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CLEAN AIR ENGINEERING-MARITIME, INC.

UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

WESTERN DIVISION

CLEAN AIR ENGINEERING-MARITIME, INC., a California corporation,

Plaintiff,

v.

ADVANCED CLEANUP TECHNOLOGIES, INC., a California corporation, and ADVANCED ENVIORNMENTAL GROUP, LLC, [sic], a California limited liability company,

Defendants.

Case No. 2:12-cv-08669-JAK-VBK

CLEAN AIR ENGINEERING-MARITIME, INC.'S SECOND AMENDED COMPLAINT FOR PATENT DECLARATORY JUDGMENT

DEMAND FOR JURY TRIAL

THE PARTIES

1. Plaintiff Clean Air Engineering-Maritime, Inc. ("CAEMI") is a corporation that is organized and existing under the laws of the State of a California having a place of business at 971 South Seaside Avenue, Terminal Island, California 90731.

2. Upon information and belief, Defendant Advanced Cleanup Technologies, Inc. ("ACTI") is a corporation that is organized and existing under the laws of the State of California having a place of business located at 20928 Lamberton Avenue, Carson, California 90810.

3. Upon information and belief, Defendant Advanced Enviornmental Group, LLC [sic] (collectively with ACTI, "Defendants") is a limited liability company that is organized and existing under the laws of the State of California having a place of business located at 20928 Lamberton Avenue, Carson, California 90810.

JURISDICTION AND VENUE

4. This action arises under the patent laws of the United States of America, 35 U.S.C. § 1 et seq. This Court has federal subject matter jurisdiction over this action pursuant to 28 U.S.C. §§ 1331, 1332, 1367, 1338(a), 2201 and 2202.

5. This Court has personal jurisdiction over the Defendants, and venue is proper in this Court pursuant to 28 U.S.C. §1391(b), (c), because, on information and belief, Defendants have their corporate headquarters and principal place of business within this judicial district amounting to sufficient minimum contacts with this judicial district, as well as employing personnel and/or representatives within this judicial district.

FACTUAL ALLEGATIONS

6. CAEMI designs and develops a barge-mounted emission control

system ("CAEMI System") designed to reduce engine emissions of ocean-going vessels entering shipping ports. The CAEMI System captures emissions from ships and treats those emissions to then release clean air.

7. On information and belief, Defendant ACTI also develops an exhaust capture system located in the Port of Long Beach to capture and treat ship emissions. On or about November 3, 2005, ACTI purportedly filed a patent application titled "Maritime Emissions Control System" that issued as U.S. Patent Number 7,258,710 ("'710 Patent") and was purportedly assigned to Defendants. A true and correct copy of the '710 Patent is attached hereto as Exhibit A.

8. On or about May 17, 2012, the City of Los Angeles Board of Harbor Commissioners ("Board") approved a Funding Agreement with TraPac, Inc. ("TraPac"), a customer of CAEMI for the CAEMI System, for funding a project to demonstrate the CAEMI System.

9. On or about May 23, 2012, on information and belief, the President of Defendant ACTI, Ruben Garcia,[1] emailed a principal of TraPac, the CAEMI customer, to update TraPac on "the progress of our [ACTI's] Emission Control Technology for the at berth regulation for ship emissions." Following additional emails exchanged that same day, TraPac informed Mr. Garcia that TraPac had "selected a vender [*sic*] to explore an emissions capture/treatment system for a vessel." In response to that email, Mr. Garcia responded by email on that same day that:

> I want to be sure you are aware TraPac MOL, Mitsui, signed multiple NDA's with us and ***we have several patents awarded protecting our technology.***
>
> ***Any violating or infringement from your contractor will be vigorously enforced.***

[1] On information and belief, Ruben Garcia is also an officer of Defendant Advanced Enviornmental Group, LLC [sic].

If you would like further information please contact me.

(Emphasis added). TraPac forwarded the emails above to CAEMI.

10. On October 10, 2012, CAEMI initiated this action, pleading causes of action for declaratory judgment of non-infringement and invalidity of the '710 Patent.

11. On May 7, 2013, Defendants filed counterclaims for infringement of the '710 Patent as well as U.S. Patent No. 8,327,631 ("the '631 Patent"). On information and belief, Defendants are purportedly the owners by assignment of the '631 Patent, titled "Air pollution control system for ocean-going vessels." A true and correct copy of the '631 Patent is attached hereto as Exhibit B.

FIRST CAUSE OF ACTION: DECLARATION OF NON-INFRINGEMENT OF THE '710 PATENT

12. CAEMI repeats the allegations of the above paragraphs as if fully set forth herein.

13. The CAEMI System and other CAEMI products, systems and services do not infringe, either directly or indirectly, any valid and enforceable claim of the '710 Patent, either literally or under the doctrine of equivalents.

14. A valid and justiciable controversy regarding the '710 Patent exists between CAEMI and Defendants based on the allegations set forth in paragraphs 6-11 herein. Based on those paragraphs, CAEMI reasonably interprets the communications from Defendants as assertions that the CAEMI System infringes the '710 Patent.

15. There is an actual, substantial and continuing justifiable controversy between CAEMI and Defendants having adverse legal interests of sufficient immediacy and reality to warrant the issuance of a declaratory judgment regarding non-infringement of the '710 Patent.

16. CAEMI is entitled to a judicial declaration that CAEMI System does

not infringe any claim of the '710 Patent.

SECOND CAUSE OF ACTION: DECLARATION OF INVALIDITY OF THE '710 PATENT

17. CAEMI repeats the allegations of the above paragraphs as if fully set forth herein.

18. The claims of the '710 Patent are invalid for failure to comply with one or more requirements of Title 35, United States Code, including 35 U.S.C. §§ 101, 102, 103 and 112.

19. A valid and justiciable controversy regarding the '710 Patent exists between CAEMI and Defendants based on the allegations set forth in paragraphs 6-11 herein. Based on those paragraphs, CAEMI reasonably interprets the communications from Defendants as assertions that the claims of the '710 Patent are not invalid and that the CAEMI System infringes the '710 Patent.

20. There is an actual, substantial and continuing justifiable controversy between CAEMI and Defendants having adverse legal interests of sufficient immediacy and reality to warrant the issuance of a declaratory judgment regarding the validity of the '710 Patent.

21. CAEMI is entitled to a judicial declaration that the claims of the '710 Patent are invalid.

THIRD CAUSE OF ACTION: DECLARATION OF NON-INFRINGEMENT OF THE '631 PATENT

22. CAEMI repeats the allegations of the above paragraphs as if fully set forth herein.

23. Defendants have asserted the '631 Patent against CAEMI.

24. The CAEMI System and other CAEMI products, systems and services do not infringe, either directly or indirectly, any valid and enforceable claim of the '631 Patent, either literally or under the doctrine of equivalents.

25. A valid and justiciable controversy regarding the '631 Patent exists between CAEMI and Defendants based on the allegations in Paragraphs 6-11 herein.

26. CAEMI is entitled to a judicial declaration that the CAEMI System does not infringe any claim of the '631 Patent.

FOURTH CAUSE OF ACTION: DECLARATION OF INVALIDITY OF THE '631 PATENT

27. CAEMI repeats the allegations of the above paragraphs as if fully set forth herein.

28. Defendants have asserted the '631 Patent against CAEMI.

29. The claims of the '631 Patent are invalid for failure to comply with one or more requirements of Title 35, United States Code, including 35 U.S.C. §§ 101, 102, 103, and 112.

30. A valid and justiciable controversy regarding the '631 Patent exists between CAEMI and Defendants based on the allegations in Paragraphs 6-11 herein.

31. CAEMI is entitled to a judicial declaration that the claims of the '631 Patent are invalid.

DEMAND FOR JURY TRIAL

32. CAEMI demands a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, CAEMI respectfully seeks the following relief from this Court:

(a) A declaration and entry of judgment in favor of CAEMI and against Defendants that the CAEMI System does not infringe any claims of the '710 or '631 Patents;

(b) A declaration and entry of judgment in favor of CAEMI and against Defendants that CAEMI and CAEMI's customers, including TraPac, are not liable for direct, contributory or induced infringement of any claim of the '710 or '631 Patents as to the CAEMI System;

(c) A declaration and entry of judgment in favor of CAEMI and against Defendants that the claims of the '710 and '631 Patents are invalid under 35 U.S.C. §§ 101, 102, 103 and/or 112;

(d) That Defendants and their officers, agents, employees, representatives, counsel and all persons in active concert or participation with any of them, directly or indirectly, be enjoined from threatening or charging infringement of, or instituting any action for infringement of the '710 or '631 Patents, based upon the CAEMI System;

(e) Its costs and disbursements in connection with this litigation, as permitted pursuant to 35 U.S.C. § 284;

(f) A determination that this is an exceptional case within the meaning of 35 U.S.C. §285, and an award to CAEMI of its reasonable attorneys' fees; and

(g) Such other relief, in law and in equity, that this Court deems appropriate.

Dated: May 28, 2012

MAYER BROWN LLP

By: [signature]
Michael A. Molano

Attorneys for Plaintiff
CLEAN AIR ENGINEERING-MARITIME, INC.

EXHIBIT A

US007258710B2

(12) **United States Patent**
Caro et al.

(10) **Patent No.:** **US 7,258,710 B2**
(45) **Date of Patent:** **Aug. 21, 2007**

(54) MARITIME EMISSIONS CONTROL SYSTEM

(75) Inventors: **Salvador Caro**, Camarillo, CA (US); **Henning Ottsen**, Ventura, CA (US); **John G. Powell**, Santa Clarita, CA (US)

(73) Assignee: **Advanced Cleanup Technologies, Inc.**, Rancho Dominguez, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 70 days.

(21) Appl. No.: **10/835,197**

(22) Filed: **Apr. 29, 2004**

(65) **Prior Publication Data**

US 2005/0244318 A1 Nov. 3, 2005

(51) **Int. Cl.**
A01F 25/00 (2006.01)
A01F 25/10 (2006.01)

(52) **U.S. Cl.** .... 55/385.1; 55/356; 55/DIG. 18; 55/DIG. 46; 95/273; 110/121; 110/125; 110/216; 110/217; 114/187; 366/22; 366/25; 366/40; 440/89 A; 440/89 R; 440/113

(58) **Field of Classification Search** .... 55/385.2, 55/356, 385.1, DIG. 18, DIG. 46; 95/273; 15/347, 352; 366/22, 25, 40; 454/187; 440/89 A, 440/89 R, 113; 114/187; 110/121, 125, 110/216, 217
See application file for complete search history.

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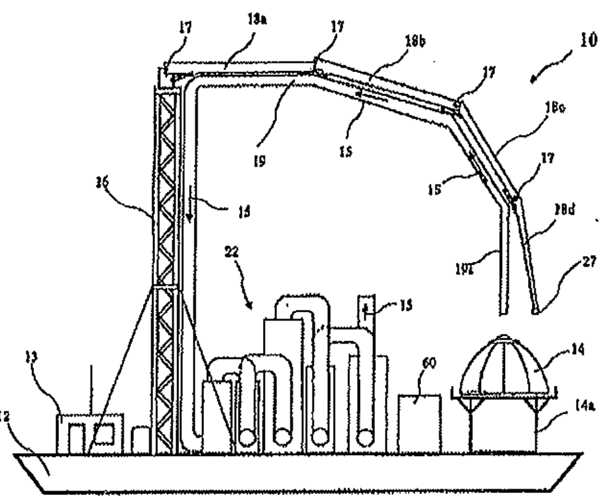
* cited by examiner

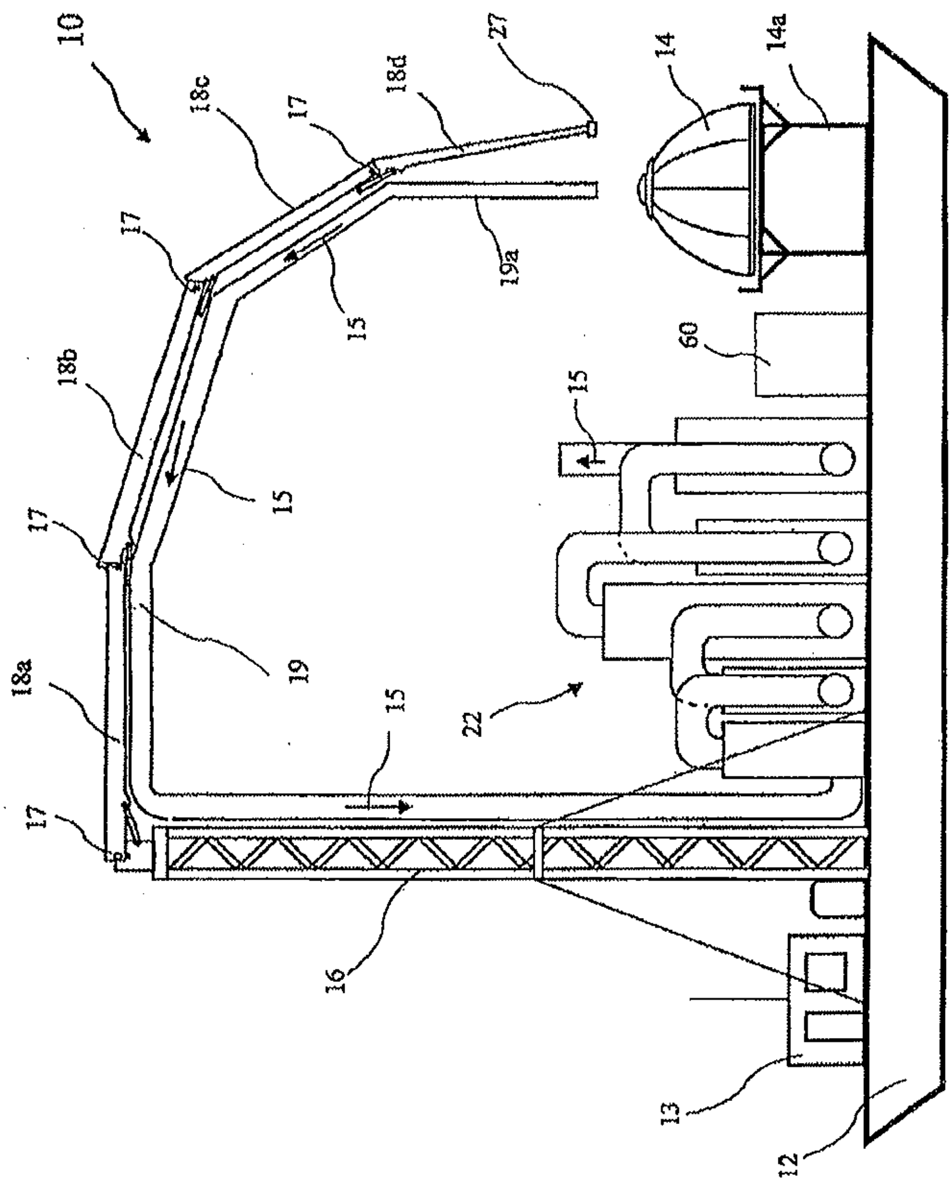
Primary Examiner—Minh-Chau T. Pham
(74) *Attorney, Agent, or Firm*—Kenneth L. Green; Edgar W. Averill, Jr.

