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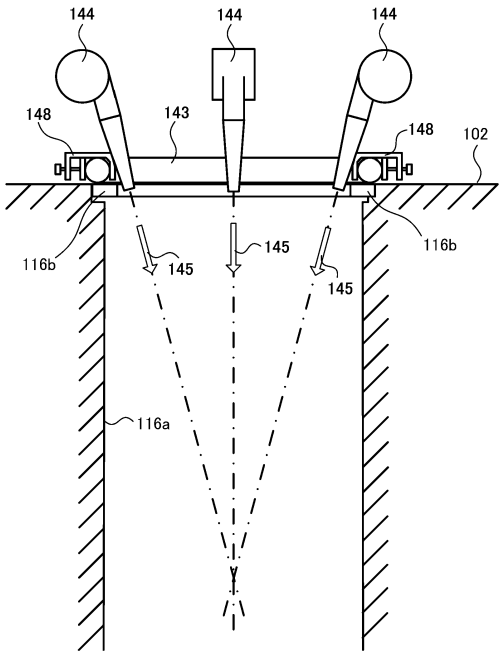
(54) BLOWER AND VENTILATING SYSTEM

(57) Provided is a blower installed at a manhole opening, with which it is possible to facilitate an entry or an exit of a worker or an import or an export of an article. The present invention provides a ventilation system comprising a frame and a single or a plurality of airflow generation means arranged at the frame, a direction of an airflow is adjusted so that the airflow generated from the airflow generation means flows along with a virtual axis penetrating a virtual surface which the frame is regarded as periphery, and the airflow flows while swallowing up the surrounding air of the virtual axis, and an air volume more than two times of total fluid volume of the airflow is generated.

[FIG. 2]



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Description

[Technical Field]

[0001] The present invention relates to a blower and a ventilation system. In particular, the present invention relates to a blower and a ventilation system preferably applied for ventilation in a structure, such as a pipe conduit, a pipe line or tunnel which is installed on and under the ground.

[Background Art]

[0002] In a pipe conduit or a pipe line of sewerage (hereinafter, simply referred to as "pipe conduit"), when a manual work such as a maintenance and inspection is carried out, a worker generally enters from a manhole into a pipe conduit. In the pipe conduit, a worker may be in an oxygen deficiency state, and a poisonous gas such as hydrogen sulfide may be generated, and thus, it is needed to ensure safety management for a worker staying in the pipe conduit.

[0003] Non Patent Literature 1 is a report on a safety in work within a sewer pipe conduit and provides recommendations and specific safety issues based on analysis of an accident case. In particular, on page 27 of the Non Patent Literature 1, a method of ventilating inside pipe conduit is described in which "a fan is installed in consideration of a wind direction of an outer air, and the air is blown from one direction and the air is exhausted to outside from another direction thereby to carry out a ventilation in the pipe conduit. The wind speed in the pipe conduit at this time should be over 0.8 m/second." The Literature illustrates an image of a cleaning work, and provides also an example of a fan and a duct by way of photo. According to the image of the cleaning work, ducts are inserted into both manholes at an air-blow side and an air-exhaust side, and the air is blown and exhausted by the fan connected to a ground surface side of each duct.

[0004] When ventilation is carried out in the structure for the purpose of securing a traffic route such as a tunnel, for example, there is adopted a ventilation method that the fan is installed on a ceiling part of the structure, an airflow is generated in the structure and ventilation is achieved in the structure by intake and exhaust of the airflow from an entrance.

[0005] It is noted that Patent Literature 1 discloses an air intake and exhaust device for a manhole and Patent Literature 2 discloses a ventilation device for an underground structure.

[Citation List]

[Patent Literature]

[0006]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2000-104966
[PTL 2] Japanese Unexamined Patent Application Publication No. 2003-328378

[Non Patent Literature]

[0007] [NPL 1] "Intermediate report on safety management on work within sewer pipe conduit", Sewer Pipe Conduit Work Safety Management Committee, April, 2002 (http://jascoma.com/siryou/k_200804_cyukanhoukoku.pdf)

[Summary of Invention]

[Technical Problem]

[0008] When the fan and the ducts are applied to the manhole as stated in the "image of a cleaning work" described in Non Patent Literature 1 so that the air is blown and exhausted, it is possible to ensure the safety of a worker and it is needed to do so in order to ensure safety in work. On the other hand, a duct inserted into the manhole blocks the manhole opening, and when the duct is inserted into the manhole, it is inconvenient to make an entry or an exit of a worker and an import or an export of a component. Further, when there is no space for an entry or an exit of a person or for an import or an export of an article between the manhole opening and the duct, it is needed to remove the duct from the manhole, resulting in a situation where the air needs be temporarily stopped from being blown or exhausted, hence not preferable for the safety management. Further, when an emergency such as a generation of poisonous gas occurs in the middle of a work in the pipe conduit, it is needed to immediately evacuate the worker from the pipe conduit.

[0009] Furthermore, when means for installing the fan on a ceiling part is adopted for ventilation of the structure for the purpose of securing a traffic route such as a tunnel, space is needed for installation of the fan, sectional area of the structure is increased more than that necessary for the traffic route, therefore cost may be increased for construction of

the structure. Furthermore, the tunnel as the structure for securing the traffic route should not intersect the traffic at an entrance and an exit. A ventilation means is required which does not intersect the traffic at the entrance and the exit.

[0010] An object of the present invention is to provide a preferable blower installed on a manhole opening, with which it is possible to facilitate an entry or an exit of a worker or an import or an export of an article. Further, an object of the present invention is to provide a blower installable at an entrance and an exit without intersecting transportation of a structure such as a tunnel. Additionally, an object of the present invention is to provide a ventilation system using the blower in a pipe conduit or the structure such as the tunnel.

[Solution to Problem]

[0011] To resolve the above-described problem, according to a first aspect of the present invention, there is provided a blower comprising a frame and a single or a plurality of airflow generation means arranged at said frame, wherein a direction of an airflow is adjusted so that said airflow generated from said airflow generation means flows along with a virtual axis penetrating a virtual surface which said frame is regarded as periphery, and said airflow flows while swallowing up the surrounding air of said virtual axis, and an air volume more than two times of total fluid volume of said airflow is generated.

[0012] Said virtual axis vertically may intersect said virtual surface at a center point of the same. Said plurality of airflow generation means may be arranged at said frame, and a direction of each airflows may be adjusted so that each airflow generated by said plurality of airflow generation means flows toward one point on said virtual axis. Said plurality of airflow generation means may be arranged at a symmetric position having a center which is an intersection point of said virtual surface and said virtual axis. A blower may comprise an installation tool for installing said airflow generation means on said frame, wherein said installation tool may include an angle adjustment mechanism for adjusting an angle of said airflow generation means against said virtual surface. An incident angle of said airflow against said virtual surface may be preferable as 16 to 24 degrees. Said airflow generation means may comprise a generation source of said airflow and injection nozzles for injecting said airflow, and said each injection nozzle may comprise a conical part for converging the airflow sent from said generation source, and a cylindrical part positioned at a top end of said conical part. Said injection nozzle may comprise a direction adjustment mechanism for adjusting a direction of said airflow. A blower may comprise a fixing tool for fixing said frame to the manhole opening. A blower may comprise a blockage member for blocking a gap between a circumferential area of the manhole opening and said frame. A blower may comprise an airflow reflection member which is installed at the manhole opening, is flexible member dropping to a lower part in the manhole, and converts a direction of airflow from a vertical direction to a horizontal direction. A blower may comprises an additive supplying means for supplying one or more additives selected among an aromatic, water or steam to an air inflowed into said airflow generation means.

[0013] According to a second aspect of the present invention, there is provided a ventilation system using the above-mentioned blower, wherein said blower is installed in an entrance or an exit of a pipe conduit, a pipe line or a path, or at least one of an entrance, an exit or a manhole of a manhole connected to the pipe conduit or the pipe line, or the manhole.

