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DESCRIPTION

[0001] This invention relates to crematoria, and in particular to mobile or portable crematoria suitable for use in humanitarian applications.

[0002] Crematoria are used for burning human or animal remains and generally comprise a combustion chamber into which a human or animal body is placed, typically inside a coffin (casket). The combustion chamber comprises a primary burner, which ignites, and which sustains the combustion of, the body within it. Once the contents of the combustion chamber have been fully burned, the resulting ash is collected, and removed, and the process can then be repeated as and when required.

[0003] In contrast to an incinerator, which is used for the burning of general waste, a crematorium needs to be specially adapted to take into account various factors. For example, the flue gasses in an incinerator typically pass through a secondary burner to minimise or eliminate toxic combustion products, whereas in the case of a crematorium, particularly in cases where infected bodies need to be burned (as was the case in the recent African Ebola outbreak), the secondary burn needs to be sustained to ensure that potentially bio-hazardous combustion products are not vented to atmosphere. Secondly, whereas in an incinerator, the ashes are emptied after a number of combustion cycles, or continuously: in the case of a crematorium, the ashes need to be collected separately at the end of each cycle, to avoid mixing the ashes of different bodies, which is of paramount importance when attempting to respect religious and cultural customs. Thirdly, incinerators can be operated on a continuous basis: that is with waste being added batch-wise or continuously-fed. However, in the case of a crematorium, this is not generally considered to be respectful, and tends to breach many religious and cultural customs and requirements.

[0004] Crematoria are typically infrastructural installations, that is to say, comprising purpose-built buildings housing the crematorium itself, as well as chapels, mortuaries and other facilities that often accompany the respectful cremation of human remains. In many cultures, or areas of the world, crematoria are not widely available due to cultural and religious taboos associated with cremation. However, there are circumstances where cremation is indicated, notwithstanding the lack of facilities. For example, during the outbreak of a contagious disease, or following on from a natural disaster, there may be a great many bodies that need to be cremated because it is not possible or safe, under those circumstances, to follow burial practices. Further, in the case of certain natural disasters, especially where key infrastructure has been damaged, any available crematoria that would ordinarily have been used, may be out of operation.

[0005] A need therefore exists for a portable crematorium which can be rapidly deployed, and which respects cultural and religious customs and requirements.

[0006] Various examples of known incinerators are described in: KR100824597 (Sung, 23 April

2008), which discloses a crematorium according to the preamble of claim 1; EP2194324 (Park, 9 June 2010); and EP2045525 (Allessandretti, 8 April 2009).

[0007] In circumstances such as those described above, it is known to use portable incinerators to cremate human remains. Containerised incinerators are well-known and have been used, in extreme situations, to cremate human remains. However, the use of portable incinerators to cremate human remains is not generally considered to be an acceptable solution for a number of reasons.

[0008] First, the secondary burn of a waste incinerator is often insufficient to kill or neutralise biological pathogens in the flue gasses. In the case of an epidemic, the use of incinerators to cremate human remains can lead to the venting of biohazardous materials into the atmosphere near to the incinerator.

[0009] Second, an incinerator is not able to respect the cultural and religious requirements associated with cremation. The reasons for this are that incinerators are not adapted to be used intermittently: there being a requirement for a prolonged pre-heat and a cool-down cycle before it can be used again. This is not conducive to one-body-at-a-time cremation.

[0010] Third, due to the size of known containerised incinerators, they are inherently inefficient: being designed to burn much larger quantities of general waste than a crematorium, which is designed to cremate a single human body.

[0011] Fourth, the recovery of ashes on a per-cycle basis is not possible or practical with an incinerator.

[0012] A need therefore exists for a solution to one or more of the above problems. This invention aims to provide a solution to one or more of the above problems and/or to provide an improved and/or alternative crematorium.

[0013] The invention is set forth in the appended independent claim. Optional and/or preferred features of the invention are set forth in the appended dependent claims.

[0014] The invention thus provides a crematorium having three combustion chambers. This arrangement may be considered to have various advantages, such as:

By re-heating the flue gasses twice after they leave the primary combustion chamber, it may be possible to operate the primary combustion chamber at a lower temperature, thus shortening the interval between cremation cycles (due to shorter heat-up and cool-down intervals). In the case of an incinerator, which only has one secondary burner, to achieve the same levels of flue gas neutralisation, the primary burn needs to be much hotter than in the case of the invention.