(57) **ABSTRACT**

An Advanced Maritime Emissions Control System (AMECS) includes several Exhaust Intake Bonnets (EIBs) of different size and/or shape, an Emissions Capture System (ECS), and an Advanced Maritime Emissions Control Unit (AMECU) mounted on an Unpowered Seagoing Barge (USB). The EIB includes a cage formed by downward curved ribs, a shroud which is lowerable to cover the ribs, a belt near a lower edge of the EIB for retaining and sealing the EIB to a stack, and a mechanism for tightening the lower edge of the EIB (and thus the belt) around the stack. The ECS lifts one of the several EIBs onto the stack of an Ocean Going Vessel (OGV). Exhaust from the stack is drawn through a large diameter duct to the AMECU. The AMECU processes the exhaust through multiple treatment stages. The stages include pre conditioning the exhaust, oxidizing, reducing, polishing, and precipitating.

35 Claims, 6 Drawing Sheets

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18d
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18b
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19a
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18a
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FIG. 1

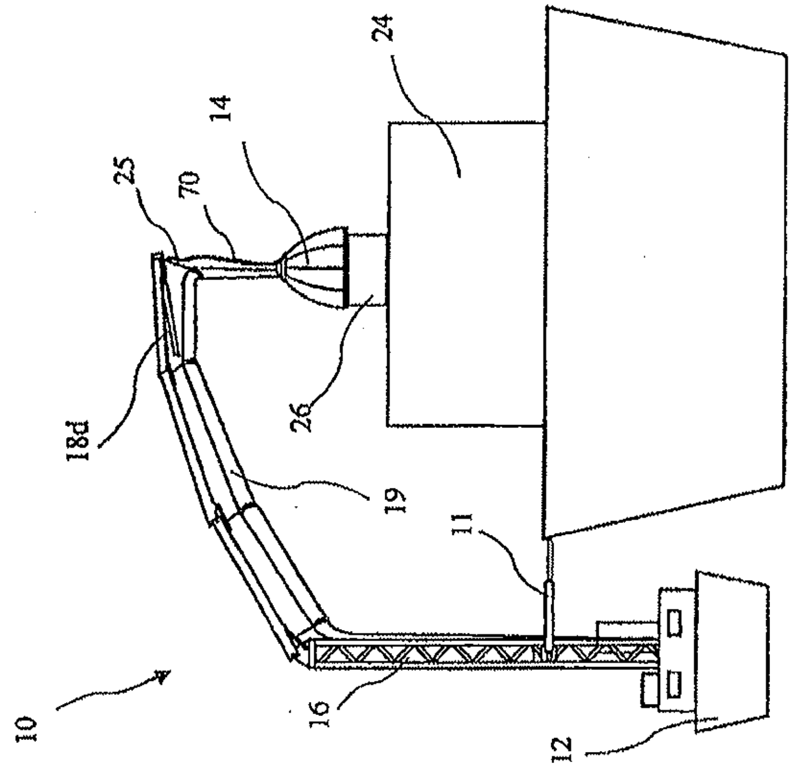

FIG. 2B

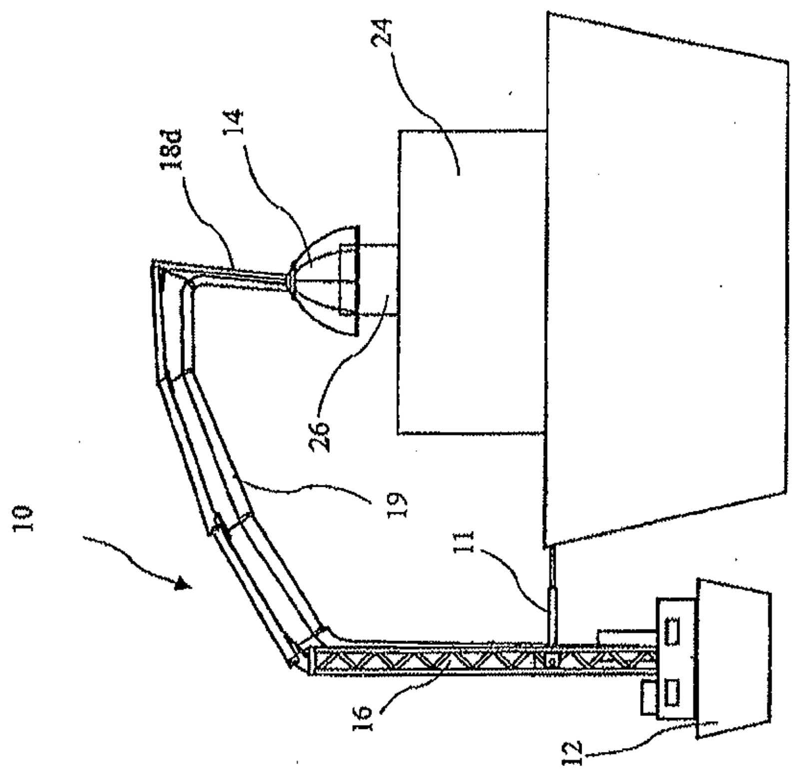

FIG. 2A

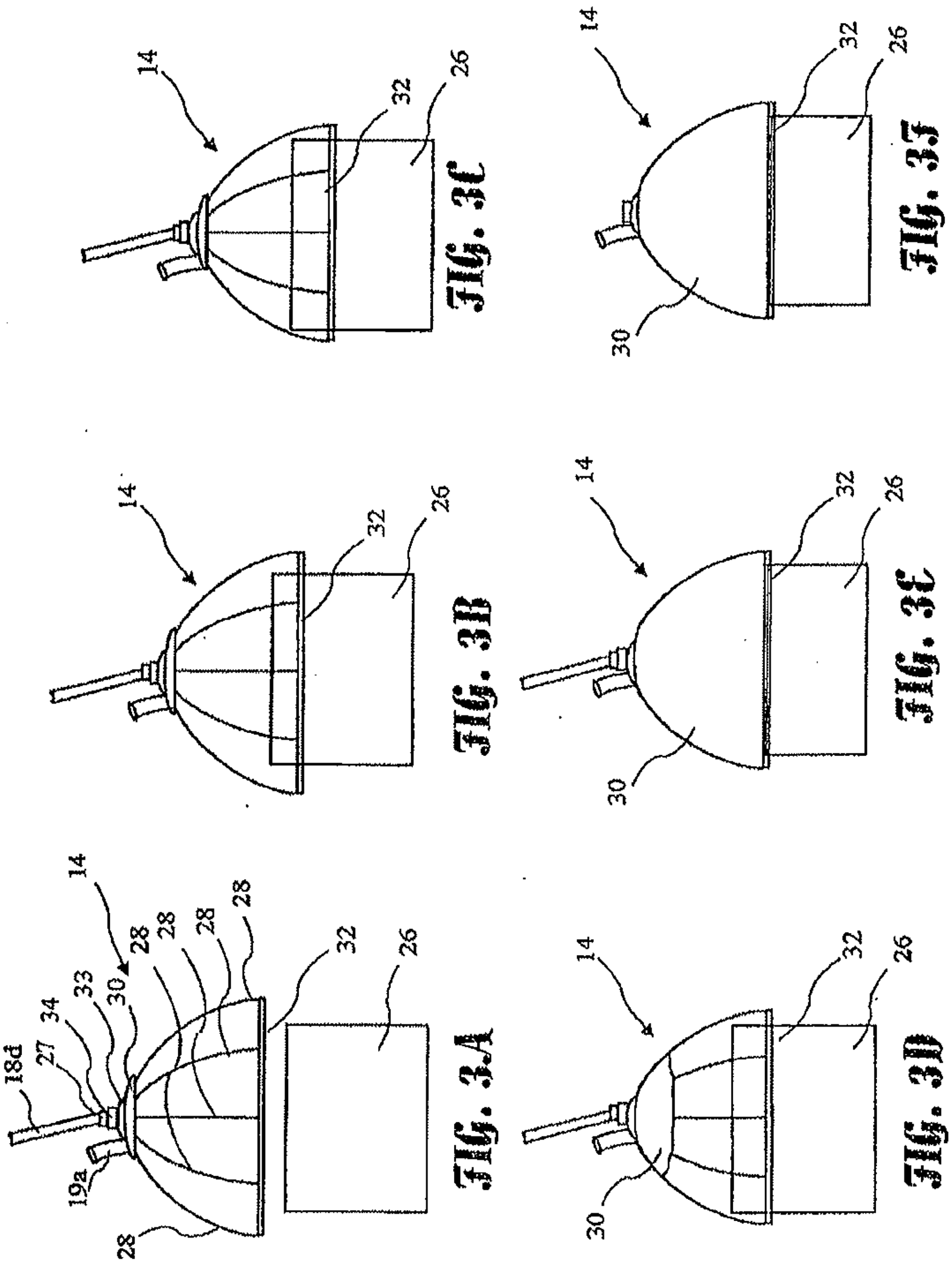

FIG. 3A FIG. 3B FIG. 3C FIG. 3D FIG. 3E FIG. 3F

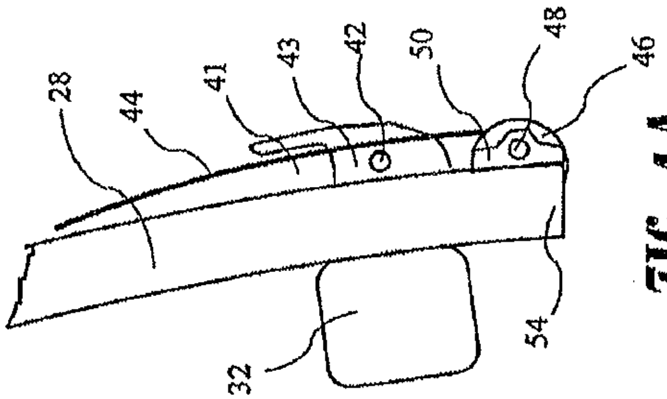
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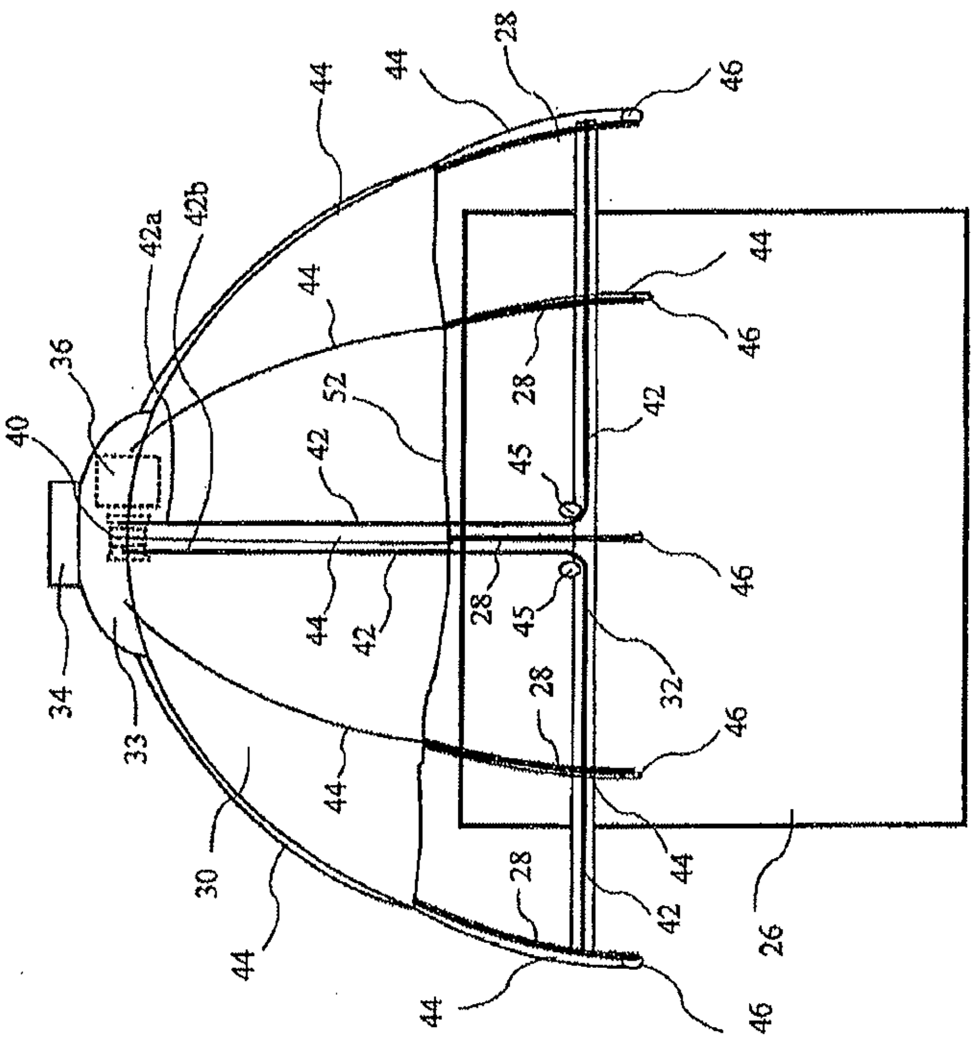
FIG. 4A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42b
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44
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52
42
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30
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28
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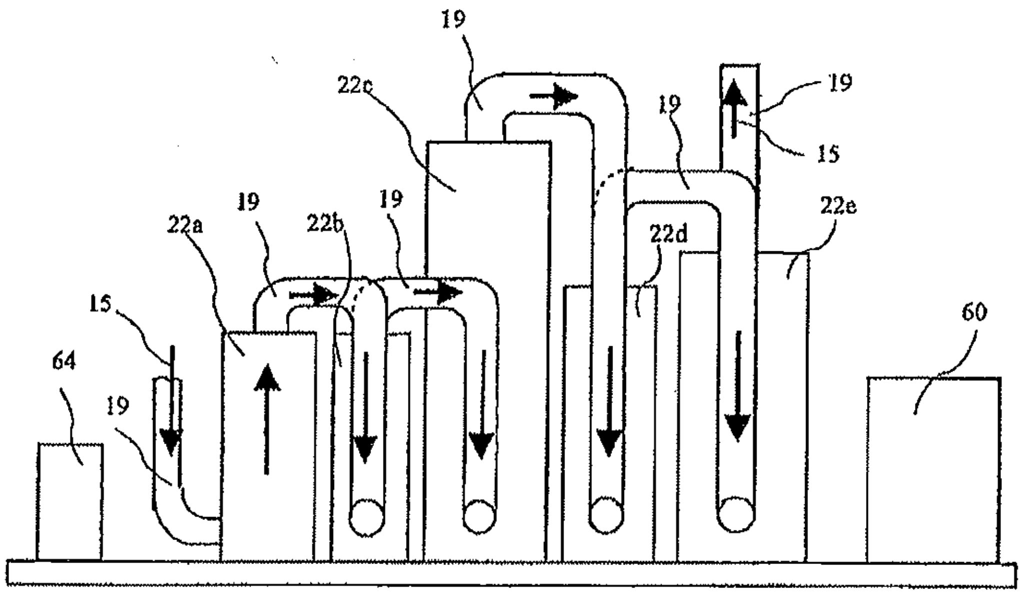
46
26

