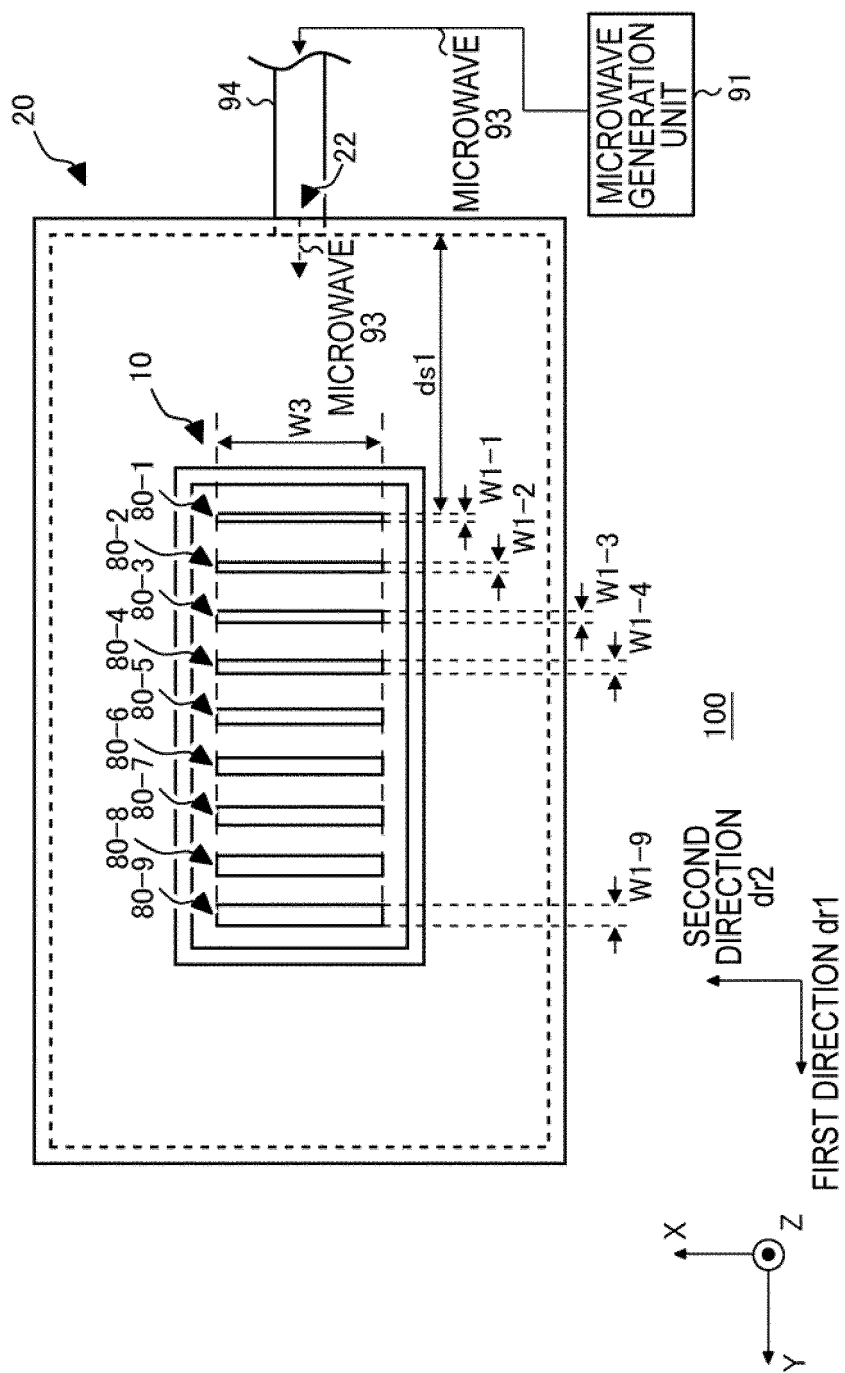
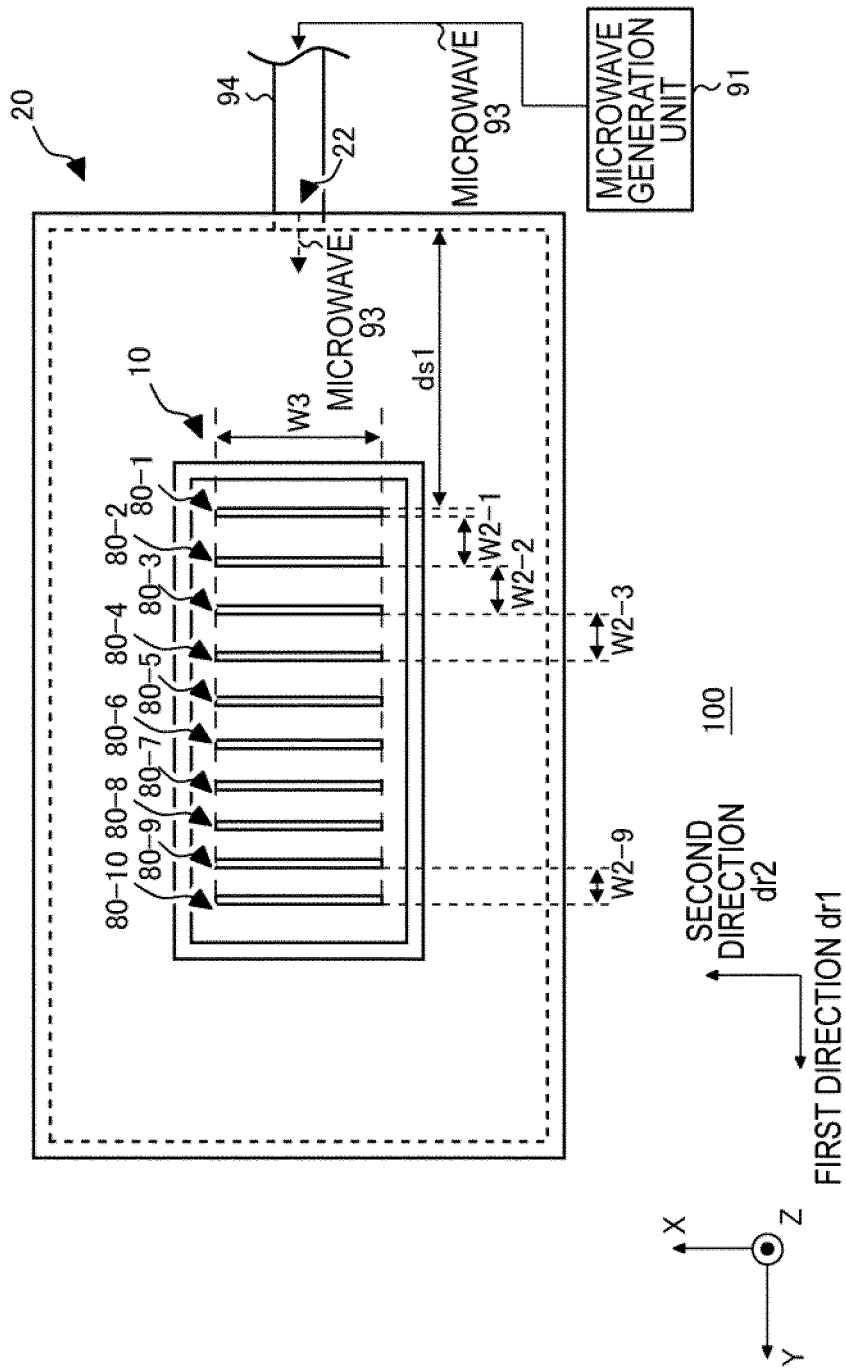