[0015] The plenum chamber may act as a heat store underneath the primary combustion chamber. Thus, the effects of cyclical thermal expansion and contraction (e.g. cracking of the

refractory materials lining the chambers) associated with intermittent burn cycles may be reduced by maintaining the base wall (at least) of the primary combustion chamber at an elevated temperature, even when the primary burners are switched off. Further, the retention of heat in the plenum chamber may serve to speed-up the re-heat cycle of the primary combustion chamber when the crematorium is re-started.

[0016] The use of a tertiary burner enables the already pre-heated flue gasses to be heated to a much higher temperature without necessarily needing higher capacity tertiary burners. In humanitarian situations, where fuel may be scarce, being able to use smaller burners with lower fuel requirements is generally considered to be advantageous.

[0017] By re-re-heating the flue gasses in the tertiary chamber, the draw on the flue can be increased.

[0018] By causing the flue gasses to pass through the secondary chamber, the plenum chamber, and the tertiary chamber increases the dwell time of the flue gasses at elevated temperature. Increased time-at-temperature is generally accepted to lead to greater neutralisation of the flue gasses, which in the case of cremating biohazardous remains, can be highly advantageous.

[0019] Other possible advantages of the invention will be readily apparent to those skilled in the art.

[0020] The crematorium comprised a primary combustion chamber, which is shaped and sized to accommodate a human body. Typically, therefore, the primary combustion chamber will be approximately 2 to 2.5 metres long, 1 to 1.5 metres wide and 1 to 1.5 metres high internally. The primary combustion chamber is suitably manufactured from a refractory material, such as concrete or other pour-mouldable refractory materials or ceramics.

[0021] The primary combustion chamber suitably comprises an entrance doorway, at one end, through which a body to be cremated can be placed inside the primary combustion chamber. The entrance doorway is suitably manufactured lined with a refractory material and due to its weight, may be mounted on a lift-assisted hinge or sliding device.

[0022] Suitably, the primary combustion chamber comprises one or more ash chutes in its base wall through which ashes drop into a collection chamber. An ash drawer may be provided within the collection chamber for conveniently containing the ashes and enabling them to be recovered from the primary combustion chamber.

[0023] The primary combustion chamber suitably comprises a plurality of primary burners. Such a configuration may serve to more evenly distribute heat with the primary combustion chamber and/or may enable smaller-capacity burners to be used.

[0024] The first outlet leads to the secondary chamber, and suitably comprises an aperture in

a side wall of the primary combustion chamber providing fluid communication with an adjacent secondary chamber.

[0025] The secondary chamber may comprise a plurality of secondary burners for similar reasons to those stated previously.

[0026] The second outlet leads to the plenum chamber, and suitably comprises an aperture in a side wall of the secondary combustion chamber providing fluid communication with an adjacent plenum chamber. The plenum chamber suitably comprises one or more baffles to cause the flue gasses to follow a serpentine path beneath the primary combustion chamber. This may increase the dwell time of the flue gasses in a re-heated state (increased time at temperature) and may also help to more evenly heat the base wall of the primary combustion chamber.

[0027] The third outlet leads to the tertiary chamber, and suitably comprises an aperture in a side wall of the plenum chamber providing fluid communication with an adjacent tertiary chamber. The tertiary chamber may comprise a plurality of tertiary burners for similar reasons to those stated previously.

[0028] The flue suitably comprises a tubular flue stack, which in a preferred embodiment of the invention, is removable for storage and transportation.

[0029] Suitably the crematorium is containerised, that is to say, designed to fit into, and fitted into an ISO bulk transport container. The containerisation of the crematorium facilitates the storage of the crematorium, in use, and also facilitates its transportation via land, sea or air. Suitably, the ISO container surrounding the crematorium is slightly oversized to provide some free space for the storage of fuel for the burners, the removed flue stack and/or other items (such as flat-packed coffins, religious artefacts etc.) that are needed when cremating a body.

[0030] The primary, secondary, plenum and tertiary chambers may be interconnected to form a unit. However, in certain embodiments of the invention, the crematorium is at least partially modular, that is to say, having separate primary, secondary, plenum and tertiary chambers. In one embodiment of the invention, there is provided a shared tertiary chamber having a plurality of inlets that can register with, and/or be connected with a respective plurality of third outlets of a respective plurality of plenum chambers. Such a configuration enables multiple crematoria to be deployed on one side and to benefit from the use of a single tertiary chamber. In a yet further embodiment of the invention, there is provided a modular crematorium system in which there is a shared tertiary and secondary chamber to which a plurality of modular crematoria connect, each modular crematorium comprising its own primary and plenum chambers whose outlets are configured to register with or otherwise connect to respective inlets of the shared secondary and tertiary chambers.