FIG. 4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22c
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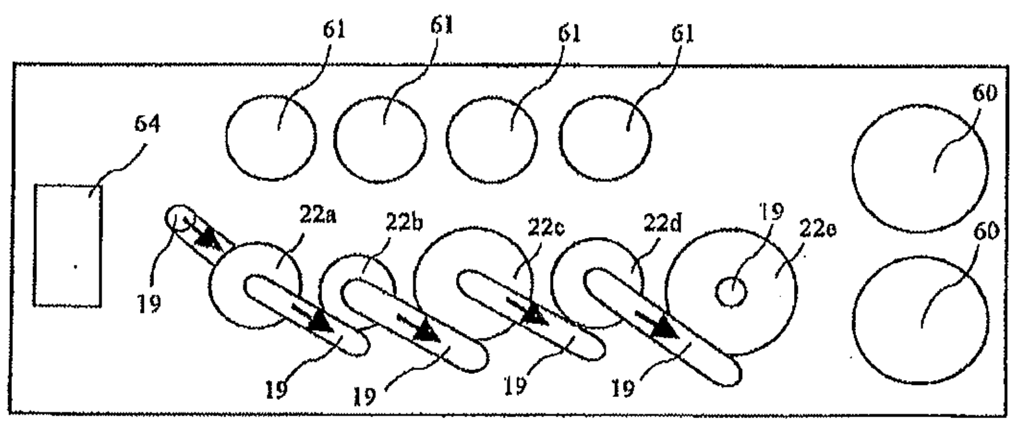
19
15
19
22a
19
22b
22d
22e
15
60
64
19

FIG. 5A


61
61
61
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64
22a
22b
22c
22d
19
22e
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19
19
19

FIG. 5B

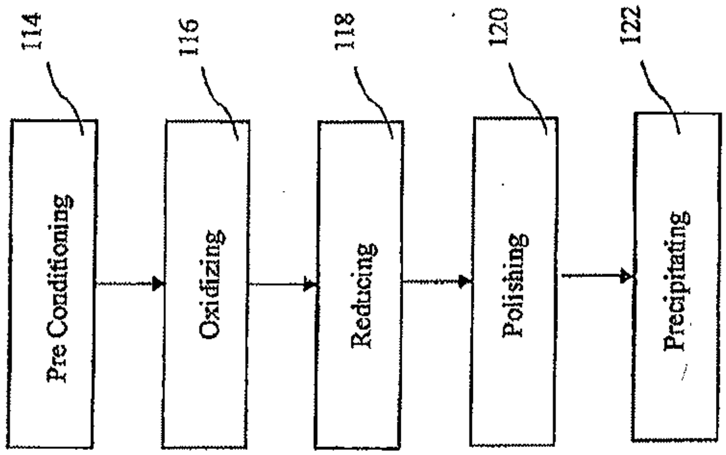
Pre Conditioning
114
Oxidizing
116
Reducing
118
Polishing
120
Precipitating
122

FIG. 6A

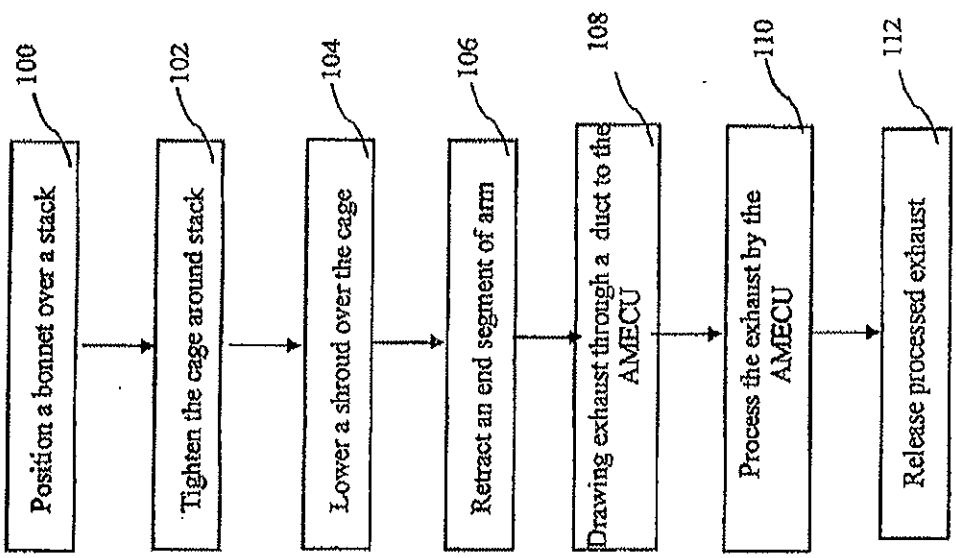
Position a bonnet over a stack
100
Tighten the cage around stack
102
Lower a shroud over the cage
104
Retract an end segment of arm
106
Drawing exhaust through a duct to the AMECU
108
Process the exhaust by the AMECU
110
Release processed exhaust
112

FIG. 6

MARITIME EMISSIONS CONTROL SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to the reduction of emissions from Ocean Going Vessels (OGVs), and more particularly to a system for capturing and processing emissions from OGVs in the vicinity of a port.

A substantial quantity of pollutants are produced by burning fuel in OGVs. The pollutants produced when an engine burns bunker an/or diesel fuel is a complex mixture of thousands of gases and fine particles, commonly known as soot, which contains more than forty toxic air contaminates. These contaminates include arsenic, benzene, and formaldehyde along with other ozone-forming pollutants that are components of smog and acid rain, such as carbon dioxide (CO_2), sulphur dioxide (SO_2), and nitrogen oxides (NO_x). An OGV may create and exhaust as much NO_x as 12,500 automobiles or as an oil refinery, and thus is a substantial health risk to port workers and residents of surrounding communities, and may physically damage structures and equipment.

BRIEF SUMMARY OF THE INVENTION

The present invention addresses the above and other needs by providing an Advanced Maritime Emissions Control System (AMECS) comprising a multiplicity Exhaust Intake Bonnets (EIBs), an Emissions Capture System (ECS) comprising a tower and actuating arm, an Advanced Maritime Emissions Control Unit (AMECU), and a duct connecting the EIB to the AMECU. The AMECS is preferably mounted on an Unpowered Seagoing Barge (USB).

The AMECS is deployed when an Ocean Going Vessel (OGV) is at sea, for example, when the OGV is approaching the three miles limit. The USB carrying the AMECS, is assisted by a tug to meet the OGV at a point off the coast. As the USB approaches the OGV, the tug positions the USB along the OGV side opposite to the side from which the OGV will be unloaded. Once alongside the OGV, the USB is secured to the OGV, and preferably, a stabilization arm is extended between the tower and the OGV, to absorb shock and provide stability for the ECS. The ECS is then activated, hosting an EIB selected from a multiplicity of EIBs shaped to accommodate the particular ship's stack configuration, onto the stack. An EIB attachment mechanism (preferably including a soft belt which may be tightened around the stack by drawing a cord) is then actuated to create a soft attachment between the EIB and the ship's stack. Once the USB is secured to the OGV, and EIB is properly attached to the stack, the AMECU is started thereby forming a pressure drop in the duct. This begins the process of directing the stack exhaust into the AMECU residing on the USB. A shroud is then lowered from a upward end of the EIB over the EIB, thereby forming a seal around the stack. An end segment of the articulating arm is then retracted, leaving a flexible end section of the duct connected to the EIB. Thus attached, the assembly is able to sustain movement between of the USB relative to the OGV of approximately five vertical feet and approximately five horizontal feet, without adversely affecting the attachment of the EIB or placing too great a stress on the stack.

The OGV and attached USB are then guided into port and docked. The AMECS system may remain alongside the OGV, ensuring that the exhausted emissions are reduced as much as existing technology can provide. Alternatively, a shore based AMECS may be connected to the stack while the OGV is docked. When the OGV is ready for departure, it is guided out of the harbor and out to sea a distance of, for example, approximately three miles, where the EIB is detached and the OGV is released allowing it to proceed to its next destination. To release the EIB, the blowers are shut down, the shroud retracted, the articulating arm reattached, and the tension to the cord removed allowing the belt to relax, thereby permitting the EIB to be removed. The AMECS is then returned to its serving dock where any stored solid contaminates are removed and the system readied for the next OGV to arrive.

In accordance with one aspect of the invention, there is provided an Advanced Maritime Emissions Control System (AMECS) for Ocean Going Vessels (OGVs) comprising a barge, a tower mounted to the barge, an articulating arm mounted to the tower, an Exhaust Intake Bonnet (EIB) attached to a last segment of the articulating arm, an Advanced Maritime Emissions Control Unit (AMECU), and a duct for carrying the exhaust from the EIB to the AMECU. The EIB captures the exhaust from an OGV stack, and the AMECU processes the exhaust. The EIB is selected from a set of several EIBs of different sizes and/or shapes.

An exemplar AMECU 22 includes two primary treatment systems. The first system accomplishes reduction of nitrogen oxides (NOx) as its primary purpose, and the second system focuses on the reduction of Particulate Matter (PM). Each system may have as a secondary benefit, the reduction of other atmospheric contaminants.

An exemplar first system is a four-stage particulate/NOx/SO_2 scrubber system. The first system includes a Pre Conditioning Chamber (PCC) quench vessel first stage, an oxidation column second stage, a reduction column third stage, and a caustic (or polishing) column fourth stage. An exemplar second system is a wet electrostatic precipitation system to further reduce the concentration of PM.

Various numbers of stages, functions of the stages, orders of the stages, or contaminant reduction processes in any or all of the stages may be utilized to construct an AMECU. Alternative exemplar first systems may include, but are not limited to, Selective Catalytic Reactors (SCR) and various emerging technologies such as thermal or plasma enhanced catalytic or non-catalytic NOx removal or NOx conversion systems, and other technologies to reduce NOx or convert NOx into more benign compounds.

Alternative exemplar second systems may include, but are not limited to, washers, ionizing wet scrubbers, wet scrubbers, packed column scrubbers, cyclone scrubbers, impingement scrubbers, eductor scrubbers, vortex scrubbers, venturi scrubbers, and others, as well as filters of various types, both passive and dynamic. Some of these devices may also be used as the first stage in a multistage system. An AMECS including any combination of these, or similar devices, is intended to come within the scope of the present invention.

In accordance with another aspect of the invention, there is provided a method for emissions control, the method comprising securing a bonnet over a stack of an Ocean Going Vessel (OGV), drawing exhaust from the stack through a duct to an emissions control system, and processing the exhaust by the emissions control system. Securing the bonnet over the stack comprises positioning a cage over a stack, tightening the cage around the stack, and lowering a shroud over the cage. Processing the exhaust by the emissions control system preferably comprises two primary treatment systems. The first system accomplishes reduction of nitrogen oxides (NOx) as its primary purpose, and the second system focuses on the reduction of Particulate Matter (PM).

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The above and other aspects, features and advantages of the present invention will be more apparent from the following more particular description thereof, presented in conjunction with the following drawings wherein:

FIG. 1 is an Advanced Maritime Emissions Control System (AMECS) according to the present invention.

FIG. 2A depicts an AMECS deploying a bonnet over a stack of an Ocean Going Vessel (OGV).

FIG. 2B shows the bonnet over the stack with an end segment of an articulating arm retracted from the bonnet.

FIG. 3A shows the bonnet positioned above the stack.

FIG. 3B shows a cage of the bonnet positioned on the stack.

FIG. 3C shows a lower edge of the cage drawn around the stack.

FIG. 3D shows a shroud partially lowered over the cage.

FIG. 3E shows the shroud fully lowered over the cage.

FIG. 3F shows the bonnet after the articulating arm is detached.

FIG. 4 shows a detailed view of the bonnet over the stack.

FIG. 4A shows a more detailed view of a lower end of a rib of the cage.

FIG. 5A is a side view of an Advanced Maritime Emissions Control Unit (AMECU) and associated equipment.

FIG. 5B is a top view of the AMECU and associated equipment.

FIG. 6 describes a method for emissions control using the AMECS according to the present invention.

FIG. 6A described the steps for processing emissions.

Corresponding reference characters indicate corresponding components throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing one or more preferred embodiments of the invention. The scope of the invention should be determined with reference to the claims.

An Advanced Maritime Emissions Control System (AMECS) **10** according to the present invention is shown generally in FIG. 1. The AMECS **10** comprises at least one Exhaust Intake Bonnet (EIB) **14**, an Emissions Capture System (ECS), and an Advanced Maritime Emissions Control Unit (AMECU) **22**. The AMECS **10** is preferably mounted on an Unpowered Seagoing Barge (USB) **12**. The ECS comprises a tower **16**, and an articulating arm. The articulating arm comprising four segments **18***a*, **18***b*, **18***c*, and **18***d* connected by joints **17**.

The EIB **14** is preferably one of a multiplicity of shaped EIBs, and more preferably one of a set of four shaped EIBs, each shaped EIB is formed to cooperate with a different size and/or shape stack. The articulating arm segments **18***a*-**18***d* are connected by joints **17**, and the end segment **18***d* is detachably attachable to the EIB **14** using a payload grip **27**. A first camera is attached to the articulating arm, preferably on or near the payload grip **27**, to aid in guiding the payload grip **27** during attachment to the EIB **14**. The EIB **14** is in fluid communication with the AMECU **22** through a duct **19**. An end section of the duct **19** proximal to the EIB **14** is a flexible duct section **19***a*. The duct **19** is connected to the

AMECU **22** which processes a flow indicated by arrows **15** to reduce undesirable emissions. When in use, the flow travels from the EIB **14** to the AMECU **22**. When not in use, the EIB **14** may be detached from the articulating arm, and rest on an EIB stand **14***a*.

The articulating arm **18***a*-**18***d* is preferably between fifty feet and one hundred and twenty feet long, and is more preferably approximately one hundred feet long. The duct **19** is preferably between twelve inches and thirty six inches in diameter, and more preferably approximately eighteen inches in diameter, and is preferably made from stainless steel. The EIBs **14** are preferably between fifteen feet and forty feet across, and are suitable for cooperation with stacks of various shape and up to twenty five feet or more across. The tower **16** is preferably between fifty feet and one hundred and twenty feet high, and is more preferably approximately one hundred feet high.

The actuating arm of the present invention is similar to known four section booms used on concrete pump trucks, for example the KVM **32** built by Schwing America Inc. in Saint Paul, Minn. The boom of the KVM **32** is capable of reaching as far as 106 feet vertically, or 93 feet laterally. Booms like the boom of the KVM **32** are described in U.S. Pat. No. 5,460,301 for "Concrete Pump Vehicle" and duct joint geometries for use with booms are described in detail in U.S. Pat. No. 6,463,958 for "Distributing Device for Thick Substance, Especially Concrete." The '301 and '958 patent are herein incorporated by reference.