[0014] A ventilation system may comprise an airflow direction conversion means for converting a direction of the airflow from a vertical direction to a horizontal direction, or from the horizontal direction to the vertical direction at an entrance or an exit to which said blower is installed, or at a bottom of the manhole. Said airflow direction conversion means may be an airflow reflection plate for converting a direction by reflecting said airflow. Said airflow direction conversion means may comprise a second airflow generation means for generating a second airflow different from the airflow from said blower, and said second airflow is joined in a different direction from the airflow from said blower and the direction of said airflow is converted. An exhaust device may be installed on at least one of an entrance, an exit or a manhole which is different from an entrance, an exit or a manhole on which said blower is installed. Said exhaust device may be preferably installed on a first entrance, exit or manhole which are located downstream relative to the entrance, the exit or the manhole on which said blower is installed. The ventilation system may comprise an airflow direction conversion means for converting a direction of the airflow from a vertical direction to a horizontal direction, or from the horizontal direction to the vertical direction at an entrance, an exit or a bottom of a manhole to which said exhaust device is installed.

[0015] It is noted that the above-described Summary of Invention does not list all the characteristics necessary for the present invention. Further, a subcombination of these groups of characteristics may be invention.

[Brief Description of Drawings]

[0016]

[FIG. 1] FIG. 1 is a cross-sectional view showing an example of a ventilation system of a sewer pipe conduit.
[FIG. 2] FIG. 2 is a cross-sectional view showing an example of a blower 140 arranged at a manhole opening.
[FIG. 3] FIG. 3 is a top view showing an example of a blower 140 arranged at a manhole opening.

[FIG. 4] FIG. 4 is a schematic view showing an example of an airflow generation means 144.
[FIG. 5] FIG. 5 is a cross-sectional view showing another example of a ventilation system of a sewer pipe conduit.
[FIG. 6] FIG. 6 is a cross-sectional view showing a variation of a ventilation system 200.
[FIG. 7] FIG. 7 is a cross-sectional view showing another variation of a ventilation system 200.
[FIG. 8] FIG. 8 is a cross-sectional view showing yet another example of a ventilation system of a sewer pipe conduit.
[FIG. 9] FIG. 9 is a cross-sectional view showing still yet another example of a ventilation system of a sewer pipe conduit.
[FIG. 10] FIG. 10 is a cross-sectional view showing another example of a blower 140 arranged at a manhole opening.
[FIG. 11] FIG. 11 is a cross-sectional view showing yet another example of a ventilation system of a sewer pipe conduit.

[Description of Embodiments]

[0017] Hereinafter, the present invention will be described by way of an embodiment of the present invention, however, an embodiment that follows is not limiting the invention as set forth in the scope of claims. Further, all the combinations of characteristics described in the embodiment are not necessary essential for the means for solving the invention.

[0018] FIG. 1 is a cross-sectional view showing an example of a ventilation system of a sewer pipe conduit. A ventilation system 100 ventilates a pipe conduit 110 buried beneath a ground surface 102. The pipe conduit 110 is an underground space divided by a bottom 114 and a wall surface 112, and includes a cross-sectional surface having a shape of a horseshoe. Between the pipe conduit 110 and the ground surface 102, a manhole 116 and a manhole 118 are arranged, and a worker is capable of entering the pipe conduit 110 through the manhole 116 or the manhole 118. In the present embodiment, description proceeds with a case where the pipe conduit 110 between the manhole 116 and the manhole 118 is ventilated. The manhole 116 is at an air-blow side and the manhole 118 is at an air-exhaust side. In this case, description proceeds with a case where the manhole 116 and the manhole 118 are adjacent to each other, however, the manhole 116 and the manhole 118 need not be adjacent to each other. In order to shield a pipe conduit region between the manhole 116 and the manhole 118 from another pipe conduit region, a shield curtain 120 may be arranged in the pipe conduit 110. The shield curtain is efficient in ventilation.

[0019] A blower 140 is installed at an opening of the manhole 116 at the air-blow side, and an exhaust device 170 is installed at the manhole 118 at the air-exhaust side. The exhaust device 170 is a conventional fan-type exhaust device, and a duct 172 connected to the exhaust device 170 is inserted into the manhole 118. It is noted that the blower 140 may be installed at a plurality of manholes, and the exhaust device 170 may be installed at a plurality of manholes. Further, the manhole 118 is preferably the first manhole on downstream side of the manhole 116. When the blower 140 is installed on upstream side and the exhaust device 170 is installed on downstream side, it is possible to blow air along a flow of sewage. Further, when the blower 140 and the exhaust device 170 are installed between the adjacent manholes, it is possible to shorten a distance between the air-blow and the air-exhaust, resulting in a good ventilation efficiency.

[0020] FIG. 2 is a cross-sectional view showing an example of the blower 140 installed in a manhole opening 116b, and FIG. 3 is a top view thereof. Reference numeral 116a shows a manhole inner wall, and a worker can go in and out of the manhole 116 by using lifting metal fittings (not shown).

[0021] The blower 140 has a frame 143 and an airflow generation means 144, and the plurality of airflow generation means 144 are arranged along the frame 143.

[0022] The frame 143 is, for example, formed with metals, and has a ring-like shape. The shape of the frame 143 is not limited. An outer appearance of the frame 143 may have a ring-like or circular arc-like outer appearance corresponding to a shape of a manhole opening 116b, however, it is not limited thereto. The shape of the frame 143 may have a polygon, such as a triangle, a square, and a hexagon, an oval shape, and a shape of horseshoe.

[0023] The airflow generation means 144 generates an airflow 145 in the direction of the arrow as shown in figures. As the airflow generation means 144. a blower having an electric fan can be illustrated. Alternatively, as the airflow generation means 144, a DC fan can be illustrated. The airflow generation means 144 is not limited to the electric fan or the DC fan, and has only to generate the airflow.

[0024] FIG. 4 is a schematic view showing an example of the airflow generation means 144. The airflow generation means 144, for example, comprises a generation source of the airflow and an injection nozzle for injecting the airflow. As the generation source of the airflow, the DC fan 144a can be illustrated, and the airflow is sent from an outgoing port 114b of the DC fan 144a. The injection nozzle comprises a conical part 144c for converging the airflow sent from the outgoing port 114b and a cylindrical part 144d placed at end part of the conical part 144c. Owing to the cylindrical part 144d, a wind speed of the airflow is maintained and turbulence of the airflow is suppressed.

[0025] A direction of airflow 145 is adjusted so that the airflow 145 generated by the airflow generation means 144 flows along with a virtual axis 147 penetrating a virtual surface 146 which the frame 143 is regarded as periphery. In the blower 140 as shown in FIGS. 2 and 3, the virtual axis 147 is a center line for vertically penetrating a center of the virtual surface 146 which the frame 143 is regarded as periphery. By adjusting the direction of the airflow 145 so that the airflow 145 flows along with the virtual axis 147, the airflow 145 flows while swallowing up the surrounding air of the virtual axis

147, and there is generated an air volume more than two times of total fluid volume of the airflow 145.

[0026] The airflow generation means 144 is installed at the frame 143 by an installation tool 148. The installation tool 148 may include an angle adjustment mechanism for adjusting the angle of the airflow generation means 144 relative to a disk surface of the frame 143 (the virtual surface 146 which the frame 143 is regarded as periphery). An installation angle of the airflow generation means 144 is adjusted by the angle adjustment mechanism and each of the plurality of airflow generation means 144 can be arranged toward one point on a normal line (the virtual axis 147) positioned to the center of the disk surface of the frame 143. The airflow generation means 144 may comprise the injection nozzle for injecting the airflow, and the injection nozzle may adjust the direction of the airflow 145.

[0027] The installation tool 148 may include a clamp part for clamping the frame 143. In this case, it is possible that the clamp part makes the airflow generation means 144 detachable from the frame 143 and the angle of the airflow generation means 144 adjustable. Further, when the installation tool 148 includes the clamp part, the airflow generation means 144 becomes detachable from the frame 143, and therefore, the frames 143 having various sizes of diameters corresponding to the manholes having various sizes of opening diameters are prepared, and the frame 143 appropriate for the opening diameter of the manhole is selected and the airflow generation means 144 is attached by the clamp part to the selected frame 143. As a result, it is possible to easily comply with manholes having various diameters.

[0028] In the present embodiment, the number of airflow generation means 144 is four, and the four airflow generation means 144 are arranged at equal intervals along the frame 143. The number of airflow generation means 144 is not limited to four, and at least two or more airflow generation means may suffice. However, in consideration of efficiency of air blow, the number of airflow generation means 144 is preferably more than three. The more the airflow generation means, the better the efficiency of the air blow, however, an unnecessary large number of airflow generation means may result in a cost increase. Therefore, the number of airflow generation means 144 is preferably decided on the basis of the balance between the air-blow efficiency and the cost. The plurality of airflow generation means 144 is preferably disposed on a symmetric position having a center which is an intersection point of the virtual surface 146 and the virtual axis 147.