[0031] Various embodiments of the invention shall now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a crematorium in accordance with the invention;

Figure 2 is a sectional view of the crematorium of Figure 1 on II-II;

Figure 3 is a cutaway view of the crematorium of Figure 1 showing its internal configuration;

Figures 4, 5 and 6 are schematic perspective, side and plan views, respectively, of a first type of modular crematorium in accordance with the invention; and

Figures 7, 8 and 9 are schematic perspective, side and plan views, respectively, of a second type of modular crematorium in accordance with the invention.

[0032] Referring to Figure 1 of the drawings, a crematorium 10 in accordance with the invention comprises a main body portion 12 that is mounted within an external enclosure 14 in the form, in the illustrated embodiment, of a bulk transport ISO container.

[0033] In Figure 1 of the drawings, one of the sidewalls of the outer enclosure 14 has been removed for clarity. The ISO container 14 is accessible via two sets of doors 16 located at opposite ends of the container, and it can be seen in Figure 1 in particular, that when the doors 16 have been opened, a narrow passageway is formed down one side of the container 14, which passageway 18 enables personnel to gain access to the crematorium 10 for servicing, maintenance and repair.

[0034] The passageway 18 additionally provides some empty space within the container 14, which enables other items to be transported along with the crematorium 10, for example fuel supplies, flat-packed coffins, etc., as may be required.

[0035] The main body 12 of the crematorium 10 is formed from a number of chambers, namely: a primary combustion chamber 20, which is located above a plenum chamber 22. The plenum chamber 22 connects to a tertiary chamber 24 and the tertiary chamber 24 is vented to atmosphere via a flue stack 26.

[0036] Although not apparent from the drawings, the flue stack 26 is removable for transportation and storage purposes, and can be stowed in the passageway 18 when the crematorium 10 is not in use.

[0037] As can be seen more clearly from Figures 2 and 3 of the drawings, the crematorium 10 additionally comprises a secondary combustion chamber 28, which interconnects the primary combustion chamber 20, and the plenum chamber 22.

[0038] Each of the primary 20, secondary 28, and tertiary 24 chambers are provided with burner units 30, 32, 34, whose functions shall be described hereinbelow.

[0039] Each of the chambers 20, 22, 24, 28 are lined with refractory materials, such as cast concrete or slabs of refractory ceramics, to withstand the elevated temperatures that they experience, in use. The refractory materials are held within a steel framework 36 to provide a robust construction and to prevent movement of the chambers relative to one another, for example during transportation.

[0040] Referring now to Figure 2 of the drawings, which shows the main body 12 of the crematorium 10 in section, it can be seen that the primary combustion chamber 20 is formed from sheets of relatively thick refractory material 38, which are held in place by the supporting steel sheet and frame support system 36 mentioned previously.

[0041] The primary combustion chamber 20 is shaped and sized to accommodate a human body although will be appreciated that the dimensions of the primary combustion chamber can be selected to suit various requirements and also to optimise the combustion process as will be readily understood by persons skilled in the art.

[0042] The primary combustion chamber 20 is accessible via a doorway 40, which is also lined with refractory material, which selectively opens and closes one end of the primary combustion chamber 20 to permit a body to be placed inside it. As can be seen from Figure 3 of the drawings, the doorway 40 is supported on a hinge system comprising gas struts 42 to facilitate lifting and lowering the considerable weight of the door 40 in use.

[0043] The primary combustion chamber 20 comprises a base wall 50, which separates the primary combustion chamber 20 from the plenum chamber 22 below it. The base wall 50 comprises an ash chute 52 that enables ashes that remain in the combustion chamber 20 after cremation, to be brushed, or otherwise fed, into an ash collection drawer 54 below. The ash collection drawer 54 facilitates the removal of the ashes from the primary combustion chamber 20 after each cremation cycle. A service hatch 56 is also provided to facilitate maintenance of the interior of the primary combustion chamber 20.

[0044] The primary combustion chamber 20 is fitted with two primary burners 30, which ignite, and sustain the combustion of, the content of the primary combustion chamber, in use. It will be apparent to those skilled in the art that the provision of a number of primary burners 30 may be advantageous from the point of view of more evenly distributing the heat and combustion process within the primary combustion chamber 20. The precise configuration of the primary burners is outside the scope of this disclosure, but will be readily apparent to those skilled in the art.