FIG. 5



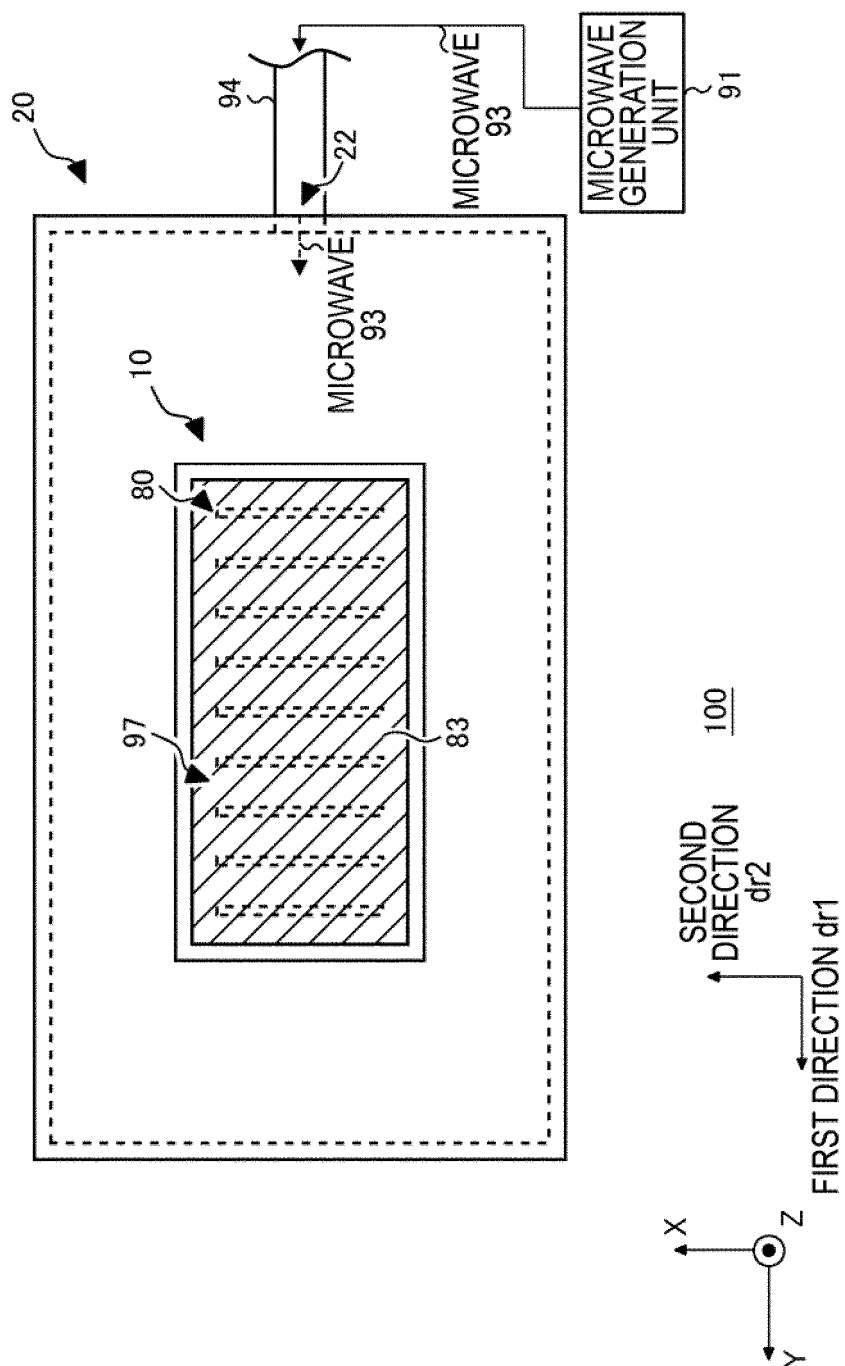


FIG. 7

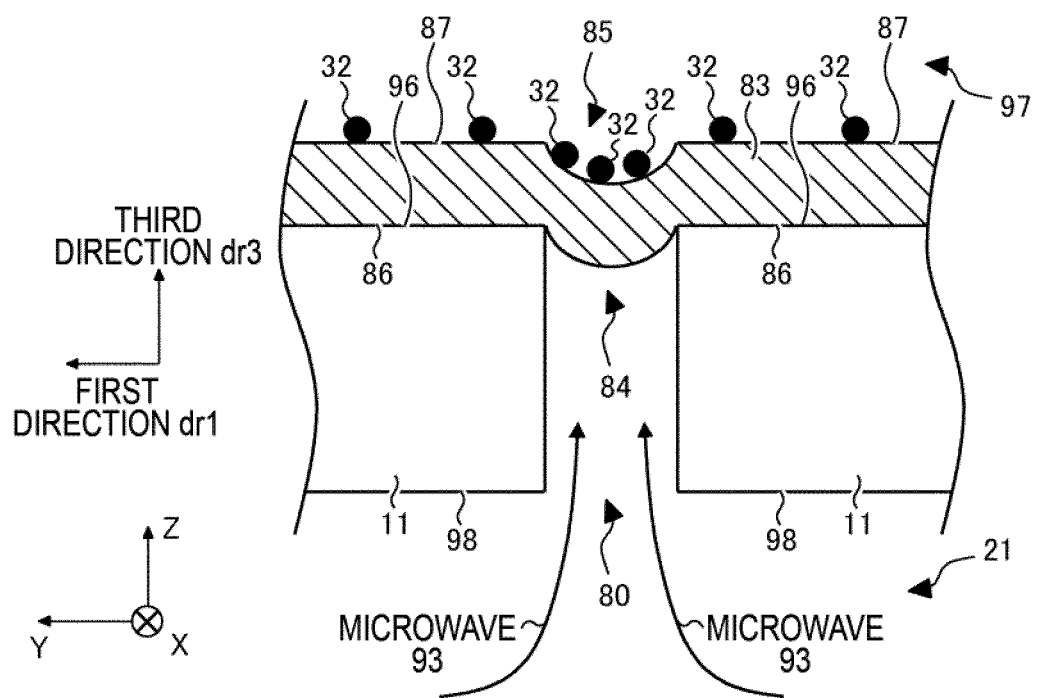


FIG. 8

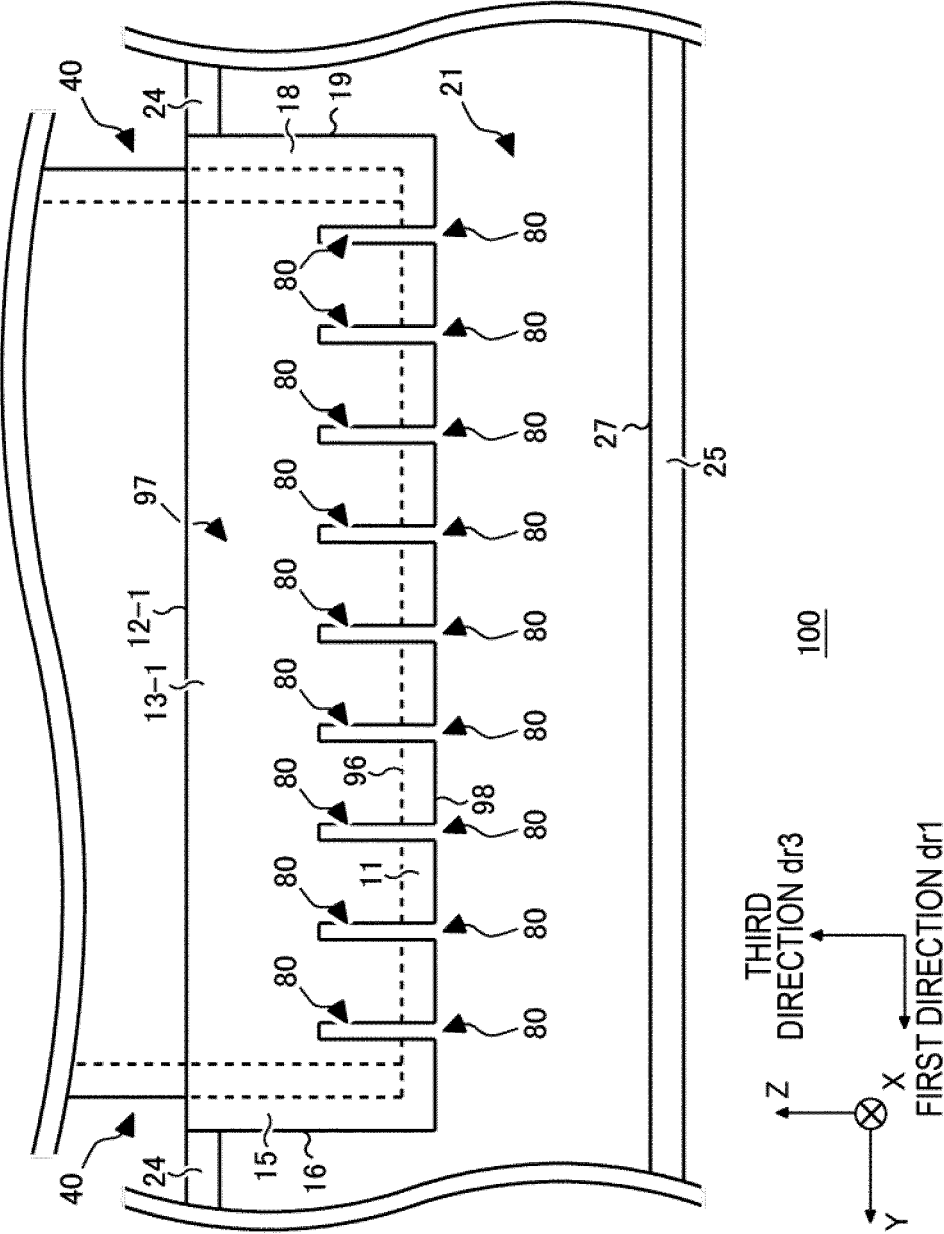


FIG. 9

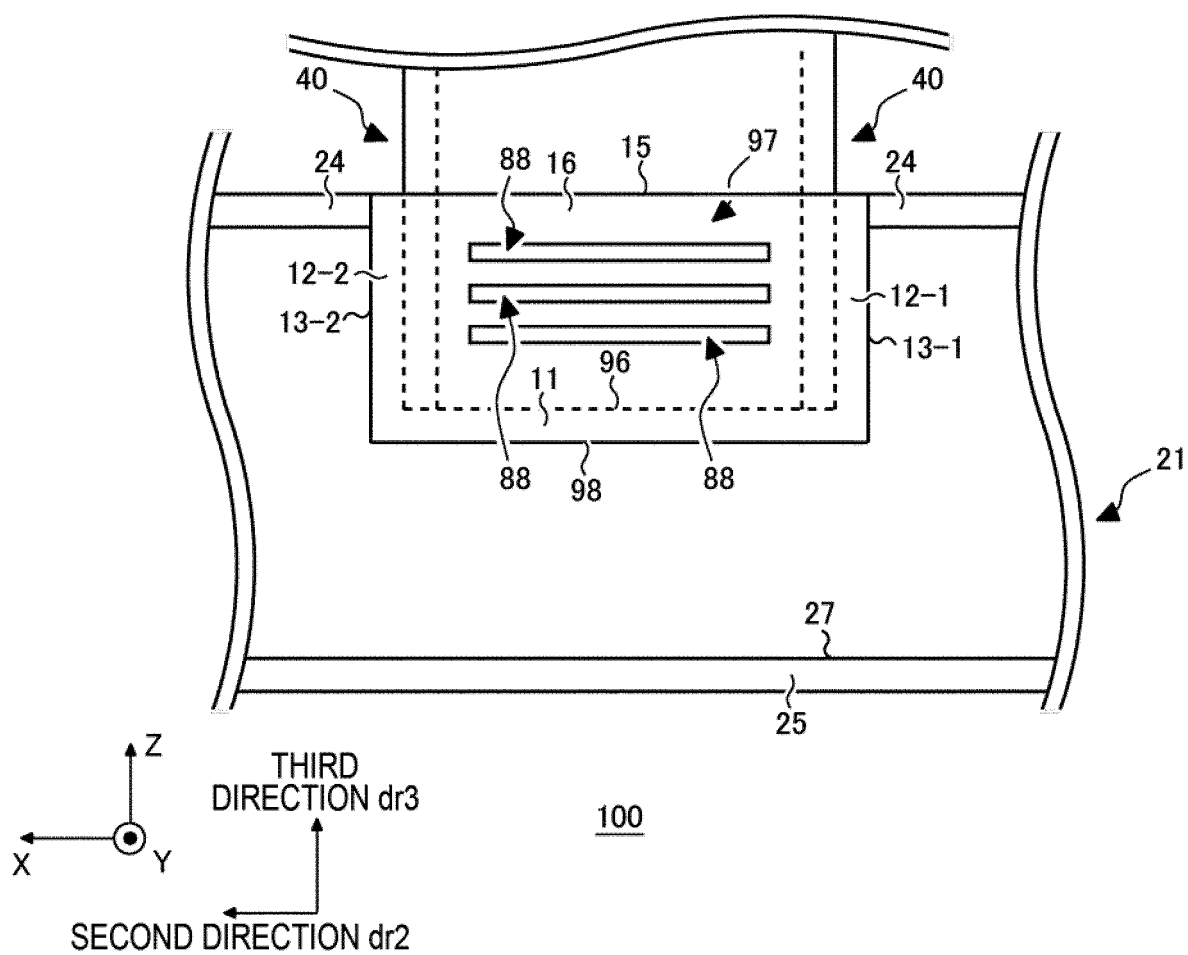


FIG. 10

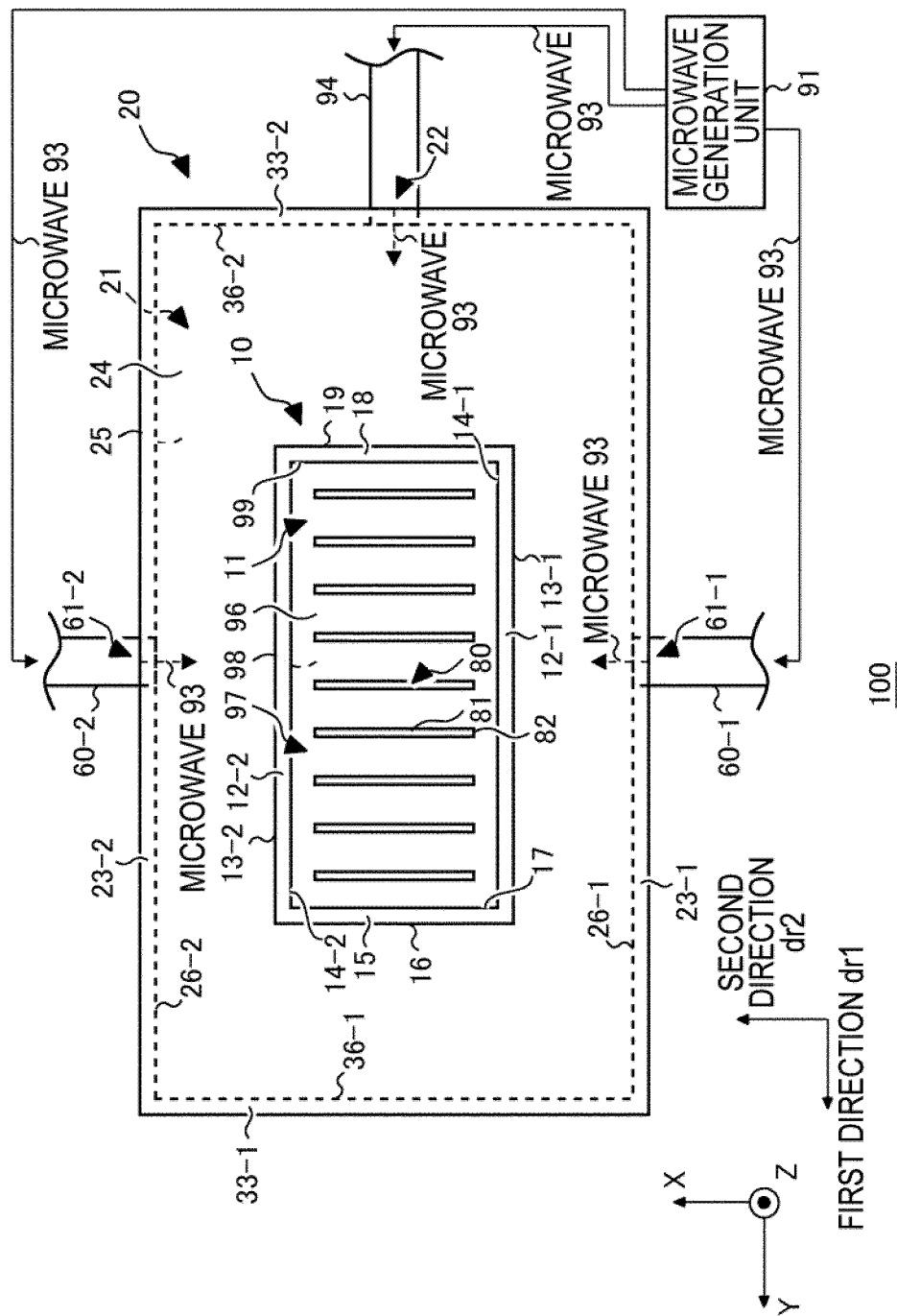


FIG.11

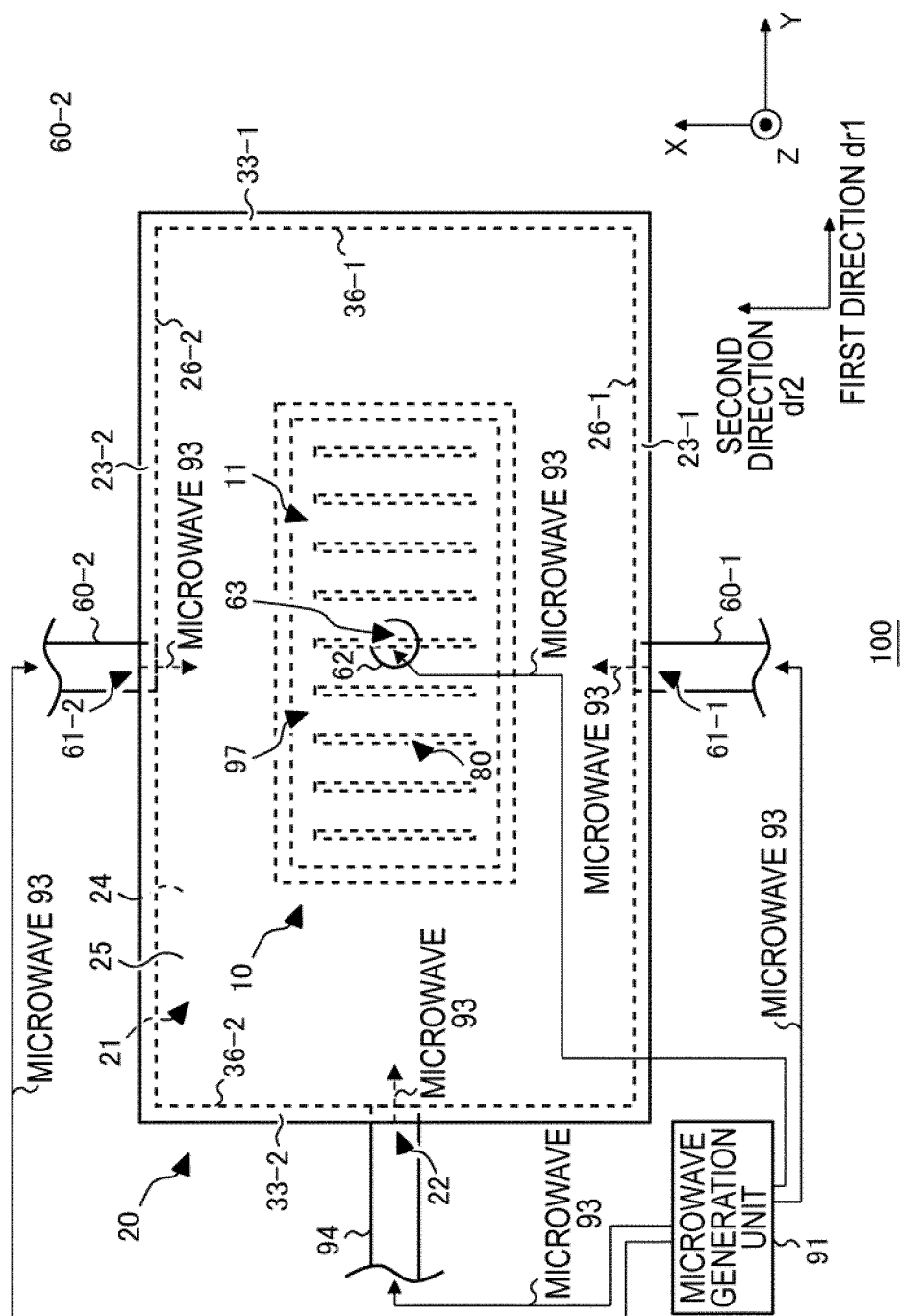


FIG.12

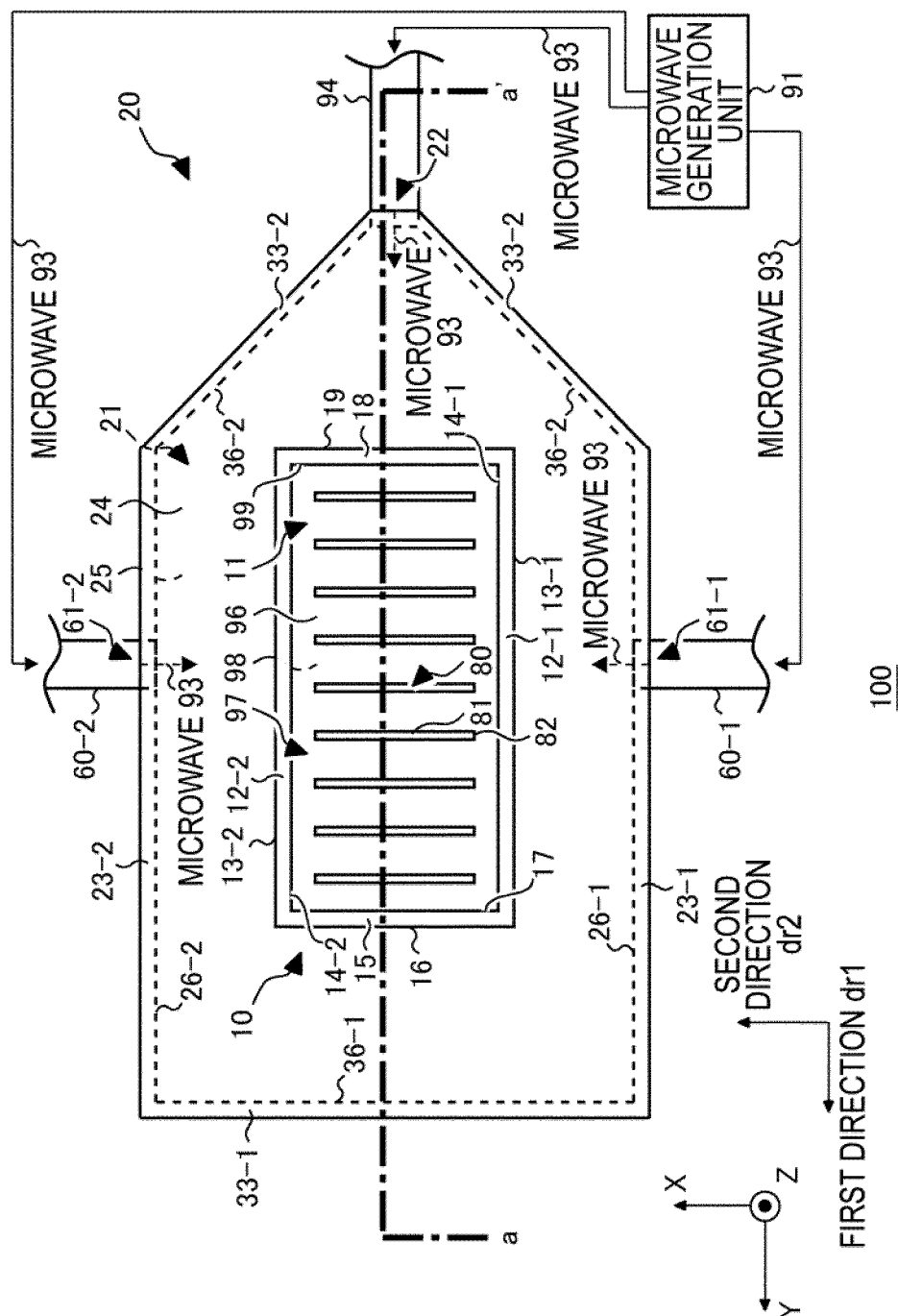


FIG. 13

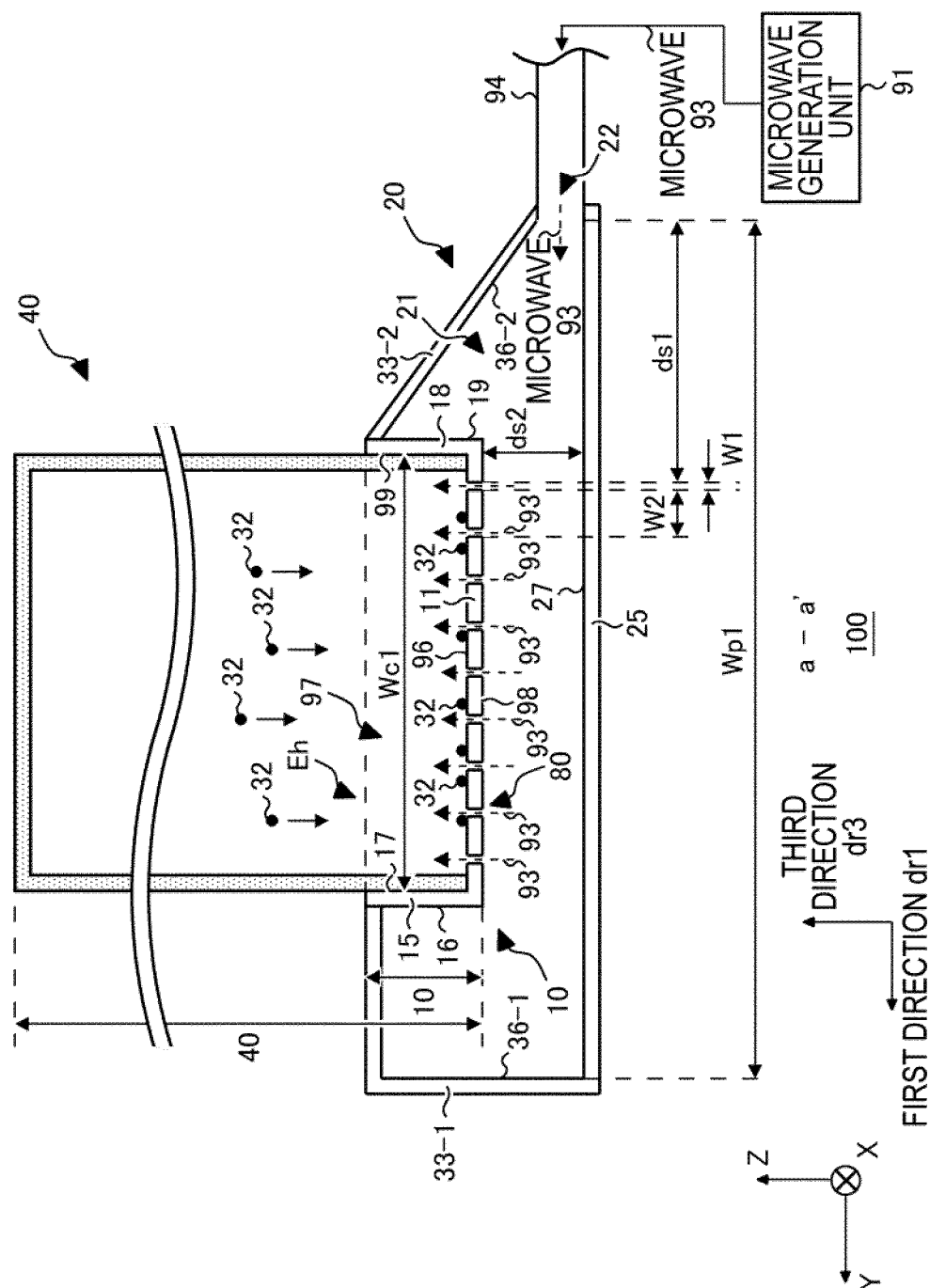


FIG. 14