The AMECS **10** is shown with the EIB **14** residing over a stack **26** of an Ocean Going Vessel **24** in FIG. 2A. The end segment **18***d* of the actuating arm remains attached to the EIB **14**. Following attachment of the EIB **14** to the stack **26** (described in FIGS. 3A-3F), the end segment **18***d* is detached from the EIB **14** and pivoted to a stored position as shown in FIG. 2B leaving the flexible portion **19***a* of the duct, and a wire harness **70** attached to the EIB **14**. The duct **19** is supported by a duct support **25** attached to the articulating arm, providing sufficient freedom of movement to allow for some relative motion between the USB **12** and the OGV **24**. Preferably, approximately five feet of lateral and vertical movement is provided.

The position of the USB **12** relative to the OGV **24** is stabilized by a stabilization arm **11** connected between the tower **16** and the OGV **24**. The arm **11** is preferably connected to the tower **16** a little below a midpoint of the tower **16**, and the arm **11** extends approximately horizontally to the OGV **24**. The arm **11** includes a shock absorber to minimize the load on the hull of the OGV **24** and to stabilize the ECS. The tower **16** and articulating arm **18***a*-**18***d* preferably provide sufficient height to place the EIB **14** over the stacks of common OGVs **24**, and more preferably allow sufficient height to place the EIB **14** over the stack of the largest OGVs **24**.

An example of a set of steps of attachment of the EIB **14** to the stack **26** are shown in FIGS. 3A through 3F. The EIB **14** including ribs **28** forming a cage-like structure (or frame), a top portion **33** above a shroud **30**, and a belt **32** near the bottom of the ribs **28**, is shown above the stack **26** in FIG. 3A. The EIB **14** is shown lowered over the stack **26** in FIG. 3B. The downward end of the EIB **14** is drawn to close around the stack **26** in FIG. 3C. The shroud **30** is partially lowered over the ribs **28** in FIG. 3D. The shroud **30** is fully lowered over the ribs **28** in FIG. 3E. The articulating arm is detached in FIG. 3F, and the attachment of the EIB **14** to the stack **26** in compete. The steps described above are not exclusive and, for example, the articulating arm may be detached before lowing the shroud **30** over the ribs **28**. The

EIB 14 preferably includes eight to twenty four ribs 28, and more preferably sixteen ribs 28.

A detailed view of the EIB 14 is shown in FIG. 4. A top portion 33 resides above the shroud 30, and preferably comprises a capture ring assembly 34 at the top of the EIB 14, which capture ring assembly 34 is used to attach to the EIB 14 to the payload grip 27 (see FIG. 1). The capture ring assembly 34 is designed to be easily attached and detached from the payload grip 27 (see FIG. 1). An upper opening of the capture ring assembly 34 has a large aperture, with a self-aligning locking mechanism for engaging the payload grip 27. Preferably, the payload grip 27 includes a spring latching mechanism which will release locking members into the capture ring assembly 34 when the payload grip 27 is in the proper position.

At least one motor 36 is connected to a hub 40, the motor 36 and hub 40 preferably residing inside the top portion 33 and are indicated by dashed lines in FIG. 4. The motor 36 is preferably a constant-torque motor that when activated, tightens a cord 42 thereby compressing the ribs 28 and providing consent pressure for a friction-seal. Cord ends 42*a* and 42*b* of the cord 42 wind around the hub 40. The cord 42 runs down to belt pulleys 45, and then around the outside of the ribs 28 through guides 43 to draw the EIB 14 around the stack 26. The EIB 14 may thus be closed (or compressed) around the stack 26 by winding ends the cord ends 42*a*, 42*b* onto the hub 40. The motor 36 controls the tension on the cord 42, to provide an air seal between the EIB 14 and the stack 26, to firmly hold the EIB 14 on the stack 26, and to prevent damage to the EIB 14 or the stack 26 during operation of the AMECS 10.

Shroud cords 44 loop vertically around the outside of the EIB 14 between an upward end and a downward end of the frame, and are attached to the shroud 30 near a lower edge 52 of the shroud 30, to raise and lower the shroud 30 over the ribs 28. A shroud notch 41 in the guide 43 provides a seat for the shroud 30 when fully lowered. A second camera and a laser guided positioning system are preferably attached to the EIB 14 to aid in guiding the EIB 14 over the stack 26. For example, a camera may be mounted in the top portion 33 and pointed down. Video from the camera is used to assist the operator in positioning the EIB 14 over the ships stack 26. Once the EIB 14 is over the stack 26, the laser positioning system guides the EIB 14 into its final position around the stack 26. Alternatively, a system for controlling a boom such as described in U.S. Pat. No. 5,823,218 for "Large Manipulator, Especially for Self-Propelled Concrete Pumps, and Method for Operating it," may be used to automatically position the EIB 14. The system described in the '218 patent may also be utilized to maintain the position of the articulating arm relative to the stack 26 during operation of the AMECS 10, and for re-attaching the articulating arm to the EIB 14 when the EIB 14 is to be removed from the stack 26. The '218 patent is herein incorporated by reference.

The EIB 14 further preferably includes a pressure sensor, and more preferably includes two pressure sensors (a primary sensor and a backup sensor) to provide feedback to a System Operational Control Unit (SOCU), which in turn regulates the speed of a tower blower assembly maintaining a constant negative pressure within the duct 19, wherein the blower is preferably a centrifugal blower. Maintaining constant pressure assures that nearly all of the exhaust gases are captured and funneled into the AMECU 22 for processing, without adversely affecting engine performance and while compensating for main and auxiliary engine turn-on and startup, and for back pressure in the AMECU 22.

A more detailed view of a lower portion of a rib 28 is shown in FIG. 4A. The rib 28 is preferably a springy (i.e., returns to an original shape when released) curved tube, is preferably made from stainless steel or fiberglass, and has a lower end 54. The rib 28 is required to retain sufficient memory to "spring" back to the open position when the cord 42 is released. A shroud pulley 46 resides on an axle 48 held by a bracket 50 near the lower end 54. The shroud cord 44 runs around the shroud pulley 46 and through the rib 28. The shroud cord 44 is preferably drawn by a motor residing above the ribs 28. In another embodiment, a motor with a hub resides near the lower end 54 of each rib 28, and the shroud cord 44 is wound around the hub. The belt 32 is shown in cross-sectional view, and the cord 42 is shown running through a guide 43. While the bracket 50 and guide 43 are shown as two distinct parts in FIG. 4A, they may be a single bracket/guide.

The shroud 30 is preferably made from a heat and emission resistant material for long life, for example, kevlar® fiber or kapton® polyimide film, and the shroud 30 preferably resists damage from chemicals found in OGV 24 exhaust, and temperatures up to 350 degrees Celsius. The belt 32 is preferably between six inches and fourteen inches thick and ten inches to fourteen inches high, and more preferably approximately ten inches thick and approximately twelve inches high. The belt 32 is preferably made from a soft or sponge-like (i.e., foam) material which provides a degree of air seal between the EIB 14 and the stack 26, and also retains the EIB 14 onto the stack 26 through surface friction and will not damage the stack. For example, the belt may be made from neoprene or the like material. Alternatively, the belt may be an inflatable belt. The cords 42, 44 are preferably made from non UV sensitive material, and more preferably from nylon.

A detailed view of an exemplar AMECU 22 layout and associated equipment is shown in FIG. 5A in side view, and in FIG. 5B in top view. The exemplar AMECU 22 comprises two primary treatment systems. The first system, accomplishes reduction of nitrogen oxides (NOx) as its primary purpose, and the second system focuses on the reduction of particulate matter (PM). Each system has as a secondary benefit, the reduction of other atmospheric contaminants.

The first system comprises four stages. The first stage comprises a Pre Conditioning Chamber (PCC) quench vessel 22*a*. The second stage comprises oxidation column 22*b*. The third stage comprises reduction column 22*c*. The fourth stage comprises a caustic (or polishing) column 22*d*. The second system comprises a single stage which is a wet electrostatic precipitation system 22*e* which further reduces the concentration of PM.

While a five stage AMECU 22 is described herein, AMECS 10 may include an emissions control unit with a different number of stages, different order of stages, different allocation, and/or, different processing to reduce other emissions, and any AMECS including any of these variations of emissions control units for processing OGV exhaust is intended to come within the scope of the present invention. Arrows 15 indicate the direction of exhaust flow through the AMECU 22.

Continuing with FIGS. 5A, 5B, The AMECU 22 resides proximal to waste tanks 60, storage tanks 61, a power source 64 and the cabin 13 which serves as a control room.

A method for using the AMECS 10 for emissions control is described in FIG. 6. The method includes positioning the EIB 14 over a stack 26 of an OGV 24 at step 100. Tightening a cage around the stack at step 102. Lowering a shroud over the cage at step 104. Retracting the end segment 22*d* at step

106. Drawing the exhaust through the duct 19 to the AMBCU 22 at step 108. Processing the exhaust at step 110. Releasing the processed exhaust at step 112.

Processing the exhaust at step 110 preferably comprises the steps of pre conditioning the exhaust at step 114, oxidizing at step 116, reducing at step 118, polishing at step 120, and precipitating at step 122.

The invention further contemplates a land based structure in place of the USB 12 for use when the OGV 24 is moored to a dock, or for control of emissions from land based equipment. The land based structure would support the same elements as the USB 12 based AMBCS 10 with the exception that the tower 16, AMBCU 22, and associated equipment would be supports on the land instead of on the USB 12. The system may, for example, be mounted to a truck, a trailer, or a rail road car.

While the invention herein disclosed has been described by means of specific embodiments and applications thereof, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope of the invention set forth in the claims.

We claim:

1. An advanced maritime emissions control system comprising:

a bonnet configured for residing over a ship stack for capturing exhaust from the ship stack, the bonnet contractable around the ship stack to sufficiently grasp the ship stack to hold the bonnet in place over the ship stack;

an emissions control unit for processing the exhaust from the stack; and

a duct for carrying the exhaust from the bonnet to the emissions control unit.

2. The emissions control system of claim 1, further including:

a tower; and

an articulating arm extending from the tower,

wherein the bonnet is positioned on the stack by the articulating arm.

3. The emissions control system of claim 1, further including:

a tower; and

an articulating arm extending from the tower,

wherein the duct is supported by the articulating arm.

4. The emissions control system of claim 3, wherein the articulating arm includes segments.

5. The emissions control system of claim 4, wherein the articulating arm includes pivoting joints between the segments.

6. The emissions control system of claim 4, wherein the segments include an end segment connectable to the bonnet for placing the bonnet on the stack, and wherein the end segment is disconnectable from the bonnet.

7. The emissions control system of claim 1, wherein the bonnet is selectable from a multiplicity of shaped bonnets.

8. The emissions control system of claim 1, wherein the bonnet comprises a top, a cage extending from the top, and a shroud lowerable over the cage.

9. The emissions control system of claim 8, wherein the cage comprises downwardly reaching curved ribs.

10. The emissions control system of claim 9, wherein the ribs comprise between eight and twenty four ribs.

11. The emissions control system of claim 10, wherein the tubes comprise about sixteen ribs.

12. The emissions control system of claim 9, wherein shroud cords attach to a lower edge of the shroud and wherein pulling on the shroud cords lowers the shroud over the tubes.

13. The emissions control system of claim 9, wherein the ribs comprise tubes, and wherein the tubes include pulleys near a lower end of each tube, and wherein the shroud cords loop around the pulleys, wherein the shroud cords are pulled upward through the tubes to lower the shroud.

14. The emissions control system of claim 1, wherein the emissions control unit includes a Pre Conditioning Chamber (PCC) quench vessel.

15. The emissions control system of claim 1, wherein the emissions control unit includes an oxidation column.

16. The emissions control system of claim 1, wherein the emissions control unit includes a reduction column.

17. The emissions control system of claim 1, wherein the emissions control unit includes a caustic column.

18. The emissions control system of claim 1, wherein the emissions control unit includes a wet electrostatic precipitation system.

19. A method for emissions control, the method comprising:

securing a bonnet over a stack of an Ocean Going Vessel (OGV) to capture exhaust;

drawing the exhaust captured by the bonnet through a duct to an emissions control unit; and

processing the exhaust by the emissions control unit.

20. The method of claim 19, wherein the bonnet includes a cage and a shroud, and wherein securing the bonnet over the stack comprises:

positioning the cage over a stack;

tightening the cage around the stack; and

lowering the shroud over the cage.

21. The method of claim 19, wherein processing the exhaust by the emissions control system comprises:

processing the exhaust using a Pre Conditioning Chamber (PCC) quench vessel;

processing the exhaust using an oxidation column;

processing the exhaust using a reduction column;

processing the exhaust using a caustic (or polishing) column; and

processing the exhaust using a wet electrostatic precipitation system.

22. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end;

a shroud on the outward side for enclosing the frame;

a belt attached to the inward side near the downward end; and

means for tightening the downward end around the stack,

wherein the bonnet is one of several bonnets of different sizes and shapes suitable to cooperating with Ocean Going Vessel (OGV) stacks of different sizes and shapes.

23. The bonnet of claim 22, wherein the several bonnets comprise four bonnets of different sizes and shapes.

24. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end;

wherein the frame comprises springy downwardly extending ribs.

25. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end,

wherein the belt is made from a foam material to provide an air seal between the shroud and the stack, and to retain the bonnet in place on the stack, when the downward end of the frame is tightened around the stack.

26. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end,

wherein the belt is between six inches and fourteen inches thick and between ten inches to fourteen inches high.

27. The bonnet of claim 26, wherein the belt is approximately ten inches thick and approximately twelve inches high.

28. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end,

a capture ring assembly at the frame upward end, the capture ring including an upward facing opening with a self-aligning locking mechanism for cooperation with an articulating arm.

29. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame;

a belt attached to the inward side near the downward end; and

a camera and laser guided positioning system, wherein video from the camera is provided to an operator to use in positioning the bonnet over the stack, and wherein when the bonnet is in position over the stack, the laser guided positioning system automatically guides the bonnet into position around the stack.

30. The bonnet of claim 24, wherein the means for tightening the downward end around the stack comprises a cord running around the outside of the frame near the downward end of the frame, and wherein drawing the cord tightens the downward end of the frame around the stack.

31. The bonnet of claim 30, further including a constant-torque motor which when activated, tightens the cord thereby tightening the belt and providing consent pressure between the belt and the stack.

32. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end,

wherein the shroud is lowerable over the frame, and raisable to a position at the upward end of the frame.

33. The bonnet of claim 32, wherein the shroud is lowerable and raisable using shroud cords attached to a lower edge of the shroud, wherein the shroud cords loop down outside the frame from the upward end of the frame, around pulleys near the downward end of the frame, and back to the upward end of the frame.

34. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end,

wherein the bonnet includes at least one pressure sensor which provides a pressure measurement to regulate the speed of a blower assembly to maintain a constant negative pressure within the intake duct.

35. A bonnet for capturing exhaust from a stack, the bonnet comprising:

a frame having an upward end, outward side, an inward side, and a downward end which is tightenable around the stack;

a shroud on the outward side for enclosing the frame; and

a belt attached to the inward side near the downward end,

wherein the bonnet includes an interface for a flexible duct, and wherein the flexible duct allows relative motion between the bonnet and an emissions control unit, wherein the exhaust from the stack is drawn through the flexible duct.

* * * * *

EXHIBIT B

US008327631B2

(12) **United States Patent**
Caro et al.