[0045] The primary combustion chamber 20 comprises a first outlet 68 through which flue gasses can escape (as indicated by arrow 62) into the secondary combustion chamber 28.

[0046] The secondary combustion chamber comprises a secondary burner 32, which re-heats the flue gases and the down-angle of the secondary burner 32 is such that it forces the flue gases down inside the secondary chamber 28 and into the plenum chamber 22 located below

the primary combustion chamber 20. Thus, the configuration of the secondary burner 32 facilitates the extraction of flue gases from the primary chamber 20 into the plenum chamber 22, via the secondary chamber 28.

[0047] The plenum chamber 22 is also formed from slabs of refractory material so that they can withstand the high temperatures of use. The slabs are arranged to support the base wall 50 of the primary combustion chamber 20, and also to form a series of staggered baffles 64, which cause the flue gases to follow a serpentine pathway (as indicated by arrow 66) through the plenum chamber 22 below the primary combustion chamber 20.

[0048] The provision of baffles 64 serves to increase the dwell time of the flue gases within the plenum chamber 22, thus increasing their time-at-temperature, and thereby improving the neutralisation of the flue gases - as will be readily apparent to those skilled in the art.

[0049] The flue gases pass through the plenum chamber 22, following the serpentine path 66 described above, before passing through an internal aperture 68 in one of the baffles 64 and then proceeding in an opposite direction, along an opposite side of the plenum chamber 22 (as indicated by dashed arrow 70), until the flue gases are discharged into the tertiary chamber 24 at the far end of the main body 12.

[0050] The tertiary chamber 24 comprises a tertiary burner 34 located towards its base and angled slightly downwardly, to direct the flue gases along the base of the tertiary chamber 24 before they escape via the flue stack 26, which is in fluid communication therewith.

[0051] It will be appreciated, from the foregoing description, that the crematorium 10 of the invention comprises essentially three chambers, namely the primary combustion chamber 20 in which the body is cremated; a secondary chamber 28 in which the flue gases are re-heated; a plenum chamber 22, through which the flue gases pass and in doing so increase the dwell time of the flue gases at elevated temperature and storing heat also in the base wall 50 of the primary combustion chamber 20; and a tertiary chamber 24 in which the flue gases are re-heated again by the tertiary burner 34 before they escape to atmosphere via the flue 26.

[0052] This particular configuration may be advantageous because the time-at-temperature of the flue gases is greatly increased, thereby increasing the neutralisation efficiency of the system. Further, some of the heat generated by the system, in use, can be preserved in a heat store formed by the various chambers of the crematorium 10.

[0053] Various modular embodiments of the invention are shown now in the remaining drawings.

[0054] Referring to Figures 4 to 6 of the drawings, a first type of modular crematorium 100 in accordance with the invention is shown, which comprises a shared, central secondary 102 and tertiary chamber 104 unit 105, to which one or more main body portions 106 can be selectively affixed. The main body portions 106 each comprise a primary combustion chamber 20 as

previously described, which sits atop a plenum chamber 22. The primary combustion chamber 20 has an outlet tube 60 that connects to an inlet 108 of the secondary chamber 102. The secondary chamber 102 has an outlet 110 that connects to an inlet tube 112 of the plenum chamber 22. Thus, flue gasses flow, as indicated by arrow 62, from the primary combustion chamber 20, into the plenum chamber 22, via the secondary chamber 102.

[0055] The plenum chamber 22 has baffles (not shown) that cause the flow of flue gasses, as indicated by arrow 66, to flow through the plenum chamber 22 to a plenum outlet tube 114 that connects to an inlet 116 of the tertiary chamber 104. The flue stack 26 provides an outlet for the twice-reheated flue gasses, as indicated by arrow 116.

[0056] Referring now to Figures 7 to 9 of the drawings, a second type of modular crematorium 120 in accordance with the invention is shown, which comprises a shared, central tertiary chamber 104 formed as a unit 105, to which one or more main body portions 106 can be selectively affixed. The main body portions 106, in this embodiment, each comprise a primary combustion chamber 20 as previously described, which sits atop a plenum chamber 22 and adjacent to a secondary chamber 122.

[0057] The primary combustion chamber 20 has an outlet 60 connecting an inlet of the secondary chamber 122. The secondary chamber 122 has an outlet 130 that connects to an inlet of the plenum chamber 22. Thus, flue gasses flow, as indicated by arrow 62, from the primary combustion chamber 20, into the plenum chamber 22, via the secondary chamber 122.