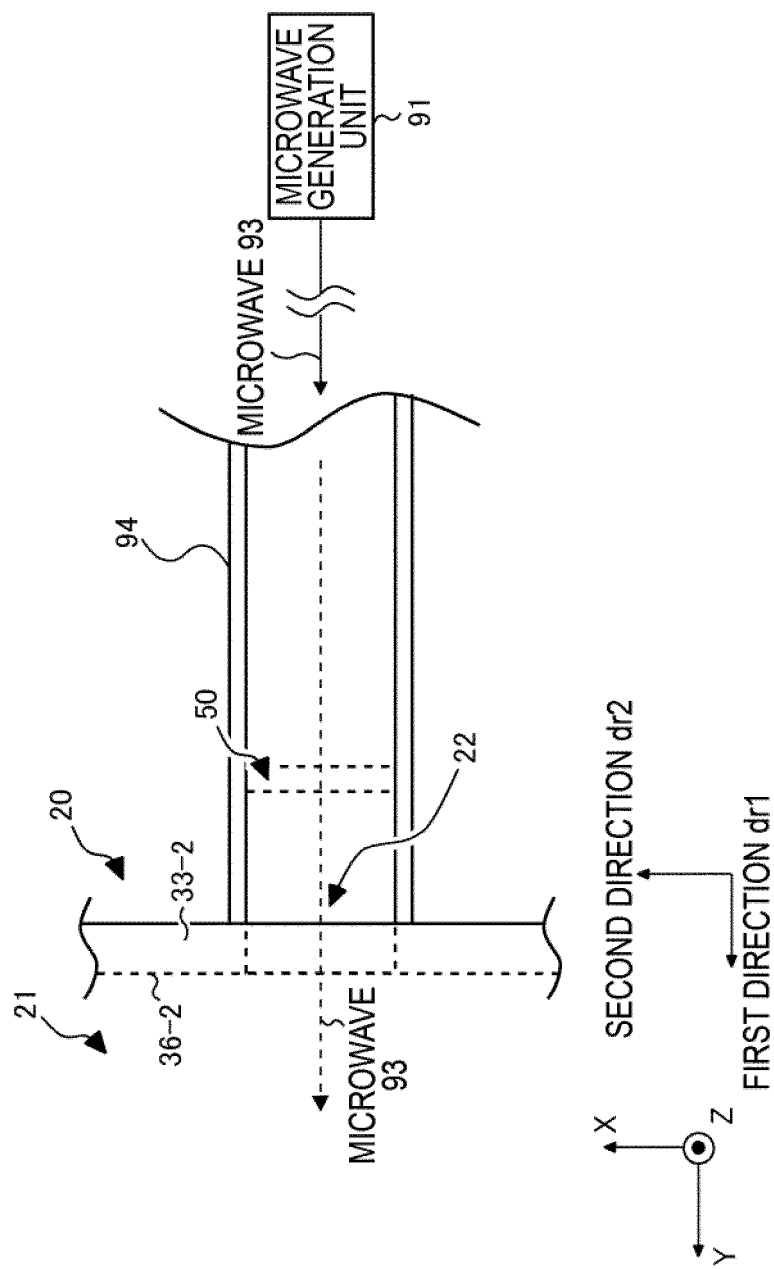


FIG.15

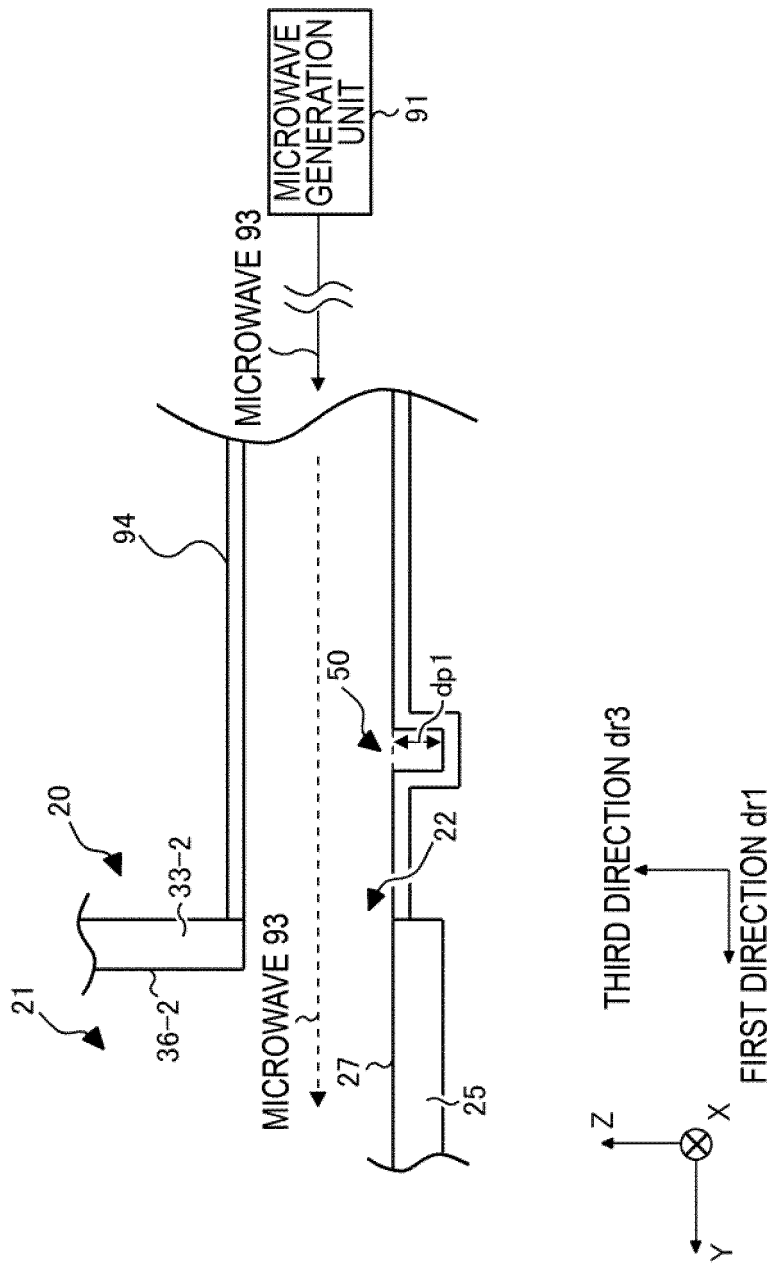


FIG.16

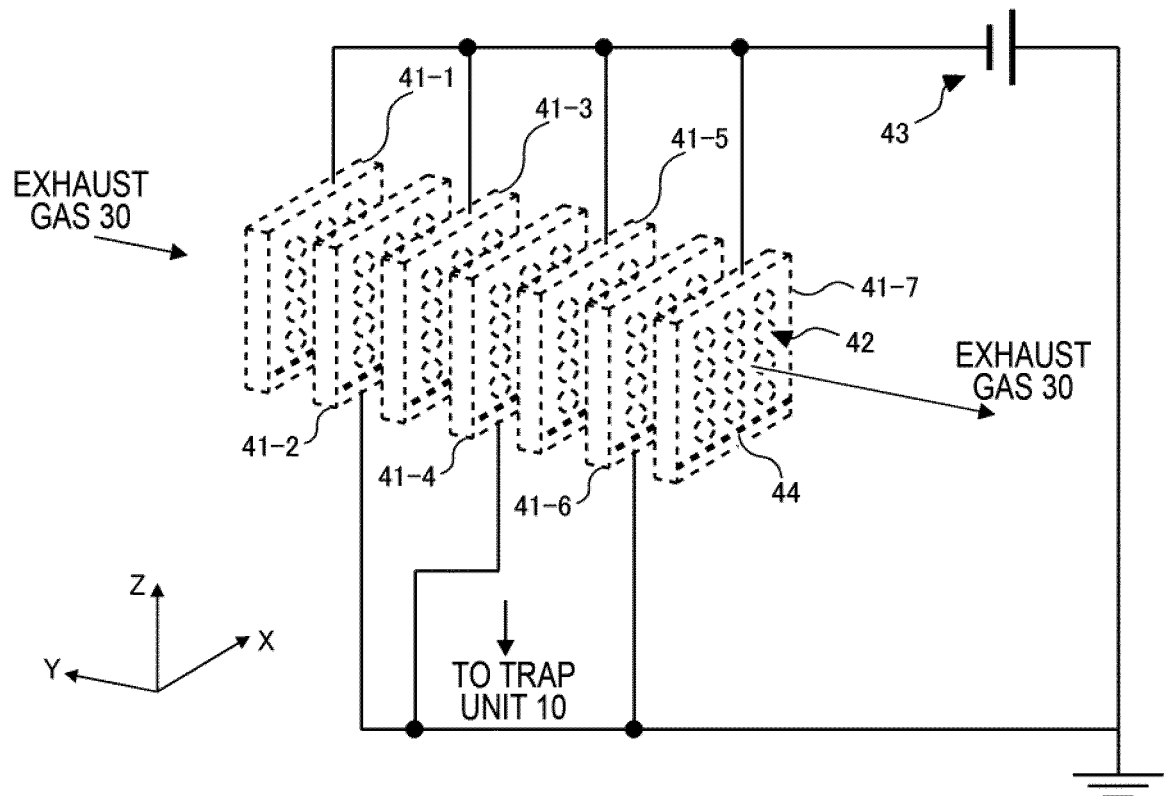


FIG.17

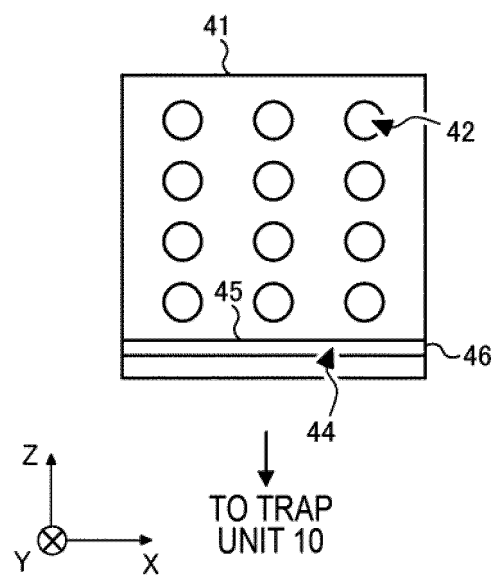


FIG. 18

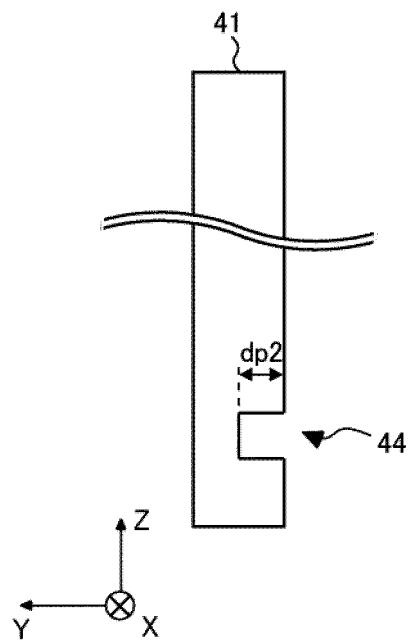


FIG. 19

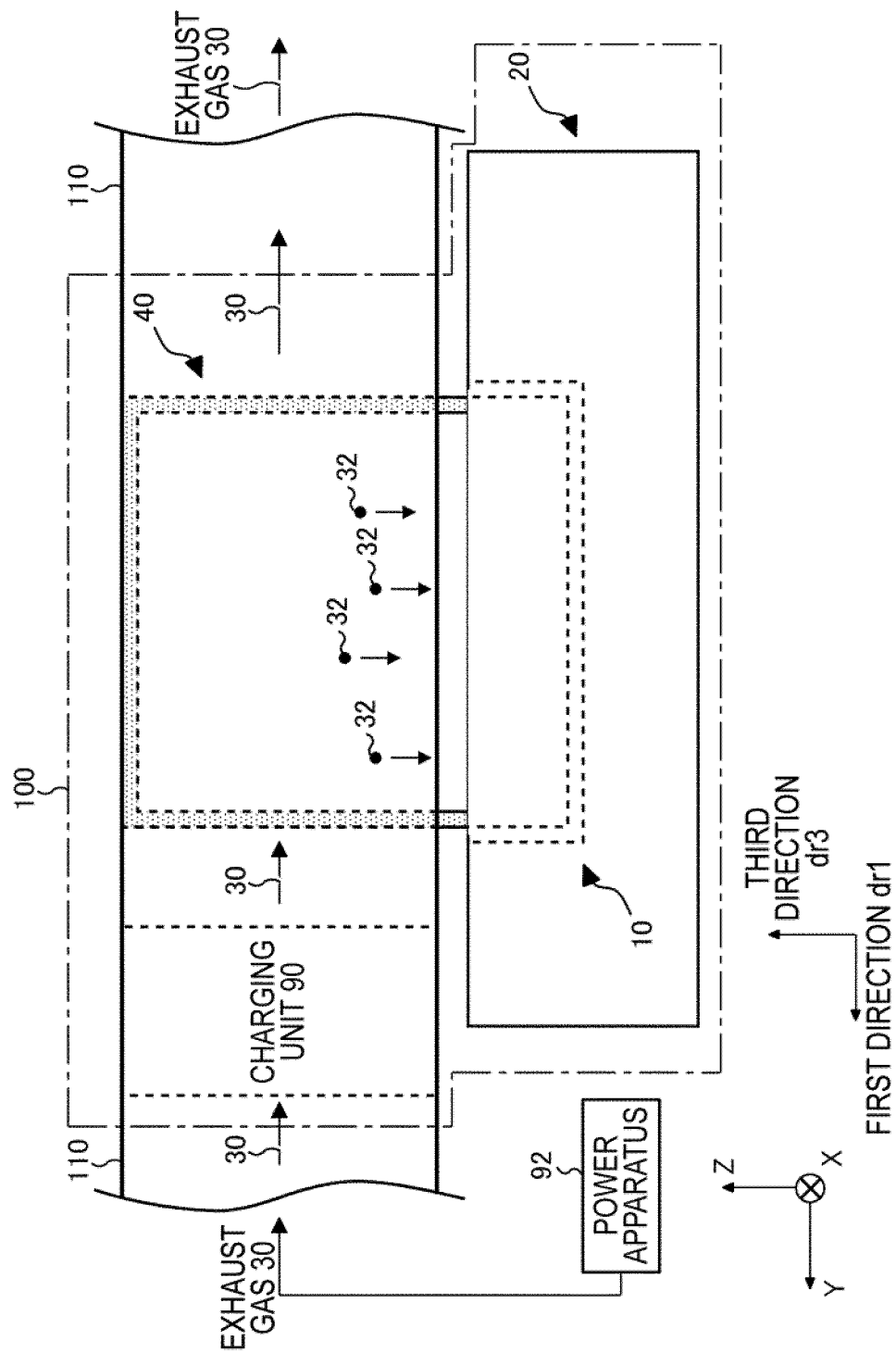


FIG. 20

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/002350

A. CLASSIFICATION OF SUBJECT MATTER <i>B03C 3/40</i> (2006.01)i; <i>B03C 