(10) **Patent No.: US 8,327,631 B2**
(45) **Date of Patent: Dec. 11, 2012**

(54) **AIR POLLUTION CONTROL SYSTEM FOR OCEAN-GOING VESSELS**

(76) Inventors: **Sal Caro**, Camarillo, CA (US); **Henning Ottsen**, Ventura, CA (US); **John Powell**, Santa Clarita, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1049 days.

(21) Appl. No.: **11/092,477**

(22) Filed: **Mar. 28, 2005**

(65) **Prior Publication Data**

US 2006/0213197 A1 Sep. 28, 2006

(51) **Int. Cl.**
F01N 3/00 (2006.01)

(52) **U.S. Cl.** **60/297**; 60/274; 60/286; 60/301; 60/303; 60/311; 60/320

(58) **Field of Classification Search** .... 60/274, 60/286, 297, 301, 303, 311, 320; 440/89 A, 440/89 R, 113
See application file for complete search history.

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U.S. Appl. No. 10/941,731, filed Sep. 14, 2004, Caro, et al.

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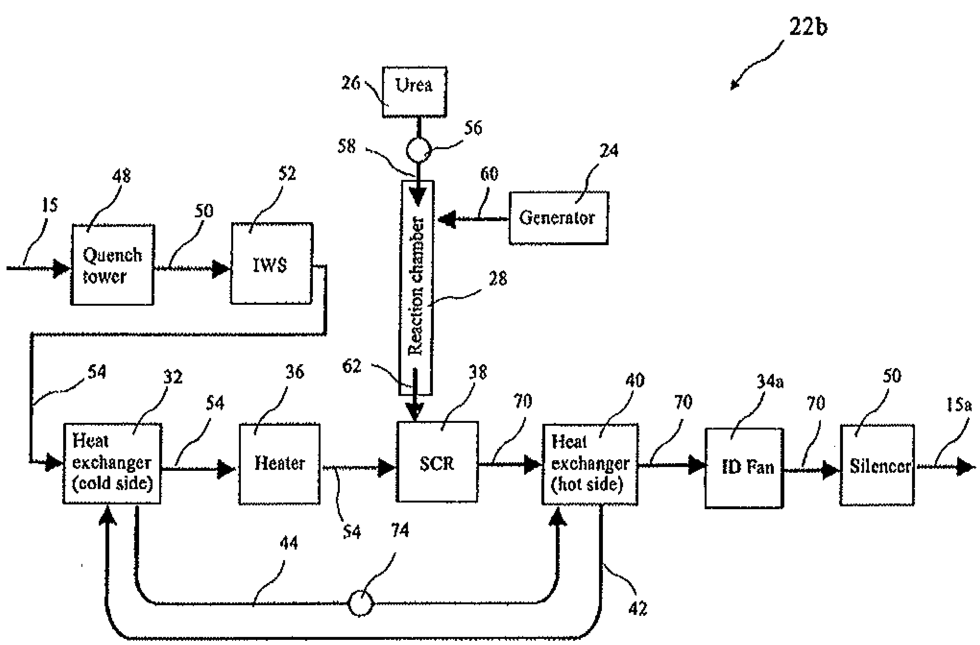
Primary Examiner — Thomas Denion
Assistant Examiner — Diem Tran
(74) *Attorney, Agent, or Firm* — Kenneth L. Green

(57) **ABSTRACT**

A platform mounted emissions control unit includes a first system to reduce Particulate Matter (PM), Sulfur Dioxide (SO_2), and Volatile Organic Compounds (VOCs), and a second system to reduce Oxides of Nitrogen (NO_x). The systems serially process exhaust from a mobile or stationary pollution source. In one embodiment, first system is an Ionizing Wet Scrubber (IWS) and the second system is a Selective Catalytic Reducer (SCR), wherein the IWS processes the exhaust first to improve efficiency and service life of the SCR. A generator produces power required by the IWS and SCR, and heat from exhaust of the generator may be used convert urea to ammonia for use by the SCR, and to heat the exhaust flow into the SCR. The SCR may further include a heat exchanger to capture heat in the flow out of the SCR and use the captured heat to heat the flow into the SCR.

23 Claims, 6 Drawing Sheets



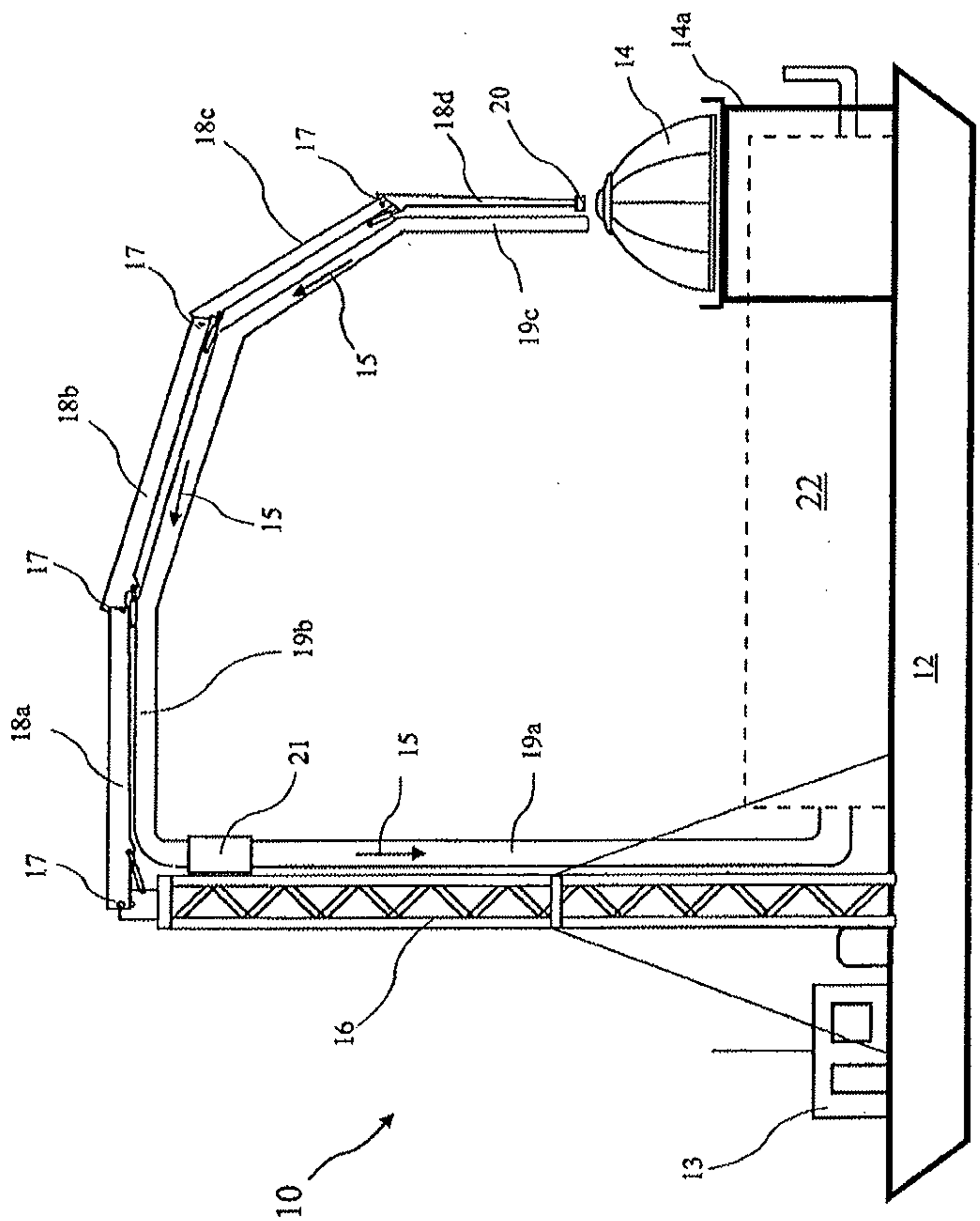


FIG. 1

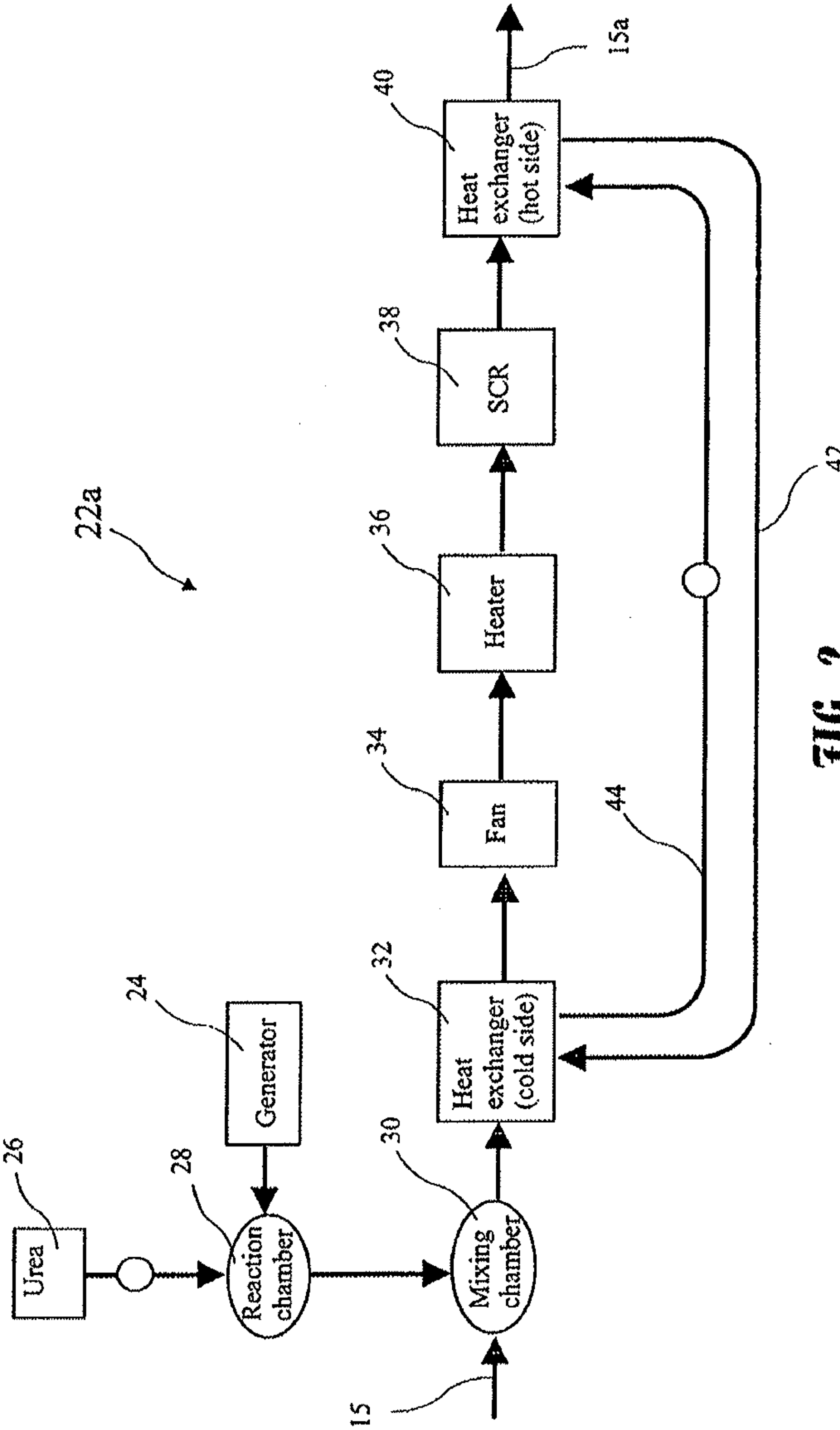


FIG. 2
(Prior Art)