[0058] The plenum chamber 22 has baffles (not shown) that cause the flow of flue gasses, as indicated by arrow 66, to flow through the plenum chamber 22 to a plenum outlet tube 124 that connects to an inlet 126 of the tertiary chamber 124. The flue stack 26 provides an outlet for the twice-reheated flue gasses, as indicated by arrow 116.

[0059] The modular systems described above enable a central unit 105 to be used in conjunction with one or more main body portions 106, 126, thus forming a group. The main advantages of such a configuration are rationalisation, flexibility and expandability: the system 100, 120 can be adapted or modified to suit different requirements from a kit of parts. Further, by grouping the central secondary 102 and tertiary chamber 104 as a unit 105, or simply by sharing a tertiary chamber 124, the burners (not shown) of these chambers can be operated independently of the burners of the primary combustion chambers 20, thus potentially leading to shorter cycle times for the main body portions 106, which now only need to partially re-heated between cycles.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not

form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR100824597 [0006]
- EP2194324A [0006]
- EP2045525A [0006]

KREMATORIER

Patentkrav

1. Krematorium (10), der omfatter sekventielt indbyrdes forbundne primære (20), sekundære (28), plenum- (22) og tertiære (24) kamre, hvor det primære kammer (20) er et forbrændingskammer, der er udformet og dimensioneret til at rumme en menneskekrop, og som omfatter én eller flere brændere (30), der er tilpasset til i anvendelse at antænde og opretholde forbrændingen af en menneskekrop, der er placeret inde i det primære forbrændingskammer (20); kendetegnet ved: det sekundære kammer (28) og det tertiære kammer (24) hvert omfatter én eller flere supplerende brændere (34, 32), der er tilpasset til i anvendelse at genopvarme røggasser, der uddrives fra det primære kammer (20), og hvor plenumkammeret (22) er anbragt stødende op til det primære kammer (20), således at genopvarmede røggasser, der uddrives fra det sekundære kammer (28), opvarmer mindst én væg (50) af det primære kammer (20).
2. Krematorium (10) ifølge krav 1, hvor det primære kammer (20) og plenumkammeret (22) er adskilt af en skillevæg (50), hvilken skillevæg opvarmes af de genopvarmede røggasser.
3. Krematorium (10) ifølge krav 1 eller krav 2, hvor det primære kammer (20) er placeret over plenumkammeret (22).
4. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor det tertiære kammer (24) omfatter en aftagelig aftrækskanal (26).
5. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor det primære kammer (20) omfatter en indgangsdøråbning (40), hvorigennem, i anvendelse, en krop, der skal kremes, kan placeres inde i det primære kammer (20), hvilken indgangsdøråbning (40) er monteret på en løfte-assisteret hængsels- eller glideanordning (42).
6. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor et hvilket som helst eller flere af: det primære kammer (20); det sekundære kammer (28); plenumkammeret (22); det tertiære kammer (24) og indgangsdøråbningen (40), hvorigennem, i anvendelse, en

krop, der skal kremes, kan placeres inde i det primære kammer, er fremstillet af, eller beklædt med, et ildfast materiale.

5 7. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor det primære kammer (20) omfatter én eller flere askeslisker (52) i en bundvæg (50) deraf, der fører til ét eller flere askeopsamlingskamre og en askeskuffe (54) inde i opsamlingskammeret.

10 8. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor plenumkammeret (22) omfatter én eller flere bafler (64), der er anbragt til i anvendelse at bevirke, at røggasserne følger en slangeformet bane (66) derigennem.

15 9. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor krematoriet er et mobilt krematorium, idet det mobile krematorium omfatter et ydre lukket rum (12), hvilket ydre lukket rum (12) omfatter en ISO-bulktransportcontainer.

10. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor ét hvilket som helst af det primære kammer (20), det sekundære kammer (28), plenumkammeret (22) og det tertiære kammer (24) omfatter en serviceluge.

20 11. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor en udgang fra én eller flere af brænderne (32, 34) er vinklet nedefter.

25 12. Krematorium (10) ifølge et hvilket som helst foregående krav, hvor det primære kammer (20), det sekundære kammer (28), plenumkammeret (22) og det tertiære kammer (24) er forbundet med hinanden som en enhed.

30 13. Krematorium (10) ifølge et hvilket som helst af krav 1 til 11, hvor det primære kammer (20) og plenumkammeret (22) er dannet som en første enhed (106), og hvor det sekundære kammer (28) og det tertiære kammer (24) er dannet som en anden enhed (122), idet den første enhed (106) og den anden enhed (122) kan adskilles fra hinanden.