[0029] The frame 143 may be configured by a plurality of members. In this case, when transported, the frame 143 may be separate in a plurality of members. The frame 143 may be folded so that the plurality of members are piled each other. Furthermore, a fixing tool for fixing the frame 143 at the manhole opening 116b may be included. When the blower 140 is fixed at the manhole opening, it is possible to increase the safety level.

(Example 1)

[0030] Table 1 shows a result of an experience by measuring an air volume, where a blower 140 is installed at one end of a pipe having an inner diameter of 600mm and a length of 2m, and at another end of the pipe, the air volume is measured.

Table 1

	experimental example 1	experimental example 2	experimental example 3	experimental example 4	experimental example 5	experimental example 6	comparative example 1
discharge diameter (mm)	24	24	24	24	24	24	300
number of discharge port	2	2	3	3	4	4	1
power supply (W)	1000	650	1440	970	1820	1240	550
discharge air volume (m^3/min)	4.6	2.4	6.9	3.5	9.2	4.5	35.9
pipe exit air volume (m^3/min)	77	67	100	77	127	86	59
multiplication constant (times)	16.7	27.9	14.5	22	13.8	19.1	1.6

[0031] Experimental examples Nos. 1 to 6 are cases that the blower 140 is applied, and a comparative example No. 1 is a case that the conventional fan and duct are applied. In the experimental examples Nos. 1 to 6, the airflow generation means 144 is an electric blower having a discharge diameter of 24mm. In the experimental examples Nos. 1 to 6, there are changes in the number of discharge ports and the number of the electric blowers within the range of 2 to 4, and power supply (total volume) to the electric blower is also changed within a range of 650W to 1820W. Total air volume at the discharge port (discharge air volume) of the electric blower is equal to a total volume of the airflow 145 at the blower 140 and is shown in Table 1. The air volume (pipe exit air volume) at another end (exit) of the pipe is, as shown in Table 1, more than two times of the discharge air volume (total volume of the airflow 145) in the experimental examples Nos. 1 to 6, and multiplication constant (pipe exit air volume / discharge air volume) becomes larger within a range of 13.8 to 27.9. This is because the airflow 145 is adjusted so as to flow along with the virtual axis, while swallowing up the surrounding air of the virtual axis. As a result, a large volume of air more than the total volume of the airflow 145 is sent out. On the other hand, in the comparative example, multiplication constant is equal to 1.6, and effect such in the present invention has not been found.

(Example 2)

[0032] A length of nozzle of the airflow generation means was changed within a range of 100mm to 300mm, and diameters of the nozzles were changed within a range of 30mm to 50mm. As a result, the maximum discharge wind speed 27m/s is obtained when the length of the nozzle is 100mm and the diameter of the nozzle is 100mm. However, when the length of the nozzle is 100mm and the diameter of the nozzle is 40mm, turbulence of the airflow at the discharge port of the nozzle became large. Taking these into consideration, a nozzle was prepared which has a length of a conical part of 100mm, a length of a cylindrical part of 50mm, and a shape of a cylinder is added to a top end of the cone. This nozzle maintains the maximum wind speed 27m/s at the discharge port and turbulence of the airflow was not found.

(Example 3)

[0033] Table 2 shows a result of an experience by measuring an average wind speed and air volume, where two airflow generation means 144 are installed with different angles at one end of a pipe having an inner diameter of 600mm and a length of 2m, and at another end of the pipe, the average wind speed and the air volume are measured.

Table 2

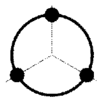
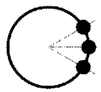
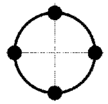
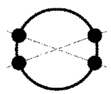
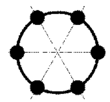
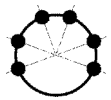
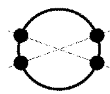
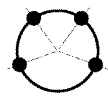
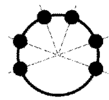
	experimental example 7	experimental example 8	experimental example 9	experimental example 10	experimental example 11	experimental example 12	experimental example 13	experimental example 14
focal position (m)	0.50	0.70	0.75	0.80	1.00	1.25	1.50	2.00
pipe exit average wind speed (m/s)	2.42	2.55	2.54	2.50	2.51	2.37	2.26	2.25
pipe exit air volume (m^3/min)	39.64	41.75	41.71	41.04	41.17	38.91	37.02	36.90

[0034] Preferable air quantities are obtained in experimental examples No. 8 (focal position being 0.70m) to No. 11 (focal position being 1.00m). A range of the focal position falls within 16.7 to 23.2 degrees of an incident angle against a cross-section of the pipe of the airflow discharged from the nozzle. It becomes apparent that preferable pipe exit air volume can be obtained when the angle against the cross-section of the pipe of the nozzle becomes 16 to 24 degrees.

(Example 4)

[0035] Table 3 shows a result of an experience by measuring an average wind speed and air volume, where the number and arrangement of airflow generation means 144 of the Example 2, and an output of a a generation source of the airflow (the discharge wind speed) are changed, and at another end of the pipe, the average wind speed and the air volume are measured. In Table 3, item of "an arrangement of nozzles" means a position of each nozzle on the frame143 of the airflow generation means 144. In experimental examples 15, 17 and 19, the airflow generation means 144 are arranged in a manner of three-fold symmetry, four-fold symmetry and six-fold symmetry against each of the virtual axis 147. On the other hand, experimental examples 16, 18 and 20 show experimental examples having axial symmetry lower than that of the experimental examples 15, 17 and 19. An angle (only an acute angle) made by each airflow generation means 144 becomes 30 degrees in the experimental example 16, 40 degrees in the experimental example 18, and 40 and 50 degrees in experimental example 20. Nozzle arrangement of the experimental examples 21 and 23 is equal to that of the experimental examples 18 and 20. An angle (only an acute angle) made by each airflow generation means 144 of the experimental example 22 becomes 73 degrees.

Table 3

	experimental example 15	experimental example 16	experimental example 17	experimental example 18	experimental example 19	experimental example 20	experimental example 21	experimental example 22	experimental example 23
number of discharge port (number of nozzle)	3	3	4	4	6	6	4	4	6
discharge wind speed (m/s)	27	27	27	27	27	27	31	31	31
nozzle arrangement									
pipe exit average wind speed (m/s)	3.18	2.53	3.62	3.40	4.34	4.58	4.47	4.47	5.33
pipe exit air volume (m^3/min)	52.09	41.45	59.37	55.72	71.18	75.06	73.24	73.24	87.44

[0036] It becomes apparent that preferable pipe exit air quantities are obtained in comparison with the experimental examples 15, 16, 17 and 18 when the nozzle arrangement is made as symmetry against a center axis. The larger the number of the airflow generation means 144 (the number of nozzles) and the larger an output of the generation source of the airflow (discharge wind speed), it becomes apparent that the preferable pipe exit air volume is obtained. In the experimental example 23, practically enough pipe exit air volume (87.44m^3/min) was obtained. In comparison with experimental examples 21 and 22, the experimental example 21 is higher in symmetry of the nozzle arrangement than that of the experimental example 22. On the other hand, considering a case a worker moves up and down with holding the frame 143 by a hand, the nozzle arrangement of the experimental example 22 is preferable due to no difficulty to hold the frame 143. In this case, the nozzle arrangement of the experimental example 22 may be applied, taking ease of moving up and down of the worker into consideration, rather than priority of the symmetry of the nozzle arrangement.

[0037] As described above, according to the ventilation system 100 of the present invention, it is possible to obtain the wind speed equivalent to or more than the conventional ventilation system. In addition, the blower 140 of the present ventilation system 100 is different from the conventional fan-type blower and does not need a flexible duct. Thus, it is possible to make the blower smaller in size. Further, in the blower 140 of the present invention, the manhole opening is not blocked as the conventional blower, so that an entry or an exit of a worker and an import or an export of an article are facilitated, and it is not necessary to stop the operation of the blower 140 during importation or exportation. Moreover, it is possible to ensure an escape route in emergency, and possible to further increase the safety of a worker.

[0038] Thus, the present invention is described by using an embodiment; however, the technical scope of the present invention is not limited to the scope of the above-described embodiment. It is evident to those skilled in the art that various modifications or improvements can be added to the embodiment above. It is also evident, based on the recitation of the claims, that the aspects to which the various modifications or improvements have been added may be also included in the technical scope of the present invention.