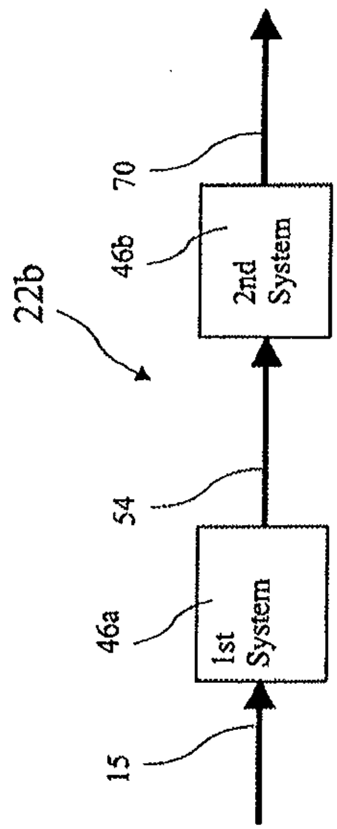

22b
15
46a
1st System
54
46b
2nd System
70

FIG. 3

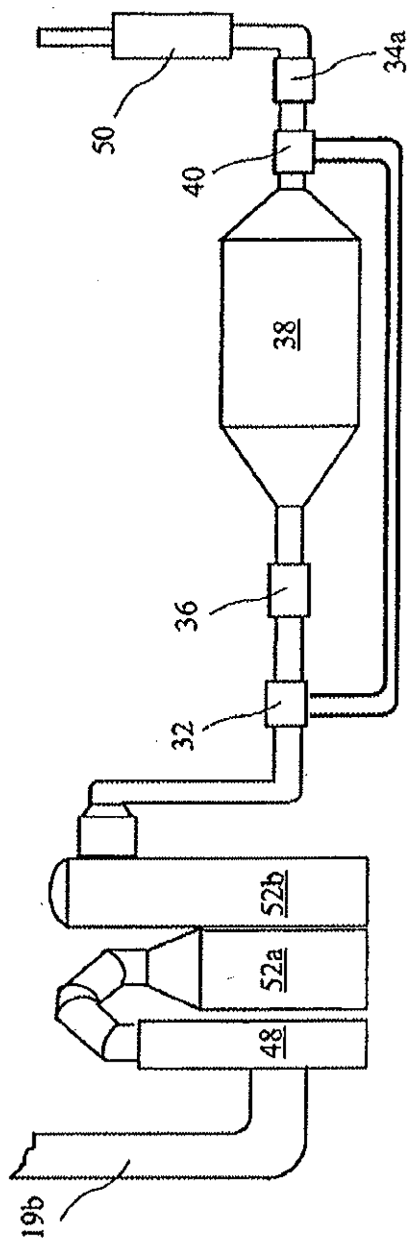

50
34a
40
38
36
32
52b
52a
48
19b

FIG. 4

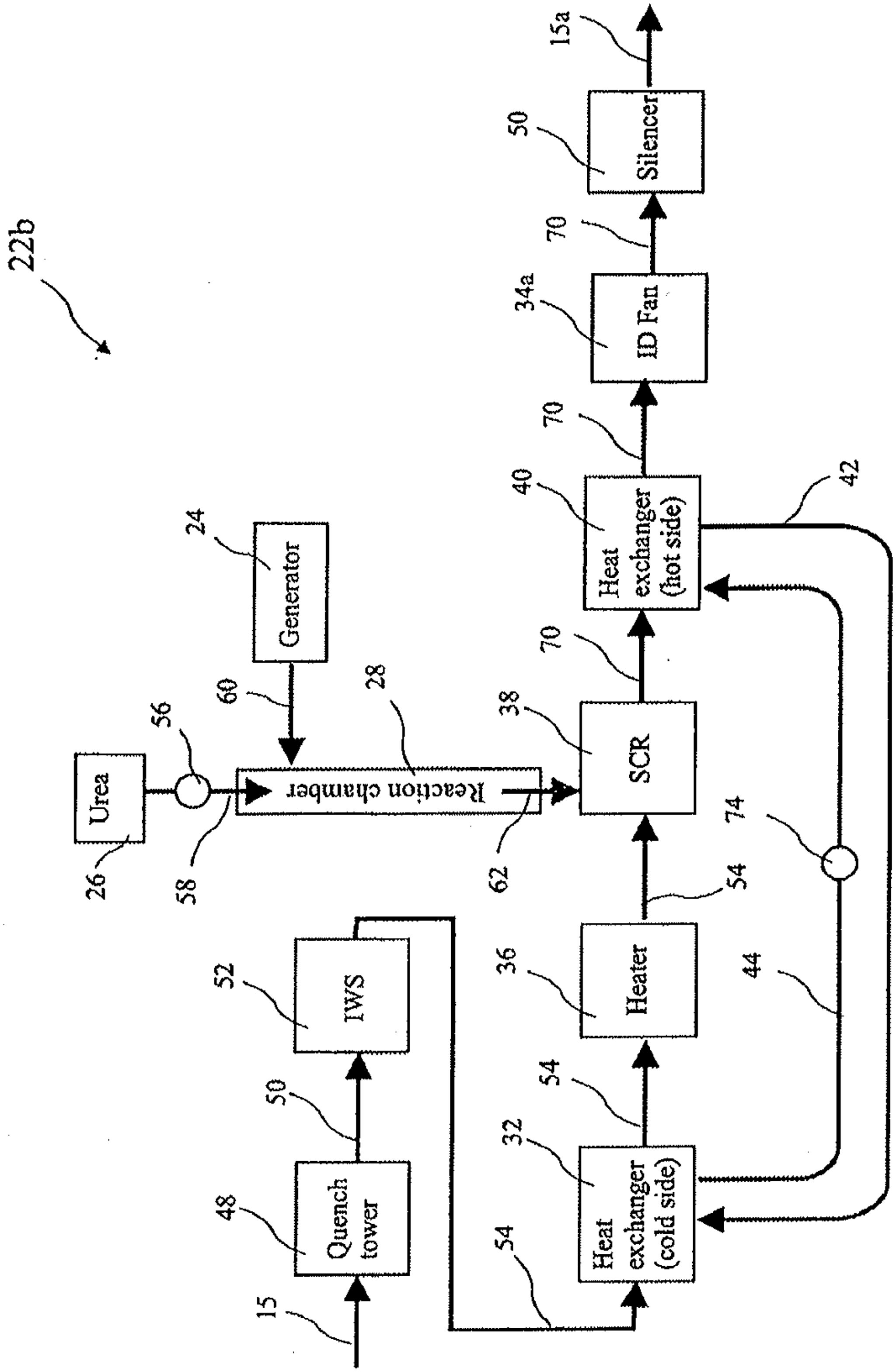

22b
15a
Silencer
50
70
ID Fan
34a
70
Heat exchanger (hot side)
40
42
Generator
24
60
28
Reaction chamber
Urea
56
26
58
62
SCR
38
70
74
54
Heater
36
44
54
IWS
52
50
Quench tower
48
15
54
Heat exchanger (cold side)
32

FIG. 5

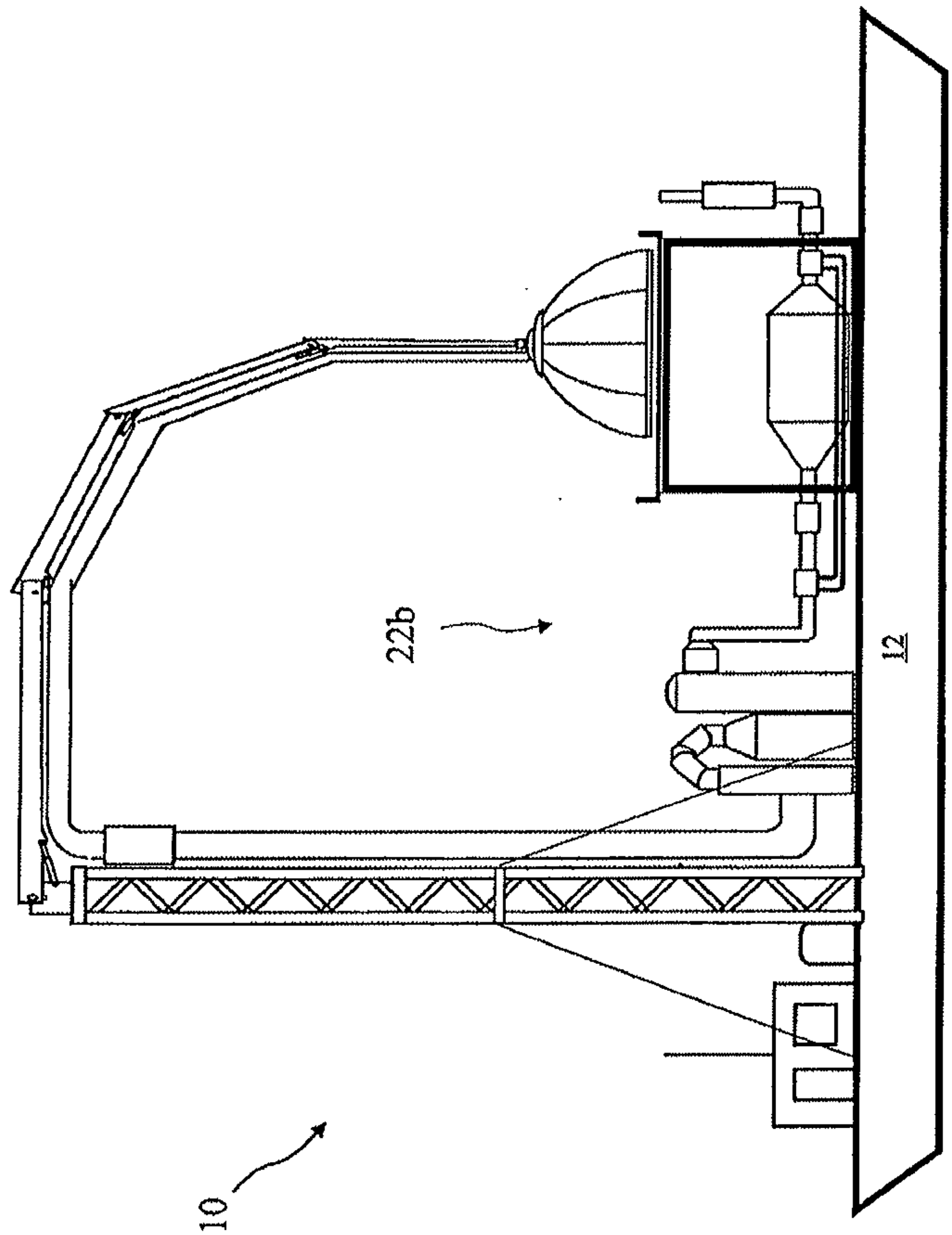


FIG. 6

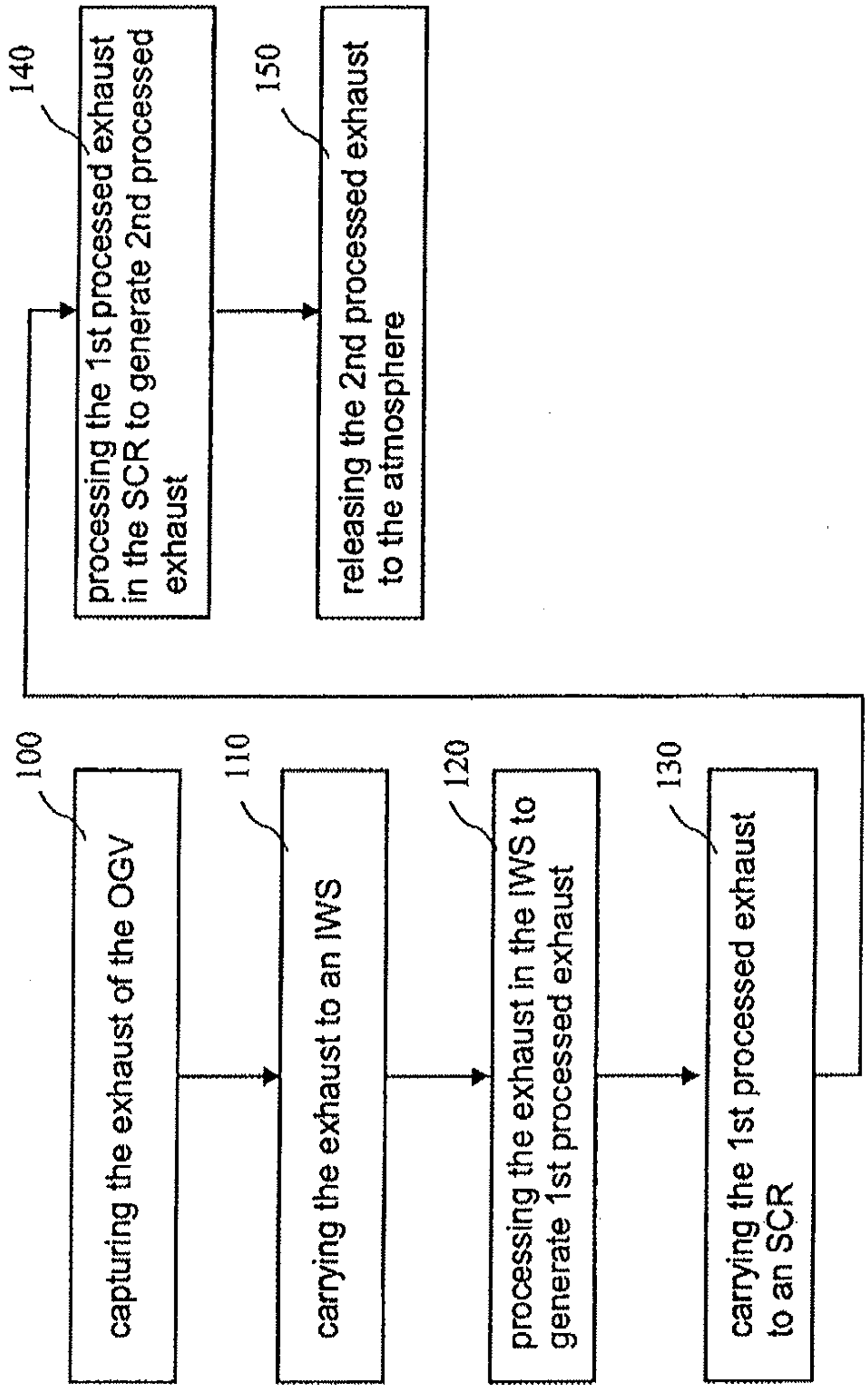

100
capturing the exhaust of the OGV
110
carrying the exhaust to an IWS
120
processing the exhaust in the IWS to generate 1st processed exhaust
130
carrying the 1st processed exhaust to an SCR
140
processing the 1st processed exhaust in the SCR to generate 2nd processed exhaust
150
releasing the 2nd processed exhaust to the atmosphere

FIG. 7

AIR POLLUTION CONTROL SYSTEM FOR OCEAN-GOING VESSELS

BACKGROUND OF THE INVENTION

The present invention relates to pollution reduction and in particular to a system for capturing and reducing airborne emissions from ocean going vessels while these vessels are in port or in the vicinity of a port, and from land based emissions sources such as trucks or locomotives.

A variety of human activities produce exhaust having harmful levels of emissions (i.e., pollution.) Large stationary emissions sources generally have dedicated co-located emissions control systems. However, some large emissions sources are mobile and require mobile emissions control systems which may be co-located with the mobile emissions sources while the mobile emissions sources are in motion, or while the mobile emissions sources are temporarily stationary. An example of such large mobile emissions source is an Ocean Going Vessel (OGV) which is stationary during calls on port. A substantial quantity of pollutants are produced by OGVs burning diesel fuel or bunker fuel. The exhaust produced by an engine burning these fuels is a complex mixture of thousands of gases and fine particulates. The particulates, which make up the commonly observed discharges known as soot or smoke, contain more than forty toxic air contaminants. These contaminants include arsenic, benzene, and formaldehyde along with other ozone-forming pollutants that are components of smog and acid rain, such as carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_x). A single OGV may produce as much NO_x as 12,500 automobiles or as an oil refinery, and thus may present substantial health risks to port workers and residents of surrounding communities. The pollutants may also cosmetically and/or physically damage local structures and equipment.

U.S. patent application Ser. No. 10/835,197, filed Apr. 29, 2004 for "Maritime Emissions Control System," and assigned to the assignee of the present invention, describes a maritime emissions control system which may be transported by barge or vessel to an OGV near or within a harbor. The maritime emissions control system captures and processes a main exhaust flow from the OGV to reduce emissions. The main exhaust flow may be from the OGV's engine(s), auxiliary engines, generators, and/or any other source of exhaust from the OGV.

The emissions control system of the '197 patent application includes a bonnet which is lowered over the OGV's stack, and a duct for carrying the main exhaust flow from the OGV's stack to emissions processing equipment carried by a barge alongside the OGV. A tower with an articulating arm deploys the bonnet over the stack. As a result of the distance the main exhaust flow must travel before reaching the emissions processing equipment, the temperature of the main exhaust flow is much lower than it's temperature upon being exhausted from an engine or engines.

The emissions control unit of the '197 application comprises a first system for reduction of nitrogen oxides (NO_x) and a second system for reduction of Particulate Matter (PM). The first system comprises four stages. The first stage comprises a Pre-Conditioning Chamber (PCC) quench vessel. The second stage comprises an oxidation column. The third stage comprises a reduction column. The fourth stage comprises a caustic (or polishing) column. The second system comprises a wet electrostatic precipitation system. The '197 application is herein incorporated by reference.

Although a preferred method for reducing NO_x emissions is a Selective Catalytic Reducer (SCR) system, the system of

the '197 application does not include an SCR system. The main exhaust flow would require heating to a high temperature before introduction into the SCR system. Also, ammonia used by SCR systems is typically generated by heating urea. The cost and space required for an energy source for such heating made known SCR systems impractical for the maritime emissions control system.

U.S. patent application Ser. No. 10/941,731, filed Sep. 14, 2004 for "High Thermal Efficiency Selective Catalytic Reduction (SCR) System," and assigned to the assignee of the present invention, describes an emissions control unit which transfers heat generated in one or more parts of the unit which generate heat to other parts of the system which require heat. For example, heat stored in exhaust from a diesel generator is used to convert urea to ammonia used by an SCR system, and/or the diesel generator exhaust may be used to heat the main exhaust flow before entry into the SCR. Additionally, a heat exchanger is used to transfer heat from a hot clean flow out of the SCR to the main exhaust flow entering the SCR. The '731 application is herein incorporated by reference.