14. Krematorium (10) ifølge et hvilket som helst af krav 1 til 11, hvor det primære kammer (20), det sekundære kammer (28) og plenumkammeret (22) er dannet som en første enhed (106), og hvor det tertiære kammer (24) er dannet som en anden enhed (105), idet den første enhed (106) og den anden enhed (105) kan adskilles fra hinanden.

5

15. Krematorium (10) ifølge krav 13 eller 14, der omfatter en anden enhed (122, 105) og en flerhed af første enheder (106, 105), der kan forbindes med den anden enhed.

DRAWINGS

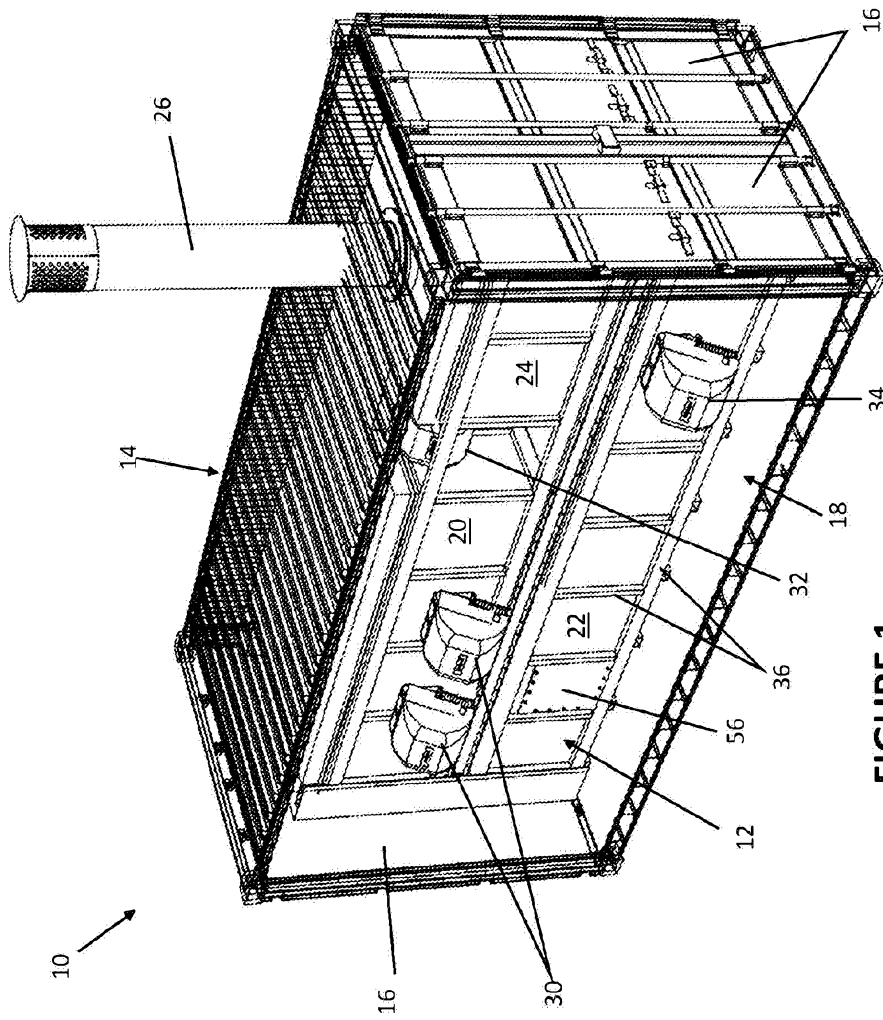