[0039] For example, FIG. 5 is a cross-sectional view showing another example of the ventilation system of the sewer pipe conduit. In a ventilation system 200 shown in FIG. 5, an airflow reflection plate 202 for converting a direction of airflow from a vertical direction to a horizontal direction or from a horizontal direction to a vertical direction is installed at a bottom of either one or both of the manhole 116 in which the blower 140 is installed and the manhole 118 in which the exhaust device 170 is installed. Such an airflow reflection plate 202 regulates a flow of air and reduces energy loss of an airflow generated when the direction of the flow of air is changed to achieve a more smooth flow, and as a result of which it is possible to increase the flow speed and the air volume in the pipe conduit 110.

[0040] As the airflow direction converting means, as shown in FIG. 6, a second airflow generation means 204 may be used. As the second airflow generation means 204, a normal fan-type blower can be illustrated. The second airflow generation means 204 generates a second airflow 206 different from the airflow from the blower 140, and the second airflow 206 is joined from a direction different from that of the airflow from the blower. The direction of the airflow is converted thereby. As shown in FIG. 7, instead of the second airflow generation means 204, the same means as the airflow generation means 144 may be used.

[0041] Further, FIG. 8 is a cross-sectional view showing yet another example of a ventilation system of a sewer pipe conduit. In a ventilation system 300 shown in FIG. 8, the blower 140 of the present invention is installed at the manhole 116 at the air-blow side, and in addition, a blower 340 equivalent to the blower 140 of the present invention is installed at the manhole 118 at the air-exhaust side. According to the ventilation system 300, the blower 340 of the present invention is installed also at the manhole 118 at the air-exhaust side, so that exhaust performance is improved, an entry or an exit of a worker and an import or an export of an article are further facilitated, and it is possible to further increase the safety of a worker while ensuring a plurality of escape routes in emergency.

[0042] Further, FIG. 9 is a cross-sectional view showing still yet another example of a ventilation system of a sewer pipe conduit. A ventilation system 400 shown in FIG. 9 is provided with a booster 402 in the pipe conduit 110. In the booster 402, a blower equivalent to the blowers 140 and 340 is provided. The booster 402 generates the airflow in a direction to accelerate a flow in the pipe conduit 110. According to the ventilation system 400, the airflow in the pipe conduit 110 is bolstered by the booster 402, and thus, it is possible to further increase the safety of a worker. It is noted that in the ventilation system 400, instead of the exhaust device 170 and the duct 172, the blower 340 may be installed at the manhole 118 at the air-exhaust side as in the ventilation system 300.

[0043] In the above-described embodiment as the blower 140, an example is described in which the airflow generation means 144 having a cylindrical flow channel is arranged discontinuously along the frame 143; however, an opening of the nozzle may be arranged sequentially or continuously along the frame. For example, a nozzle having a slit-like opening is adopted, an air is supplied to a flow channel connected to the slit-like opening, the air is emitted in a normal direction of a disk surface of which the circumference is a frame, and the air is emitted while swallowing up the surrounding air. In this way, the airflow may be generated in the normal direction of the disk surface. The slit-like nozzle in this case may be formed with an opening continuously all across the entire frame, and in a slit-like nozzle having an opening with an appropriate length, the opening may be arranged continuously along the frame.

[0044] In the above-described embodiment, an example is described that the frame 143 suitable for the diameter of

the manhole opening 116b is applied, however, as shown in FIG. 10, a blockage member 502 and the frame 143 having a diameter smaller than the diameter of the manhole opening 116b may be applied to the manhole 116 having a larger opening. The blockage member 502 is to block a gap between a circumferential area of the manhole opening 116b and the frame 143, and is capable of making the frame 143 suitable for the manhole opening 116b having a larger diameter.

[0045] Further, as shown in FIG. 11, the blower 140 may include an airflow reflection member 602. The airflow reflection member 602 is a flexible member such as nylon, for example, and converts the direction of air flow from a vertical direction to a horizontal direction. The airflow reflection member 602 installed on the manhole opening 116b is dropped, by a rope member 604, for example, to a lower part in the manhole 116. When folded back, the airflow reflection member 602 and the rope member 604 can be stored in a compact manner, and convenient to simply expand by being installed at the manhole opening 116b and then dropped, hence convenient.

[0046] Further, in the above-described embodiment, an additive supplying means for supplying the one or more additives selected among an aromatic, water or steam to an air inflowed into the airflow generation means 144. As the additive supplying means, it has only to put the aromatic, the water or the steam at the entrance of airflow. By supplying the aromatic, it is possible to inform a worker working in the pipe conduit 110 that the air is normally supplied. Furthermore, by supplying the water and the steam, it is possible to protect the worker working in the pipe conduit 110 from drying.

[0047] In the above-described embodiment, description is made about an example that the blower and the ventilation system are applied to mainly the manhole and the underground pipe conduit, however, it is not necessary the pipe conduit arranged underground, and the present invention is applied to the pipe conduit and a pipe line installed on the ground. In addition, the above-described blower and ventilation system can be applied to the structure which should not intersect the traffic at the entrance and the exit of the tunnel. When the blower and the ventilation system according to the present invention are applied to the tunnel, it is not necessary to install an additional blower on the ceiling for ventilation and the structure of the tunnel can be made small and cost for construction can be suppressed.

Claims

1. A blower comprising a frame and a single or a plurality of airflow generation means arranged at said frame, wherein a direction of an airflow is adjusted so that said airflow generated from said airflow generation means flows along with a virtual axis penetrating a virtual surface which said frame is regarded as periphery, and
said airflow flows while swallowing up the surrounding air of said virtual axis, and an air volume more than two times of total fluid volume of said airflow is generated.

2. A blower according to claim 1, wherein
said virtual axis vertically intersects said virtual surface at a center point of the same.

3. A blower according to claim 1 or 2, wherein
said plurality of airflow generation means are arranged at said frame, and
a direction of each airflow is adjusted so that each airflow generated by said plurality of airflow generation means flows toward one point on said virtual axis.

4. A blower according to claim 3, wherein
said plurality of airflow generation means are arranged at a symmetric position having a center which is an intersection point of said virtual surface and said virtual axis.

5. A blower according to any one of claims 1 to 4 comprising an installation tool for installing said airflow generation means on said frame, wherein said installation tool may include an angle adjustment mechanism for adjusting an angle of said airflow generation means against said virtual surface.

6. A blower according to any one of claims 1 to 5, wherein an incident angle of said airflow against said virtual surface becomes 16 to 24 degrees.

7. A blower according to any one of claims 1 to 6, wherein
said airflow generation means comprises a generation source of said airflow and injection nozzles for injecting said airflow, and
said each injection nozzle comprises a conical part for converging the airflow sent from said generation source, and a cylindrical part positioned at a top end of said conical part.

8. A blower according to claim 7, wherein said injection nozzle comprises a direction adjustment mechanism for

adjusting a direction of said airflow.

9. A blower according to any one of claims 1 to 8, further comprising a fixing tool for fixing said frame to the manhole opening.

10. A blower according to any one of claims 1 to 9, further comprising a blockage member for blocking a gap between a circumferential area of the manhole opening and said frame.

11. A blower according to any one of claims 1 to 10, further comprising an airflow reflection member which is installed at the manhole opening, is flexible member dropping to a lower part in the manhole, and converts a direction of airflow from a vertical direction to a horizontal direction.

12. A blower according to any one of claims 1 to 11, further comprising an additive supplying means for supplying one or more additives selected among an aromatic, water or steam to an air inflowed into said airflow generation means.

13. A ventilation system using the blower according to any one of claims 1 to 12, wherein
said blower is installed in an entrance or an exit of a pipe conduit, a pipe line or a path, or at least one of an entrance, an exit or a manhole of a manhole connected to the pipe conduit or the pipe line, or the manhole.

14. A ventilation system according to claim 13, comprising an airflow direction conversion means for converting a direction of the airflow from a vertical direction to a horizontal direction, or from the horizontal direction to the vertical direction at an entrance or an exit to which said blower is installed, or at a bottom of the manhole.

15. A ventilation system according to claim 14, wherein
said airflow direction conversion means is an airflow reflection plate for converting a direction by reflecting said airflow.