Although the '731 patent application provides significant energy savings, the emissions control unit described in the '731 application may suffer reduced efficiency if the OGV uses a fuel resulting in high-sulfur diesel exhaust. The high-sulfur diesel exhaust requires higher temperatures at entry to the SCR, and therefore higher energy costs. Further, the sulfur and ammonia combine to form ammonium bisulfate, NH_4HSO_4. Ammonium bisulfate is a sticky, gummy substance which may clog and foul the SCR, severely reducing the SCR service life. Also, sulfur and water can combine to form sulfuric acid, H_2SO_4, which may cause serious corrosion problems to the SCR. Additionally, the emissions control unit described in the '731 application employs a SCR upstream of an Ionizing Wet Scrubber (IWS). This ordering of the system components was logical and obvious because the IWS requires significant cooling of the initially hot gas stream, whereas the SCR requires a hot gas stream which would otherwise have to be reheated after cooling for passage through the IWS. However, such an arrangement subjects the SCR to a gas stream laden with particulates and sulfur compounds, components that are later removed by the IWS, which particulates and sulfur compounds can clog and otherwise impair the performance and operational longevity of the SCR.

BRIEF SUMMARY OF THE INVENTION

The present invention addresses the above and other needs by providing a mobile platform mounted emissions control unit (ECU) which includes a first system to reduce Particulate Matter (PM), Sulfur Dioxide (SO_2), and Volatile Organic Compounds (VOCs), and a second system to reduce Oxides of Nitrogen (NO_x). The first system and the second system serially process exhaust from a mobile pollution source when in motion or stationary. In one embodiment, the first system is an Ionizing Wet Scrubber (IWS) and the second system is a Selective Catalytic Reducer (SCR), wherein the IWS processes the exhaust prior to entering the SCR to improve the efficiency and service life of the SCR. An diesel generator produces power required by the IWS and SCR, and heat from exhaust of the diesel generator may be used convert urea to ammonia for use by the SCR, and to heat the exhaust flow into the SCR. The SCR may further include a heat exchanger to capture heat in the flow out of the SCR and use the captured heat to heat the flow into the SCR. An ECU according to the present invention is particularly applicable to Ocean Going Vessels (OGVs), as well as to temporarily stationary or nearly stationary sources of air pollution such as trucks or locomotives at maintenance or waiting areas.

In accordance with one aspect of the invention, there is provided a maritime emissions control system comprising a barge, a generator, and an Emissions Control Unit (ECU) comprising an IWS system and an SCR system. The IWS system is mounted on the barge and is adapted to process an exhaust flow from an Ocean Going Vessel (OGV) to generate a first processed flow. The SCR system likewise is mounted on the barge and is adapted to receive the first processed flow and generate a second processed flow. The entire ECU system is powered by the barge mounted generator. The maritime emissions control system may further include a bonnet and an Emissions Capture System (ECS) mounted to the barge. The ECS includes a tower, an articulating arm extending from the tower, and a duct running the length of the tower and the articulating arm and connecting the bonnet to the ECU. The ECS is adapted to position the bonnet over a stack of an OGV.

Otherwise wasted heat from the generator exhaust may be mixed with urea to produce ammonia for the SCR, and a heat exchanger may be adapted to carry heat from the outflow of the SCR to the inflow of the SCR.

In accordance with another aspect of the invention, there is provided a method for cleaning OGV exhaust. The method includes delivering the exhaust to an ECU and processing the exhaust in the ECU. Delivering the exhaust to the ECU includes capturing the exhaust of the OGV and carrying the exhaust to the ECU. Processing the exhaust in the ECU comprises first processing the exhaust in an IWS to generate first processed exhaust, carrying the first processed exhaust to an SCR, processing the first processed exhaust in an SCR to generate second processed exhaust, and releasing the second processed exhaust to the atmosphere.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The above and other aspects, features and advantages of the present invention will be more apparent from the following more particular description thereof, presented in conjunction with the following drawings wherein:

FIG. **1** is an Advanced Maritime Emissions Control System (AMECS).

FIG. **2** is a prior art emissions control unit.

FIG. **3** shows an emissions control unit according to the present invention.

FIG. **4** shows details of one embodiment of the emissions control unit according to the present invention.

FIG. **5** shows a processing diagram of one embodiment of the emissions control unit according to the present invention.

FIG. **6** shows the emissions control unit according to the present invention mounted on a barge.

FIG. **7** describes a method according to the present invention.

Corresponding reference characters indicate corresponding components throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing one or more preferred embodiments of the invention. The scope of the invention should be determined with reference to the claims.

An Advanced Maritime Emissions Control System (AMECS) **10** suitable for incorporation of the present invention is shown generally in FIG. **1**. The AMECS **10** comprises at least one Exhaust Intake Bonnet (EIB) **14**, an Emissions Capture System (ECS), and an Emissions Control Unit (ECU) **22**. The AMECS **10** is preferably mounted on an Unpowered Seagoing Barge (USB) **12**. The ECS comprises a tower **16**, an articulating arm comprising four segments **18***a*, **18***b*, **18***c*, and **18***d*, a duct tower portion **19***a* running along the tower **16**, and duct articulating arm portion **19***b* running along the actuating arm. The four segments **18***a*, **18***b*, **18***c*, and **18***d* are connected by joints **17**.

The EIB **14** is preferably one of a multiplicity of shaped EIBs, and more preferably one of a set of four to six shaped EIBs, each shaped EIB is formed to cooperate with a different size and/or shape stack. The articulating arm end segment **18***d* is detachably attachable to the EIB **14** using a payload grip **20**. A first camera is attached to the articulating arm, preferably on or near the payload grip **20**, to aid in guiding the payload grip **20** during attachment to the EIB **14**.

The EIB **14** is in fluid communication with the ECU **22** through the duct **19***a*, **19***b*. An end section of the duct **19***b* proximal to the EIB **14** is a flexible duct section **19***c* to allow for motion between the USB **12** and the OGV when the EIB **14** is attached to the OGV stack. In case of excessive wind loadings, the tip of the articulating arm may remain attached to the EIB to provide additional support; in this case, the controls of the articulating arm will incorporate a station keeping system to maintain the position of the EIB above the stack. The duct **19***a*-**19***c* carries an exhaust flow **15** (indicated by arrows) to the ECU **22**, which ECU **22** processes the exhaust flow **15** from the OGV, to reduce undesirable emissions. When in use, the exhaust flow **15** travels from the EIB **14** to the ECU **22**. When not in use, the EIB **14** may be detached from the articulating arm, and rest on an EIB stand **14***a*. The EIBs **14** are preferably between fifteen feet and forty feet across, and are suitable for cooperation with stacks of various shape and up to twenty five feet or more across.

The articulating arm is preferably between fifty feet and one hundred and twenty feet long, and is more preferably between approximately one hundred feet and approximately one hundred and twenty feet long, and most preferably approximately one hundred feet long. The duct **19***b* is preferably between twelve inches and thirty six inches in diameter, and more preferably between eighteen inches and twenty four inches in diameter, and most preferably approximately twenty two inches in diameter. The duct **19***b* is preferably made from a heat resistant fabric reinforced with a external stainless steel helix. The fabric is preferably a high temperature impervious compound fabric.

The tower **16** is preferably between fifty feet and approximately one hundred and twenty feet high, more preferably between eighty feet and one hundred and approximately twenty feet high, and most preferably approximately one hundred and twenty feet high measured from the deck of the barge **12**. Stays may be employed between the tower **16** and the barge **12** for additional support. The duct **19***a* is preferably rigid, preferably made from stainless steel, carbon steel, or aluminum, and is preferably coated to protect the duct **19***a* from the internal and external environment. The duct **19***a* is preferably between twenty four inches and thirty six inches in diameter, and more preferably approximately thirty inches in diameter. An inline duct fan **21** may be integrated into the duct **19***a*, preferably near the top of the tower **16**. The fan **21** allows suitable pressure to be maintained within the EIB **14** to draw the OGV's exhaust into the ECU **22** without creating excessive back pressure on the OGV's engines or ingesting excessive amounts of atmospheric air from an imperfect seal of the EIB **14** around the OGV's exhaust stack, as well as avoiding excessive stress on the EIB 14 due to overpressure or underpressure within the EIB 14. Additionally, dampers and/or bypass valves may be integrated into the EIB 14 and/or the ducts 19*a*, 19*b* to help control the flow 15 through the ducts 19*a*, 19*b*. Adjustments to the fan 21 and/or to dampers and/or bypass valves and/or the EIB shroud allow the AMECS 10 to accommodate a variety of OGVs with different exhaust flows, as well as respond to changes in the exhaust flow on a given OGV due to starting or stopping an engine, or altering the load on engines.

The pressure within the EIB 14 is preferably controlled by varying the inline fan 21 operating parameters and/or by adjusting dampers and/or bypass valves and/or the EIB 14 shroud, such adjustments preferably being made automatically by an AMECS control system in response to inputs from pressure and flow sensors located in the EIB 14 and elsewhere. These adjustments may be made in concert with control system logic commands to the primary Induced Draft (ID) fan 34*a* (See FIGS. 4 and 5) and/or ID fan dampers located elsewhere in the AMECS, preferably at or near the downstream point of the cleaned OGV exhaust gas exit to atmosphere.

An actuating arm suitable for use with the present invention is similar to known four section booms used on concrete pump trucks, for example the KVM 32 built by Schwing America Inc. in Saint Paul, Minn. The boom of the KVM 32 is capable of reaching as far as 106 feet vertically, or 93 feet laterally. Booms like the boom of the KVM 32 are described in U.S. Pat. No. 5,460,301 for "Concrete Pump Vehicle" and duct joint geometries for use with booms are described in detail in U.S. Pat. No. 6,463, 958 for "Distributing Device for Thick Substance, Especially Concrete." The '301 and '958 patent are herein incorporated by reference. An AMECS 10 is described in U.S. patent application Ser. No. 10/835,197, filed Apr. 29, 2004 for "Maritime Emissions Control System," incorporated by reference above.

A prior art Emissions Control Unit (ECU) 22*a* configured for energy efficiency is shown in FIG. 2. The exhaust flow 15 flows into a mixing chamber 30. An diesel generator 24 provides generator exhaust as a heat source for a reaction chamber 28. The generator exhaust mixes with urea 26 to provide heat to convert the urea 26 to ammonia in the reaction chamber 28, and the generator exhaust remains mixed with the ammonia to add heat for subsequent processing. The ammonia mixed with the generator exhaust passes into the mixing chamber 30 where the ammonia and generator exhaust mixes with the OGV or other primary exhaust flow 15.

The flow from the mixing chamber 30 passes through a heat exchanger cold side 32 and is urged forward by the a fan 34 through a heater 36 and into a Selective Catalytic Reducer (SCR) 38. The heater 36 is preferably a burner or an electric heater, and more preferably a burner type heater, using the same fuel as the diesel generator. A chemical reaction in the SCR 38 between the ammonia and NO_x in the exhaust flow converts the NO_x to nitrogen gas and water producing a cleaned exhaust flow 15*a*. The flow 15*a* (now a hot flow) from the SCR 38 passes through a heat exchanger hot side 40. A heat transfer fluid is heated in the heat exchanger hot side 40 and flows through a rearward heat transfer tube 42 to the heat exchanger cold side 32 where heat is transferred to the flow through the heat exchanger cold side 32. The heat transfer fluid then flows back to the heat exchanger hot side 40 through a forward heat transfer tube 44. An emissions control unit 22*a* is described in U.S. patent application Ser. No. 10/941,731, filed Sep. 14, 2004 for "High Thermal Efficiency Selective Catalytic Reduction (SCR) System," incorporated by reference above.

Although the ECU 22*a* described in the '731 application provides the advantage of reducing energy requirements for the AMECS 10, in some cases, the ECU described in the '731 application may suffer reduced efficiency if the OGV uses a fuel resulting in a high sulfur content in the exhaust flow 15. The high sulfur exhaust requires higher temperatures at entry to the SCR 38, and therefore higher energy costs. The sulfur and ammonia combine to form ammonium bisulfate, NH_4HSO_4. Ammonium bisulfate is a sticky, gummy substance which may clog and foul the SCR 38, severely reducing its service life, and particulate matter (PM) can collect in the SCR 38 and reduce its effectiveness. Also, sulfur and water can combine to form sulfuric acid, H_2SO_4, which can cause serious corrosion problems to the SCR 38 and Particulate Matter (PM) can collect in the SCR and reduce its effectiveness.

Additionally, the ECU described in the '731 application places the SCR upstream of the IWS. This relative placement of the system components was chosen because the IWS requires significant cooling of the initially hot gas stream, whereas the SCR requires a hot gas stream which would otherwise have to be reheated after cooling for passage through the IWS. However, such an arrangement as in the '731 application subjects the SCR to a gas stream laden with particulates and sulfur compounds, components which are later removed by the IWS, and which can clog and otherwise impair the performance and operational longevity of the SCR.

An improved Emissions Control Unit (ECU) 22*b* according to the present invention is shown in FIG. 3. The ECU 22*b* comprises a first system 46*a* and a second system 46*b* serially processing the exhaust flow (or dirty flow) 15. The system 46*a* is adapted to reduce Particulate Matter (PM) and Sulfur Dioxide (SO_2) and the system 46*b* is adapted to reduce NO_x. The system 46*a* may further reduce, in addition to reducing PM and SO_2, Volatile Organic Compounds (VOCs). The systems 46*a* and 46*b* are ordered with the system 46*a* processing the exhaust flow 15 to generate a first processed flow 54 and the system 46*b* processing the first processed flow to generate a second processed flow 70.

A Ionizing Wet Scrubber (IWS) suitable for use with the present invention is available from Ceilcote Corporation located in Strongsville, Ohio. The IWS combines features of an electrostatic precipitator, which device is relatively generic and made by several companies, with a wet scrubber which is also generic and made by numerous companies. A somewhat similar device is the Cloud Chamber Scrubber manufactured and patented by Tri-Mer Corporation in Owosso, Mich.

Selective Catalytic Reducer systems are well known and available from numerous companies including the following: Argillon LLC, Alpharetta, Ga., Babcock Power Environmental, Worchester, Mass., CRI, Inc., Houston, Tex., Englehard Corp, Iselin, N.J., Haldor-Topsoe, Houston, Tex., Mitsubishi Power Systems, Newport Beach, Calif., and Johnson Matthey, San Diego, Calif.

An ECU comprising the systems 46*a* and 46*b* is preferably self contained (e.g., unitized or modular) and may be mounted to a mobile platform, for example the barge 22 (see FIG. 1), and may be palletized to allow moving the ECU between locations. Operating power for the systems 46*a* and 46*b* is preferably provided by a generator 24 (see FIG. 5) also mounted on the mobile platform. Further, a preferred system 46*b* for reducing NO_x is a selective catalytic reduction system consuming ammonia and requiring a hot in-flow. Ammonia is commonly derived from nonhazardous liquid urea, which is a method preferred for the present invention. The conversion of urea to ammonia requires heat, and such heat may be provided by the hot exhaust gas of the diesel generator **24**, saving energy otherwise required to heat the urea. The hot exhaust gas, now containing ammonia, may also be used to add heat to the OG V exhaust flow into the SCR.