3/74</i> (2006.01)i FI: B03C3/74 Z; B03C3/40 A 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) B03C3/00-3/88; F01N3/00-3/38 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2022 Registered utility model specifications of Japan 1996-2022 Published registered utility model applications of Japan 1994-2022 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)																														
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>JP 8-290029 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 05 November 1996 (1996-11-05) claim 5, paragraphs [0018]-[0021], [0023]-[0025], fig. 2, 3</td> <td>1</td> </tr> <tr> <td>A</td> <td></td> <td>2-16</td> </tr> <tr> <td>Y</td> <td>WO 2015/129233 A1 (PANASONIC CORP.) 03 September 2015 (2015-09-03) claim 1, paragraphs [0021]-[0024], fig. 4</td> <td>1</td> </tr> <tr> <td>A</td> <td></td> <td>2-16</td> </tr> <tr> <td>Y</td> <td>JP 2000-173799 A (SUMITOMO METAL INDUSTRIES, LTD.) 23 June 2000 (2000-06-23) paragraph [0023], fig. 1</td> <td>1</td> </tr> <tr> <td>A</td> <td></td> <td>2-16</td> </tr> <tr> <td>Y</td> <td>JP 2011-252387 A (DENSO CORP.) 15 December 2011 (2011-12-15) claims 1, 8-9</td> <td>1</td> </tr> <tr> <td>A</td> <td></td> <td>2-16</td> </tr> <tr> <td>A</td> <td>WO 2020/084934 A1 (FUJII ELECTRIC CO., LTD.) 30 April 2020 (2020-04-30) entire text</td> <td>1-16</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	JP 8-290029 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 05 November 1996 (1996-11-05) claim 5, paragraphs [0018]-[0021], [0023]-[0025], fig. 2, 3	1	A		2-16	Y	WO 2015/129233 A1 (PANASONIC CORP.) 03 September 2015 (2015-09-03) claim 1, paragraphs [0021]-[0024], fig. 4	1	A		2-16	Y	JP 2000-173799 A (SUMITOMO METAL INDUSTRIES, LTD.) 23 June 2000 (2000-06-23) paragraph [0023], fig. 1	1	A		2-16	Y	JP 2011-252387 A (DENSO CORP.) 15 December 2011 (2011-12-15) claims 1, 8-9	1	A		2-16	A	WO 2020/084934 A1 (FUJII ELECTRIC CO., LTD.) 30 April 2020 (2020-04-30) entire text	1-16
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International application No.

PCT/JP2022/002350

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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