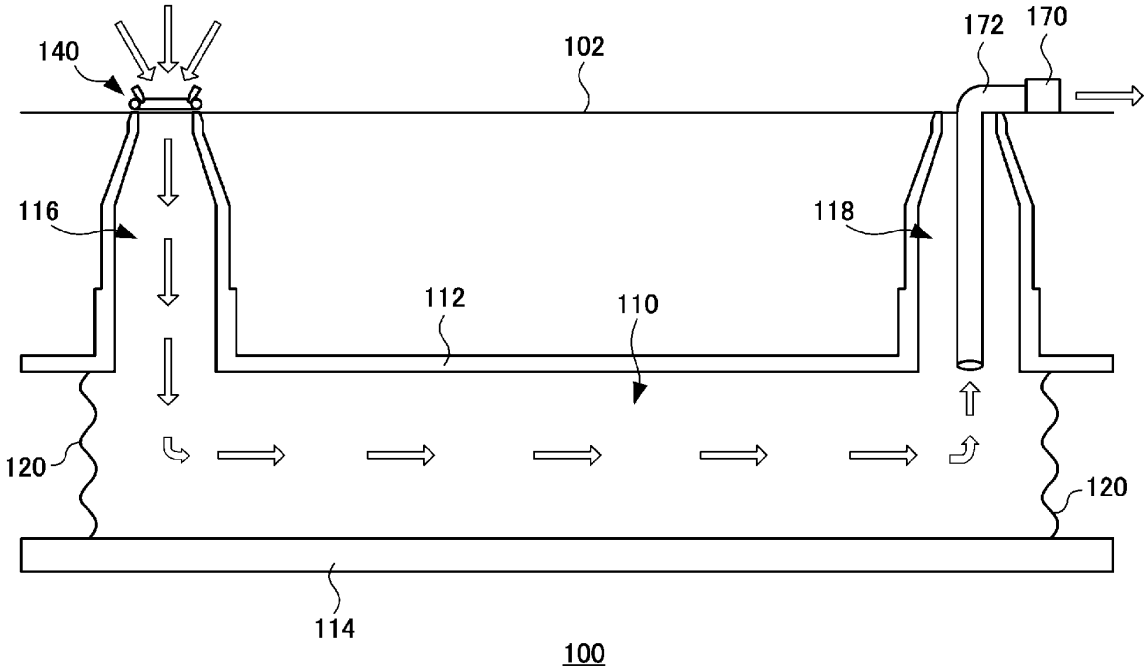
16. A ventilation system according to claim 14, wherein
said airflow direction conversion means comprises a second airflow generation means for generating a second airflow different from the airflow from said blower, and
said second airflow is joined in a different direction from the airflow from said blower and the direction of said airflow is converted.

17. A ventilation system according to any one of claims 13 to 16, wherein
an exhaust device is installed on at least one of an entrance, an exit or a manhole which is different from an entrance, an exit or a manhole on which said blower is installed.

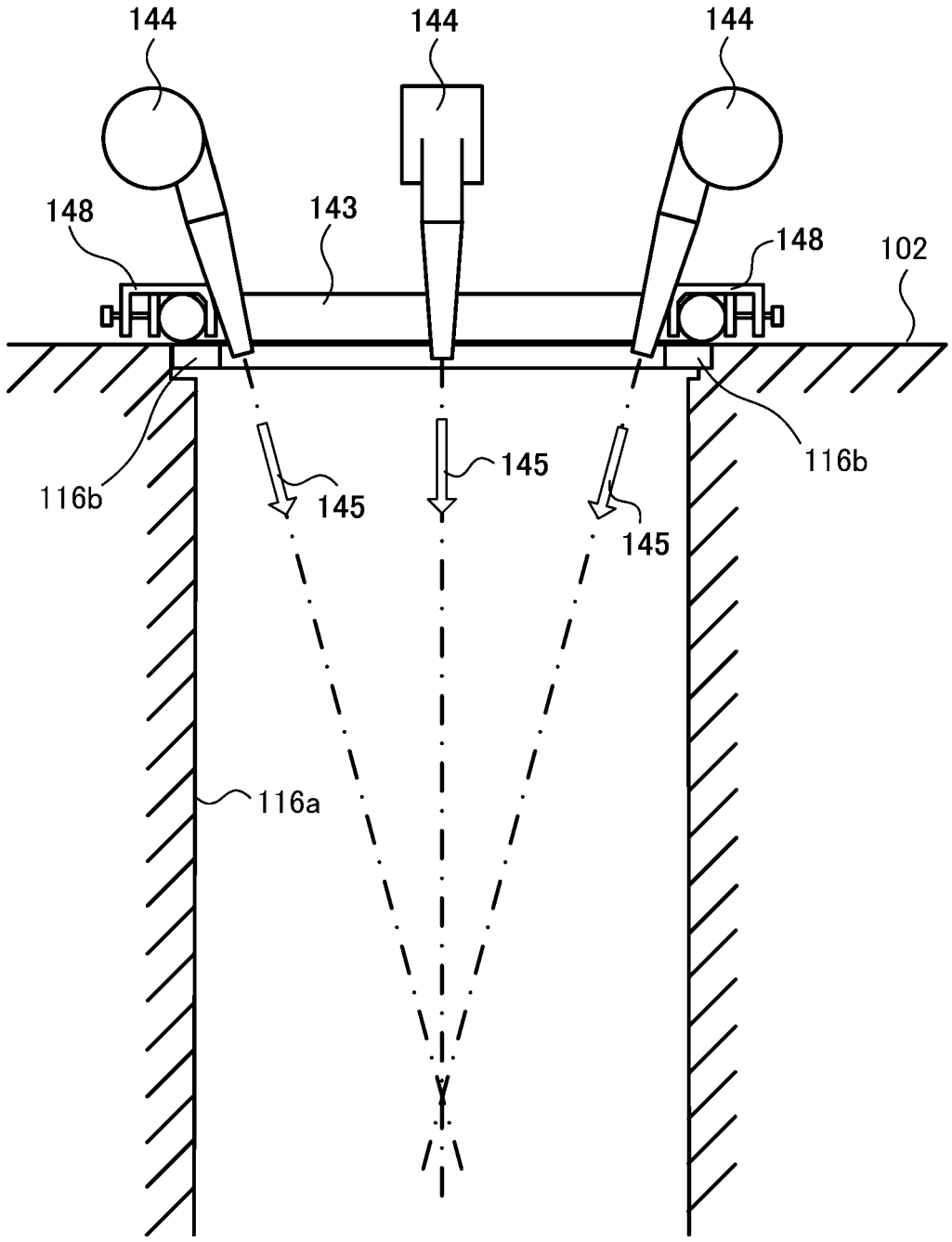
18. A ventilation system according to claim 17, wherein
said exhaust device is installed on a first entrance, exit or manhole which are located downstream relative to the entrance, the exit or the manhole on which said blower is installed.

19. The ventilation system according to claim 17 or 18, comprising an airflow direction conversion means for converting a direction of the airflow from a vertical direction to a horizontal direction, or from the horizontal direction to the vertical direction at an entrance, an exit or a bottom of a manhole to which said exhaust device is installed.