The system **46a** is preferably an Ionizing Wet Scrubber (IWS), a cloud chamber scrubber, a wet electrostatic precipitator, an electrostatic precipitator, a scrubber, an absorption device, a mechanical separator, a filter, a thermal device, or a plasma reactor, and is more preferably an IWS or a cloud chamber scrubber, and most preferably an IWS. The IWS may further be described as a combination of an electrostatic ionizer to reduce PM, and a wet scrubber to reduce SO_2.

The second system **46b** is preferably a mid temperature Selective Catalytic Reducer (SCR), a low temperature SCR, a plasma based NO_x reduction system, an ionization based NO_x reduction system, a thermal NO_x reduction system, a photochemical based NO_x reduction system, a chemical NO_x reduction system, or an electrochemical based NO_x reduction system, and more preferably a mid temperature SCR or a low temperature SCR, and is most preferably a mid temperature SCR. The SCR preferably includes a core comprising a honeycomb structure or a granular or pelletized media composed of materials to support the reactions required to reduce NO_x, and more preferably includes a core comprising a honeycomb structure containing catalyst material comprising a titanium vanadium tungsten compound.

A physical layout of the ECU **22b** according to the present invention is shown in FIG. **4**. The duct **19b** is connected to an inlet of a quench tower **48**. An outlet of the quench tower **48** is connected to the ionizing section of an Ionizing Wet Scrubber (IWS) system comprising an ionizer **52a** followed by a wet scrubber **52b**. An outlet of the wet scrubber **52b** is connected to the inlet section of a Selective Catalytic Reducer (SCR) **38** through a heat exchanger cold side **32** and a heater **36**. An outlet of the SCR **38** is connected to a silencer **50** through a heat exchanger hot side **40** and an Induced Draft (ID) fan **34a**.

A process diagram for the ECU **22b** according to the present invention is shown in FIG. **5**. The exhaust flow **15** is provided to the quench tower **48** where the temperature of the flow **15** is lowered to a temperature suitable for processing by the IWS **52**. The temperature of the exhaust flow **15** is typically between 300 degrees Fahrenheit and 700 degrees Fahrenheit at entry into the quench tower **48**. A cooled exhaust flow **50** is carried between the quench tower **48** and the IWS **52**. The cooled exhaust flow preferably has a temperature between 100 degrees Fahrenheit and 120 degrees Fahrenheit, and more preferably has a temperature between 105 degrees Fahrenheit and approximately 115 degrees Fahrenheit, and most preferably has a temperature of approximately 115 degrees Fahrenheit. A first processed flow **54** is carried from the IWS **52** to the SCR **38** through the heat exchanger cold side **32** and the heater **36** where the temperature of the first processed flow is raised to a temperature sufficient for operation of the SCR **38**. The raised temperature may be as low as approximately 450 degrees Fahrenheit for a low temperature catalyst, but is preferably between 600 degrees Fahrenheit and 700 degrees Fahrenheit, and is more preferably approximately 650 degrees Fahrenheit.

A generator exhaust flow **60** from a generator **24** is mixed in a reaction chamber **28** with aqueous urea flow **58** urged by a pump **56** from urea **26**. The liquid urea is atomized by mixing with compressed air prior to injecting it into the reaction chamber **28** by means of a nozzle or nozzles. The reaction chamber **28** is preferably an exhaust manifold extension duct of the generator **24** and the extension duct is sized to ensure adequate residence time of the gas/urea mixture within the reaction chamber **28** so that the conversion of urea to ammonia is complete prior to injection into the SCR **38**. The reaction chamber **28** is therefore sized to the application and, for example, a reaction chamber **28** sized to an OGV may be approximately 60 feet long and approximately 2 feet in diameter. The reaction chamber **28** preferably is connected directly to the SCR **38**. To maximize the heat transfer to the urea flow **58**, the exhaust manifold may be insulated to reduce heat loss.

As the urea flows through the reaction chamber **28**, the urea flow **58** is converted into an ammonia flow **62**, by the heat provided by the generator exhaust **60**. The ammonia flow **62** enters SCR **38** where it mixes with the first processed flow **54**. The ammonia flow **62** may be injected into the first processed flow **54** by either an ammonia injection grid or by other means that facilitates uniform mixing of the ammonia flow **62** and the first processed flow **54**. The injection grid may be a manifold piping system for distributing the ammonia mixture evenly inside the SCR housing and injecting the ammonia into the first processed flow **54** as it enters and passes through the front section of the SCR **38**. This front section of the SCR **38** is thus a mixing chamber. The generator exhaust **60**, which now carries the ammonia, may be injected into the mixing area of the SCR through an injection grid which geometrically disperses the ammonia-carrying gas uniformly across the face of the catalyst. In some cases, the heat contained in the generator exhaust **60** may not be sufficient to completely convert the required amount of urea to ammonia. In these cases, the generator exhaust **60** may be further heated by a burner, or by an electric heater powered by the generator **24**.

More specifically, the aqueous urea (typically a 40% solution) is heated, by the exhaust from the power generator **24**, to produce evaporated ammonia. An "ammonia skid" meters the aqueous urea into the generator's exhaust according to the level of NO_x in the main (e.g., the OGVs) exhaust stream. The heat in the generator exhaust stream causes a chemical reaction to occur wherein the urea is converted into ammonia, the reaction occurring over a finite time interval, such time interval provided for by making the generator exhaust pipe long enough that by the time the gas has traveled the length of the pipe, the reaction has gone to completion, resulting in the transformation of the urea into ammonia vapor. The liquid urea may atomized, or vaporized, by forcing it through a nozzle with high pressure air, into the reaction chamber **28** proximal to an end opposite the SCR **38**. The vaporized ammonia enters the main OGV exhaust stream at the Ammonia Insertion Grid within the SCR **38** housing. The following mixing chamber is to ensure that the temperature of the flow and the concentration of ammonia is evenly distributed across the face of the catalyst prior to its passing through the catalyst. The mixing chamber is preferably the inlet section of the SCR **38**.

An alternative to urea as a source for ammonia is aqueous ammonia (also known as ammonium hydroxide.) The aqueous ammonia is preferably an approximately 19% to 40% concentration of ammonia in water, and more preferably an approximately 19% concentration of ammonia in water. The aqueous ammonia may be injected into the generator exhaust **60** stream in a manner similar to the urea injection described above. The main differences are that the exhaust temperature need not be as high for the aqueous ammonia and a residence time in a reaction chamber is not required for the aqueous ammonia. The exhaust temperature need only be approximately 600 degrees Fahrenheit for the aqueous ammonia as opposed to the approximately 1000 degrees Fahrenheit needed for urea, and because the residence time in the reaction chamber is not required, a reaction chamber is not needed. Thus, although urea is the more benign substance, aqueous ammonia requires less heating and less apparatus, so the choice may depend on economics, on the installation environment, or on the preference of the user, rather than be dictated by process requirements. Either urea or aqueous ammonia is a suitable source for ammonia, and both may be converted to ammonia using the heat available in the diesel generator exhaust **60**.

A second processed flow **70** flows from the SCR **38** into the silencer **50** through the heat exchanger hot side **40** and the ID fan **34***a*. A cleaned and quieted exhaust flow **15***b* is released from the silence **50** into the atmosphere. A heat transfer fluid is heated in the heat exchanger hot side **40** and flows through a rearward heat transfer tube **42** to the heat exchanger cold side **32** where heat is transferred to the flow through the heat exchanger cold side **32**. The heat transfer fluid then flows back to the heat exchanger hot side **40** through a forward heat transfer tube **44**.

An AMECS **10** including the ECU **22***b* mounted to a barge **12** is shown in FIG. **6**. However, an ECU according to the present invention may be incorporated into various emissions control systems, and an ECU according to the present invention used with any means for capturing exhaust gases is intended to come within the scope of the present invention. For example, actuating arms having completely different designs are contemplated having fewer segments, lighter weight, and/or incorporating features specific to the present invention, and an ECU according to the present invention used with an AMECS **10** including any actuating arm for positioning the bonnet, or any other means of capturing exhaust gases, is intended to come within the scope of the present invention.

A method for cleaning the exhaust flow of the OGV according to the present invention is described in FIG. **7**. Exhaust flow from the OGV is captured at step **100**. The exhaust flow is carried to an IWS **52** at step **110**. The exhaust is process in the IWS **52** to generate a first processed exhaust flow at step **120**. The first processed the exhaust flow is carried to the SCR **38** at step **130**. The first processed exhaust flow is processed in the SCR **38** to generate a second processed exhaust flow at step **140**. The second processed exhaust flow is released to the atmosphere at step **150**. The method may further include using heat in the exhaust of a diesel generator to convert urea into ammonia used by the SCR **38**.

While the invention herein disclosed has been described by means of specific embodiments and applications thereof, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope of the invention set forth in the claims.

We claim:

1. A method for cleaning Ocean Going Vessel (OGV) exhaust, the method comprising:

capturing the exhaust of the OGV;

carrying the exhaust to a first system of a maritime emissions control system;

processing the exhaust in the first system to first reduce the temperature of the exhaust and then to process the reduced temperature flow to generate a first processed flow with reduced Particulate Matter (PM) and reduced Sulfur Dioxide (SO_2);

carrying the first processed flow to a second system of the maritime emissions control system;

heating the first processed flow, increase the temperature of the first processed flow;

processing the heated first processed flow in the second system to generate a second processed flow with reduced NO_x; and

releasing the second processed flow to the atmosphere.

2. The method of claim **1**, wherein carrying the exhaust to the first system comprises carrying the exhaust to an Ionizing Wet Scrubber (IWS).

3. The method of claim **1**, further including a heat exchanger capturing heat from the second processed flow and transferring the heat to first processed flow before heating the first processed flow.

4. The method of claim **1**, wherein carrying the exhaust to the second system comprises carrying the exhaust to a Selective Catalytic Reducer (SCR).

5. The method of claim **4**, further including:

providing power for operation of the first system and the second system using a generator producing hot generator exhaust;

mixing the hot generator exhaust with the flow into the SCR to increase the efficiency of the SCR; and

extracting heat from a gaseous discharge of the SCR and transferring the heat to the gaseous inlet to the SCR.

6. A maritime emissions control system comprising:

an Ocean Going Vessel (OGV) producing a dirty main exhaust flow;

a platform selected from a land based platform, barge and a vessel;

an emissions control system carried by the platform;

support apparatus carried by the platform;

a duct carried by the support apparatus, the duct disconnectably connectable to the OGV to place the main exhaust flow from the OGV in fluid communication with the emissions control system carried by the platform, the emissions control system sequentially comprising:

a Particulate Matter (PM) and Sulfur Dioxide (SO_2) reduction system mounted to the platform and connected in fluid communication to the duct to receive the main exhaust flow from the OGV and to first cool the exhaust and second process the cooled exhaust to reduce PM and SO_2 in the main exhaust flow to produce a first processed flow from the first system; and

an NO_x reduction system mounted to the platform and connected to the PM and SO_2 reduction system to receive the first processed flow, first into a heater adding heat to the first processed flow, and then to reduce NO_x in the heated first processed flow to produce a second processed flow.

7. The emissions control unit of claim **6**, wherein the first system includes an ionizer to reduce PM and a wet scrubber to reduce SO_2 in the main exhaust flow.

8. The emissions control unit of claim **6**, wherein the first system is further adapted to reduce Volatile Organic Compounds (VOCs) in the main exhaust flow.

9. The emissions control unit of claim **6**, wherein power for operation of the emissions control system is generated by a diesel generator and generator exhaust from the diesel generator is processed by the second system.

10. The emissions control unit of claim **6**, wherein the first system is selected from a group consisting of an Ionizing Wet Scrubber (IWS) and a cloud chamber scrubber.

11. The emissions control unit of claim **10**, wherein the first system is an IWS.

12. The emissions control unit of claim **6**, wherein the second system is selected from a group consisting of a low temperature SCR and a mid temperature SCR.

13. The emissions control unit of claim **12**, wherein the second system is a mid temperature SCR.

14. The emissions control unit of claim **12**, wherein the second system includes a catalyst material comprising a titanium vanadium tungsten compound.

15. The emissions control unit of claim 12, wherein the second system includes a core comprising a honeycomb structure containing materials to support the reactions required to reduce NO_x.

16. The emissions control unit of claim 12, wherein the second system includes a core comprising a granular media structure containing materials to support the reactions required to reduce NO_x.

17. The emissions control unit of claim 6, wherein the first system receives the main exhaust flow containing PM, SO_2, and NO_x, and produces the first processed flow having reduced PM and SO_2 and containing NO_x, and the second system receives the first processed flow having reduced PM and SO_2 and containing NO_x and produces the second processed flow having reduced PM, SO_2, and NO_x.

18. The emissions control unit of claim 17, wherein the emissions control unit further including a quench tower for cooling the main exhaust flow before the first system receives the main exhaust flow.

19. The emissions control unit of claim 18, wherein the quench tower reduced the temperature of the exhaust flow to between 105 degrees Fahrenheit and 115 degrees Fahrenheit.

20. The emissions control unit of claim 6, wherein the first system and the second system operate from power generated by a diesel generator carried on the platform.

21. The emissions control unit of claim 20, wherein:
the second system is a Selective Catalytic Reducer (SCR); and
generator exhaust from the diesel generator is mixed with urea to produce ammonia for use with the SCR.

22. The emissions control unit of claim 20, wherein:
the second system is a Selective Catalytic Reducer (SCR); and
generator exhaust from the diesel generator is mixed with aqueous ammonia to produce ammonia for use with the SCR.

23. A maritime emissions control system comprising:
an Ocean Going Vessel (OGV) producing a dirty main exhaust flow;
an Emissions Control System (ECS);
support apparatus for the ECS;
a duct carried by the support apparatus, the duct disconnectably connectable to the OGV to place the main exhaust flow from the OGV in fluid communication with the ECS, the ECS sequentially comprising:
a quench tower in direct fluid communication with the duct producing a cooled exhaust flow;
a particle reduction apparatus in fluid communication with the quench tower, selected from selected from a group consisting of an Ionizing Wet Scrubber (IWS), a cloud chamber scrubber, a wet electrostatic precipitator, an electrostatic precipitator, a scrubber, an absorption devices, a mechanical separator, a filter, a thermal device, and a plasma reactor to process the cooled exhaust to reduce Particulate Matter (PM) and Sulfur Dioxide (SO_2) in the main exhaust flow to produce a first processed flow from the first system;
a heating apparatus connected in fluid communication with the particle reduction apparatus, to increase the temperature of the first processed flow;
an NO_x reduction apparatus selected from a group consisting of a low temperature Selective Catalytic Reducer (SCR), a mid temperature SCR, a non-selective catalytic reducer, a plasma based NO_x, reduction system, an ionization based NO_x, reduction system, a thermal NO_x, reduction system, a photochemical based NO_x reduction system, a chemical NO_x, reduction system, and an electrochemical based NO_x, reduction system, connected in fluid communication with the heating apparatus, to receive the heated first processed flow and to reduce NO_x, in the heated first processed flow to produce a clean second processed flow; and
a heat exchanger capturing heat from the second processed flow and transferring the heat to first processed flow before heating the first processed flow.

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