FIGURE 1

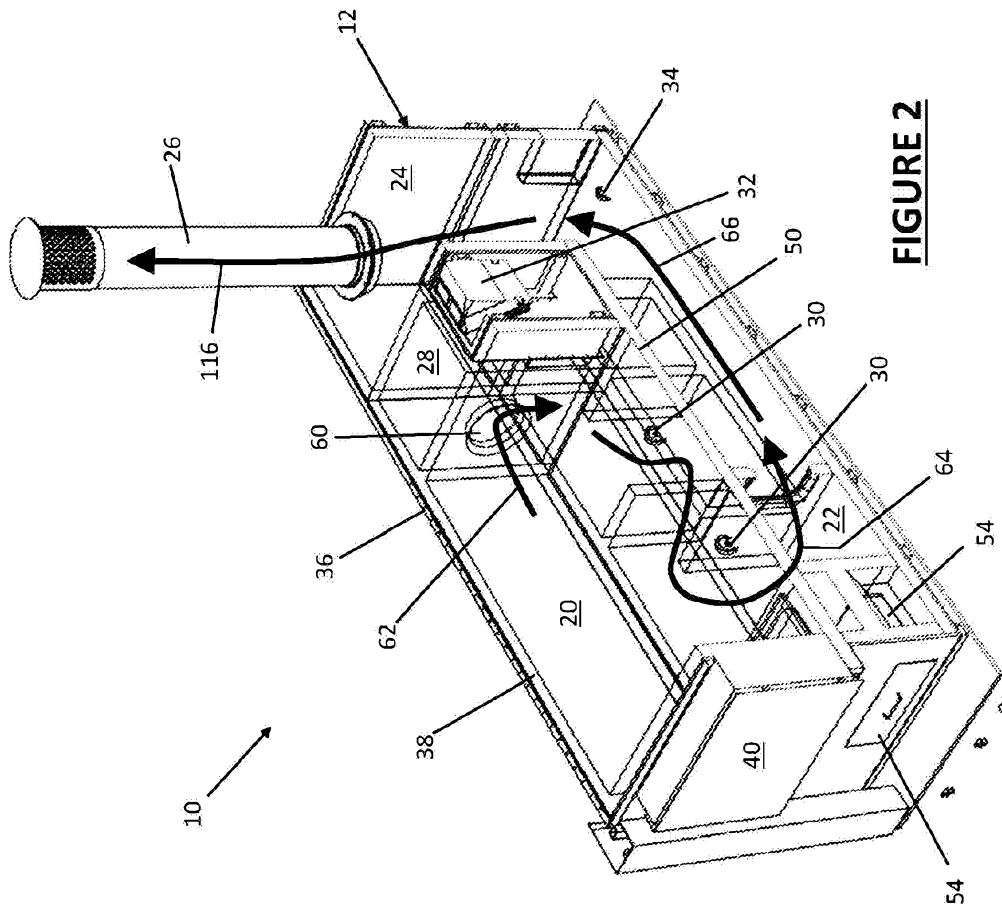


FIGURE 2

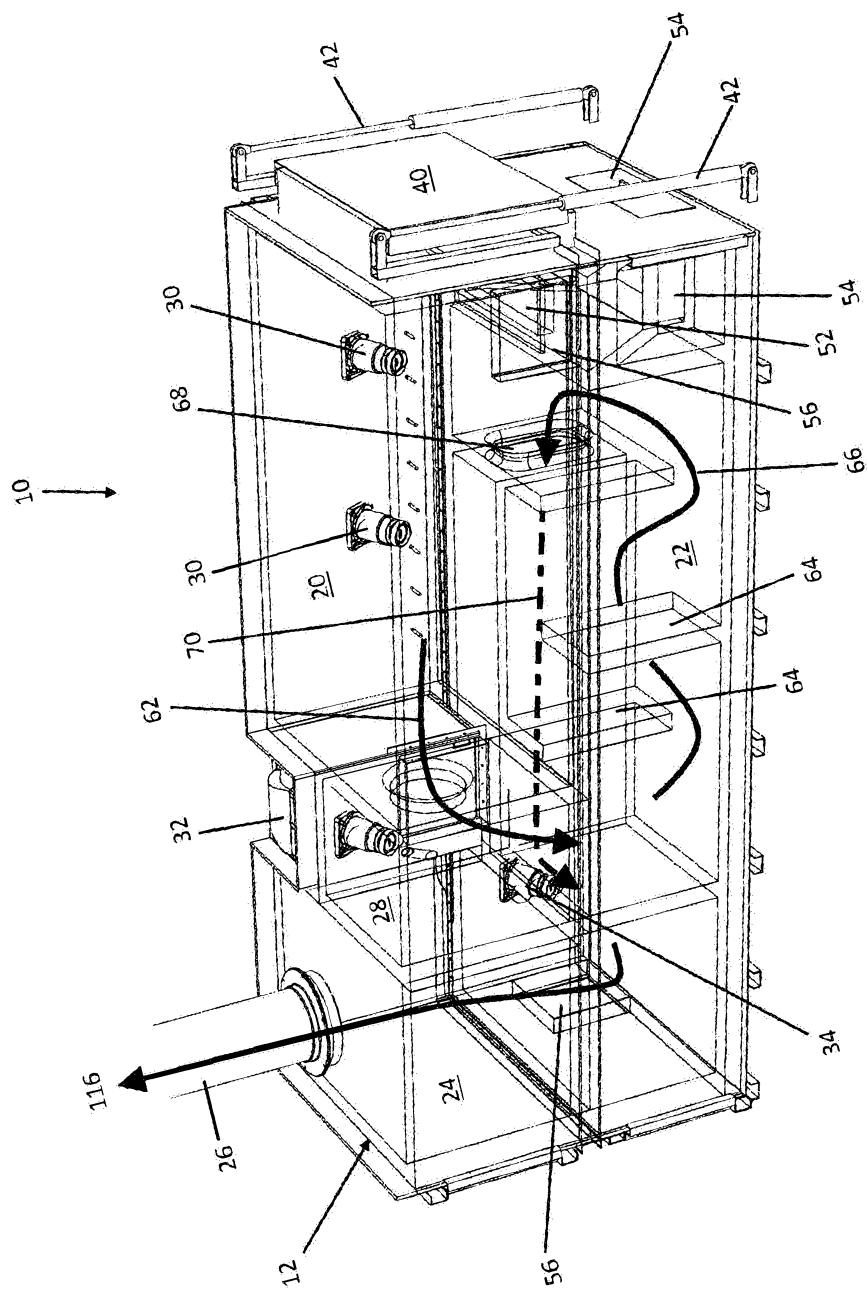


FIGURE 3

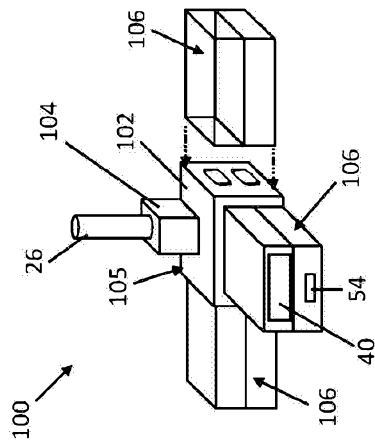


FIGURE 4

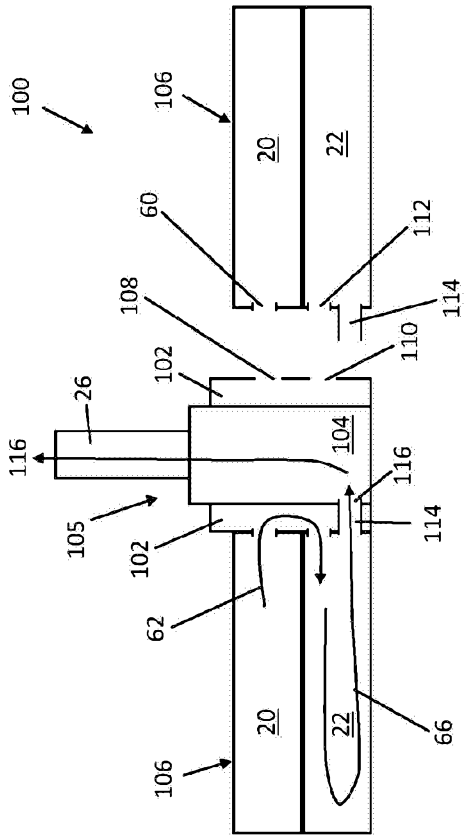


FIGURE 5

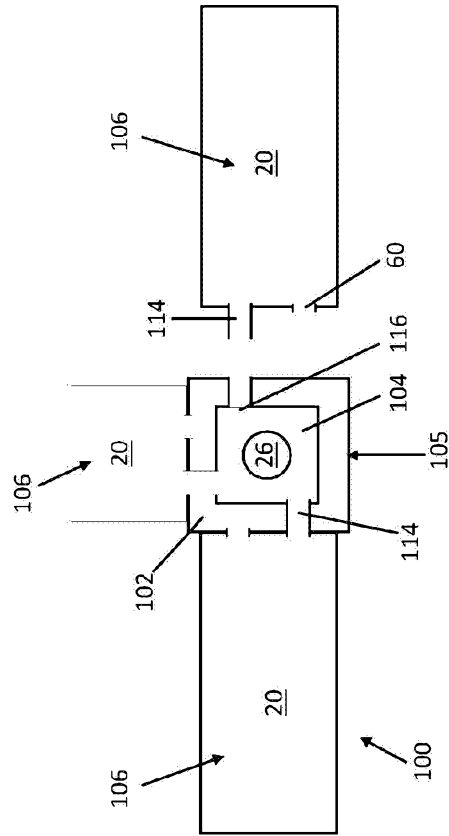


FIGURE 6