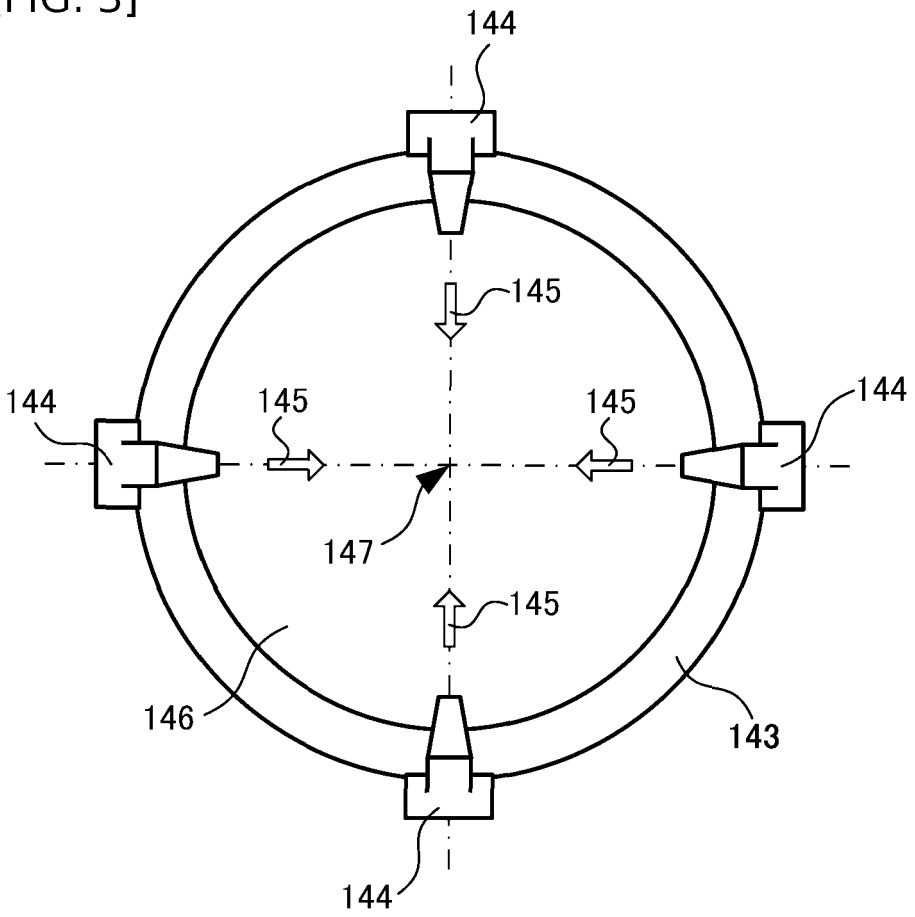
[FIG. 1]



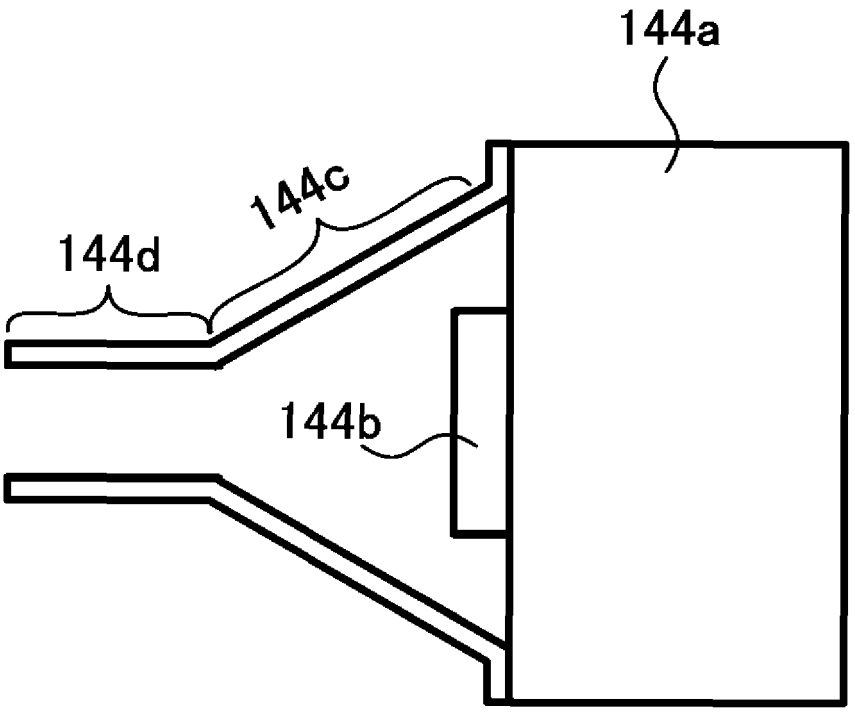
[FIG. 2]



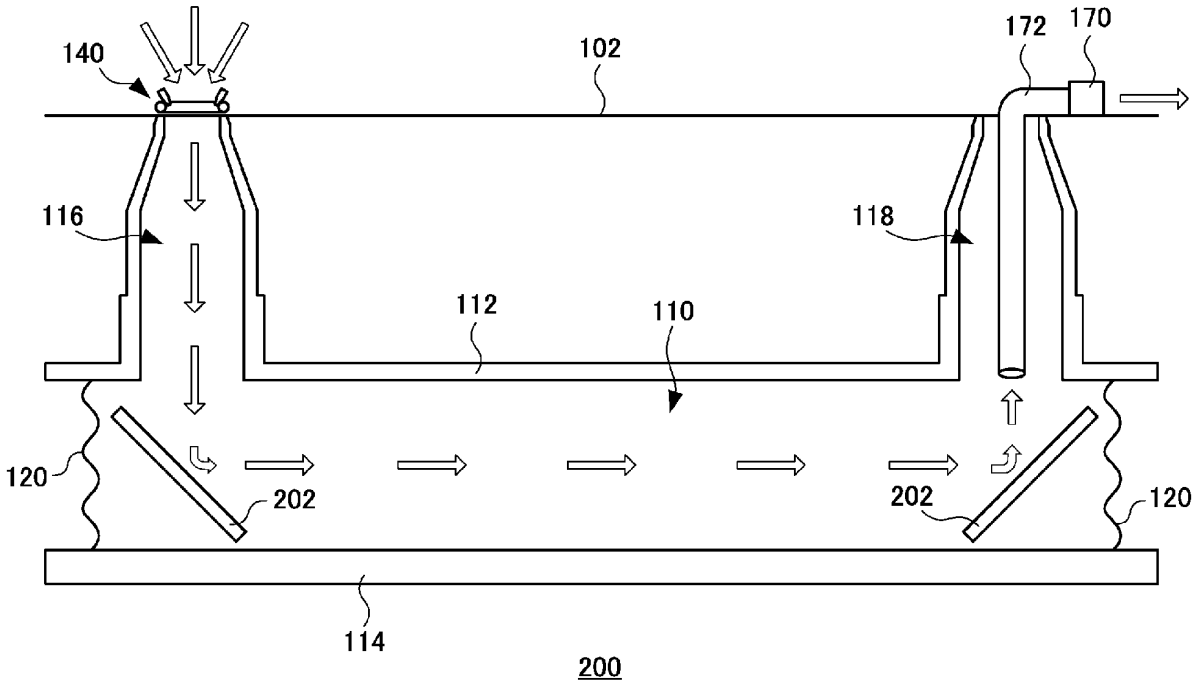
[FIG. 3]



[FIG. 4]



[FIG. 5]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172
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116
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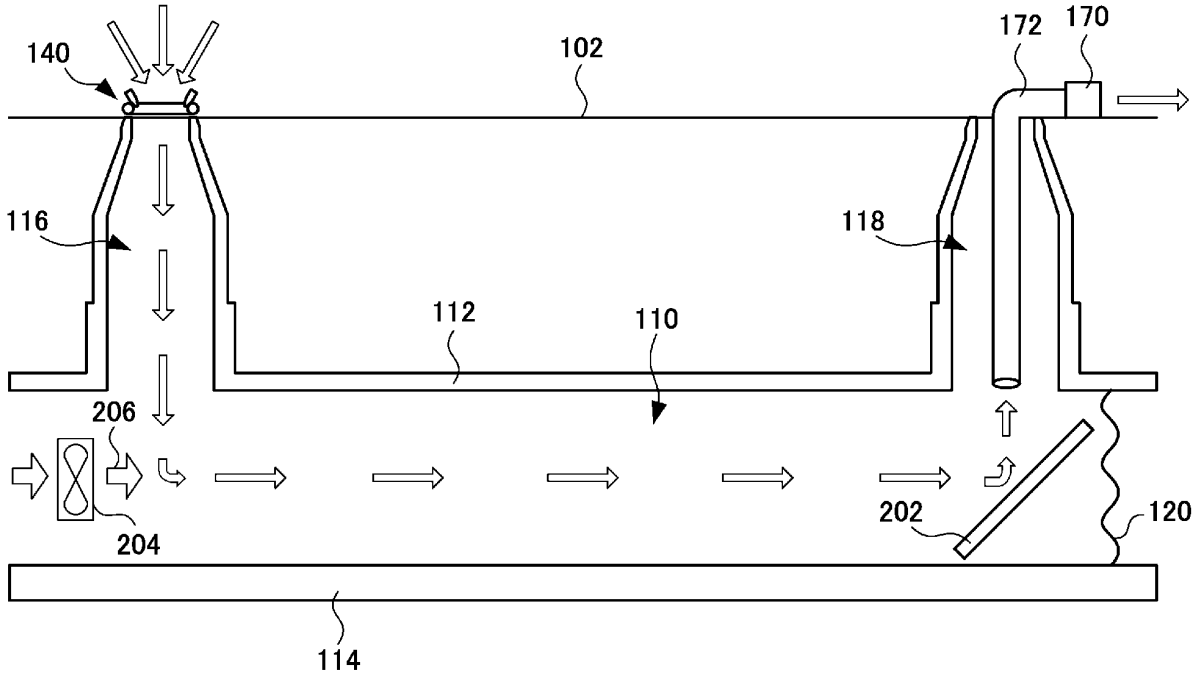
114
200

[FIG. 6]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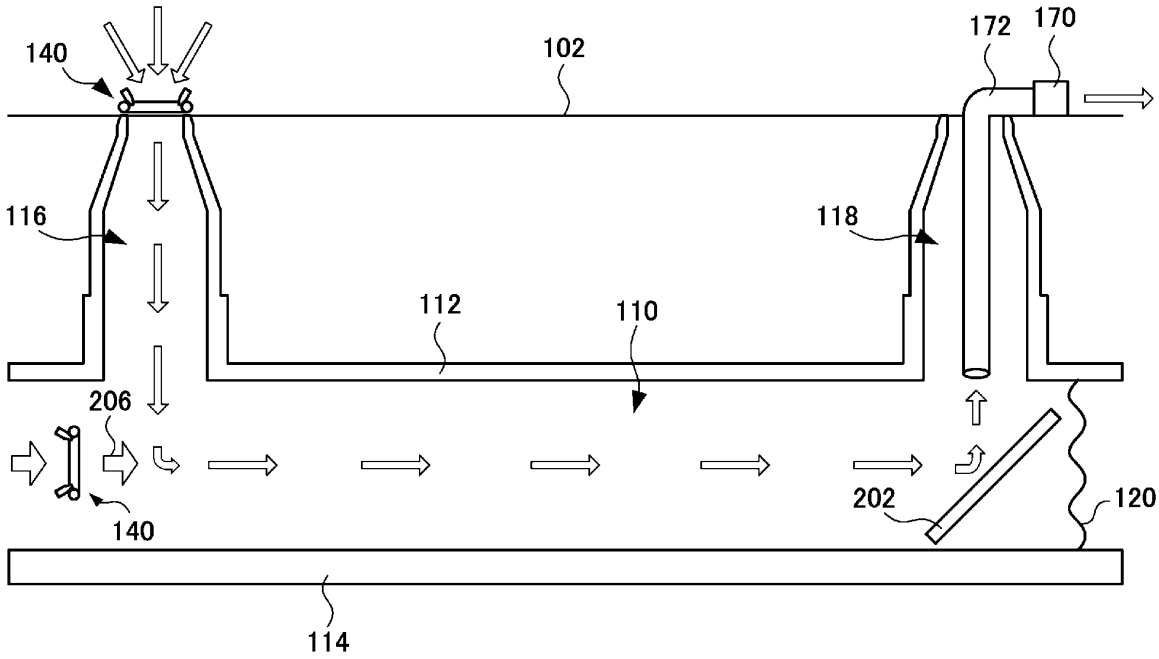
[FIG. 7]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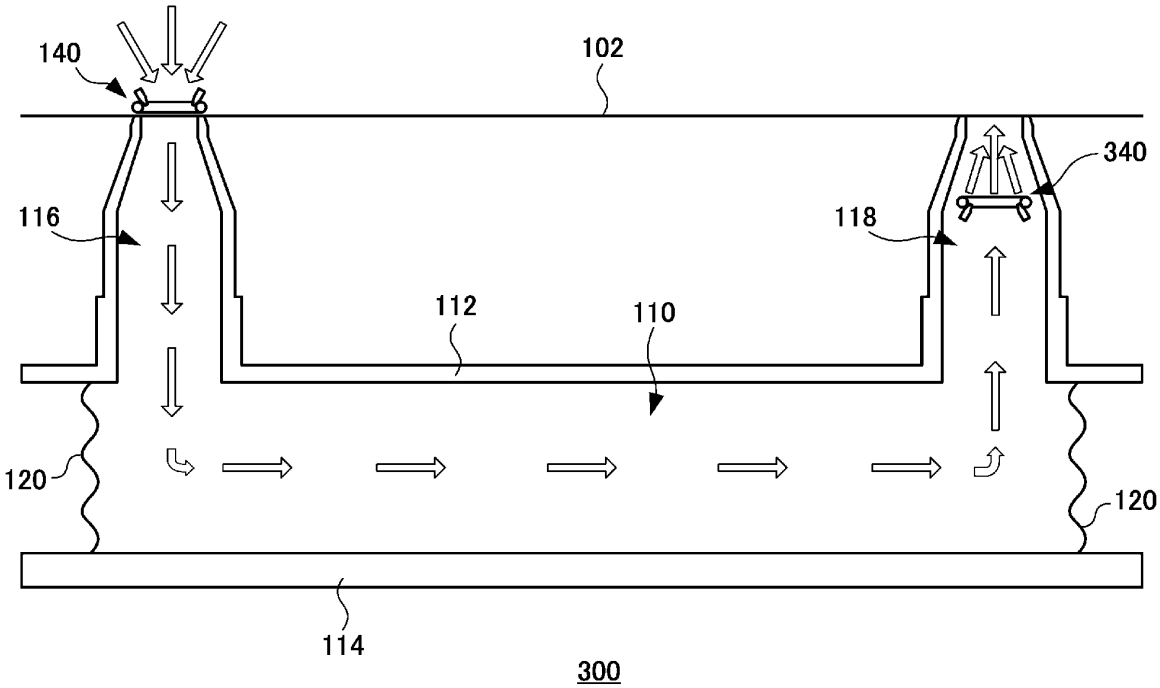
[FIG. 8]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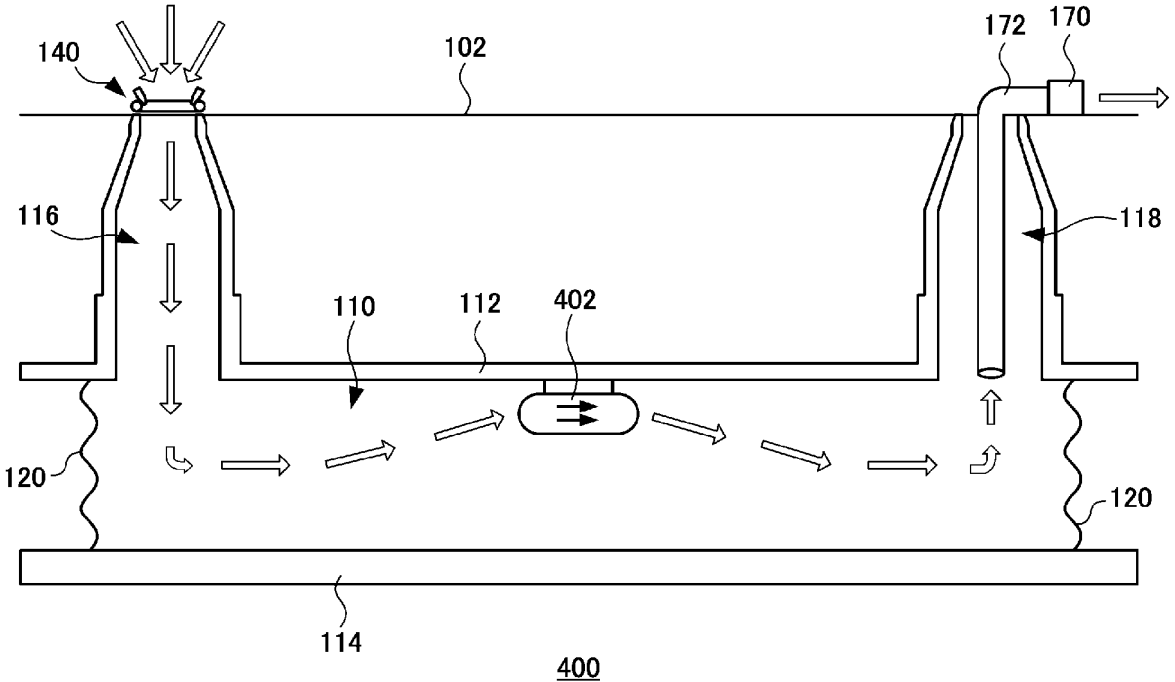
300

[FIG. 9]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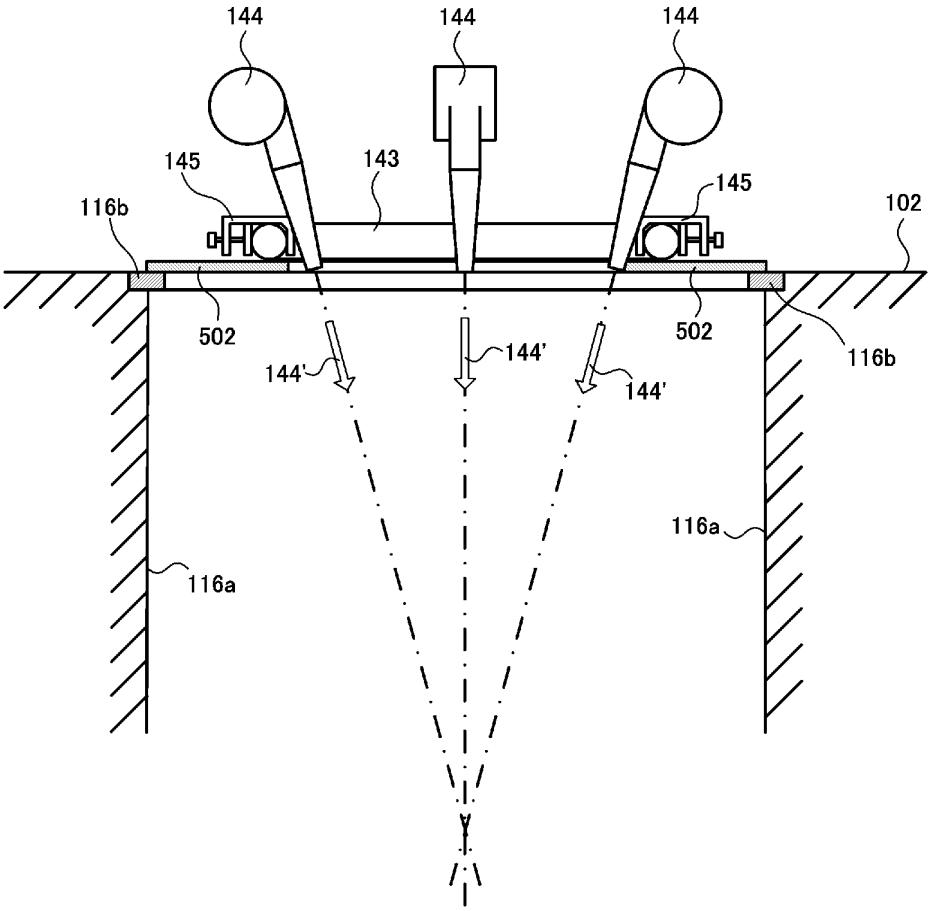
[FIG. 10]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116b
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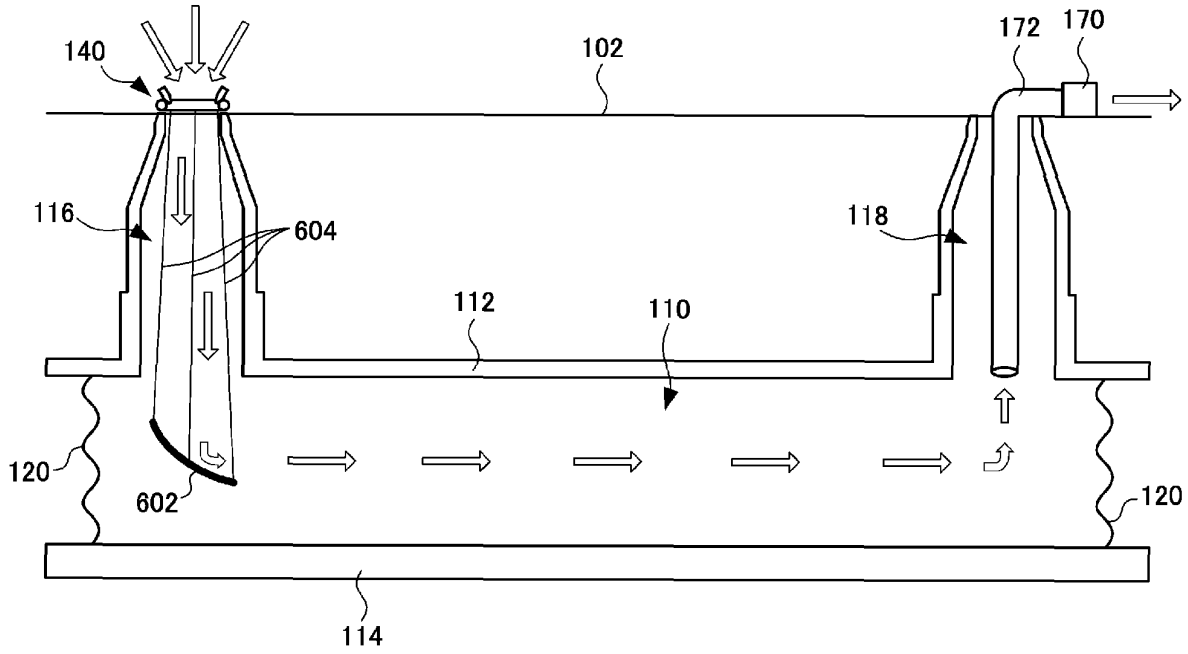
502
144'
144'
144'
116b
116a
116a

[FIG. 11]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/084408

A. CLASSIFICATION OF SUBJECT MATTER
E03F5/08(2006.01)i, *E21F1/00*(2006.01)i

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)
E03F5/08, E21F1/00, F04F1/00-99/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2013/054861 A1 (Tokyo Metropolitan Sewerage Service Corp. et al.), 18 April 2013 (18.04.2013), paragraphs [0001], [0019] to [0035], [0037] to [0040]; fig. 1 to 4, 9 to 10, 12 & US 2014/0227954 A1 paragraphs [0001], [0032] to [0048], [0051] to [0053]; fig. 1 to 4, 9 to 10, 12 & WO 2013/054861 A & WO 2013/054861 A1 & EP 2767641 A1 & KR 10-2014-0090627 A	1-6,8 7,9-19

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 January 2016 (15.01.16)	09 February 2016 (09.02.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/084408

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 4-19400 A (Hisamoto SUZUKI), 23 January 1992 (23.01.1992), specification, page 2, upper left column, lines 8 to 13; page 3, upper right column, line 12 to lower left column, line 4; lines 15 to 16; fig. 1 to 5 (Family: none)	7,9-19
Y	JP 2731145 B2 (Nishimuradenki Co., Ltd.), 25 March 1998 (25.03.1998), column 3, lines 13 to 24; column 5, lines 2 to 17; fig. 1 to 2 (Family: none)	7,9-19
Y	JP 6-313603 A (Mitsubishi Electric Corp.), 08 November 1994 (08.11.1994), paragraphs [0001], [0030] to [0031]; fig. 1 to 2 & JP 6-313603 A & GB 2286856 A page 1, lines 2 to 5; page 10, lines 1 to 19; fig. 1 to 2 & GB 2316131 A & GB 9405230 A0 & SG 48931 A & HK 1009984 A & CN 1112219 A & MY 122554 A	7,9-19
Y	JP 55-150443 A (The Furukawa Electric Co., Ltd.), 22 November 1980 (22.11.1980), specification, page 2, upper right column, lines 5 to 18; fig. 1 (Family: none)	16-19
Y	JP 49-25493 A (The Furukawa Electric Co., Ltd.), 06 March 1974 (06.03.1974), specification, page 2, lower left column, lines 8 to 10; figures (Family: none)	16-19
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 037217/1979(Laid-open No. 137821/1980) (The Furukawa Electric Co., Ltd.), 01 October 1980 (01.10.1980), specification, page 3, line 13 to page 4, line 2; fig. 1 (Family: none)	16-19

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000104966 A **[0006]**
- JP 2003328378 A **[0006]**

Non-patent literature cited in the description

- Intermediate report on safety management on work within sewer pipe conduit. *Sewer Pipe Conduit Work Safety Management Committee,* April 2002, http://jascoma.com/siryou/k_200804_cyukanhoukoku.pdf **[0007]**