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(54) **ODOR CONTROL THROUGH AIR-FACILITATED INJECTION OF HYDROXYL RADICALS**

(76) Inventors: **Guy G. Morneault**, Kelowna (CA); **Stephen G. Morneault**, Kelowna (CA)

Correspondence Address:
BENNETT JONES
C/O MS ROSEANN CALDWELL
4500 BANKERS HALL EAST
855 - 2ND STREET, SW
CALGARY, AB T2P 4K7 (CA)

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(30) **Foreign Application Priority Data**

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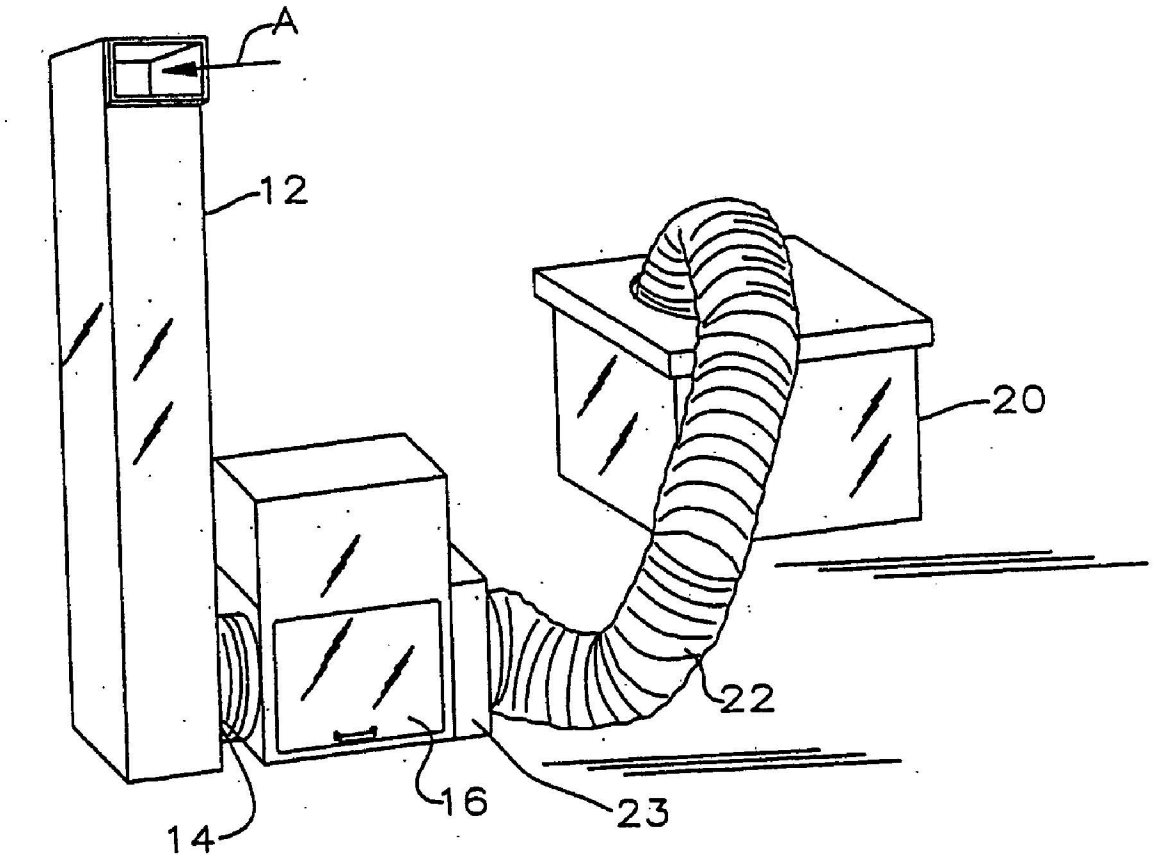
(57) **ABSTRACT**

An apparatus for decontaminating air within an enclosed workspace located downstream and in fluid communication with the apparatus. The apparatus includes a housing containing an array of ultraviolet lamps mounted within an enclosure in the housing. The enclosure has an intake aperture and an exhaust aperture. The housing and the array form an airflow processor such that uncontaminated air entering the intake aperture passes through the array before exiting the exhaust aperture. An airflow motivator, which may be a fan, urges the airflow through the housing and the array from the intake aperture and out through the exhaust aperture. A downstream conduit, which may be a flexible hose, is in fluid communication between the exhaust aperture and the workplace directs the airflow into the workplace after being processed in the airflow processor. The intake aperture is positionable relative to the workspace so that the airflow entering the intake aperture is uncontaminated air.



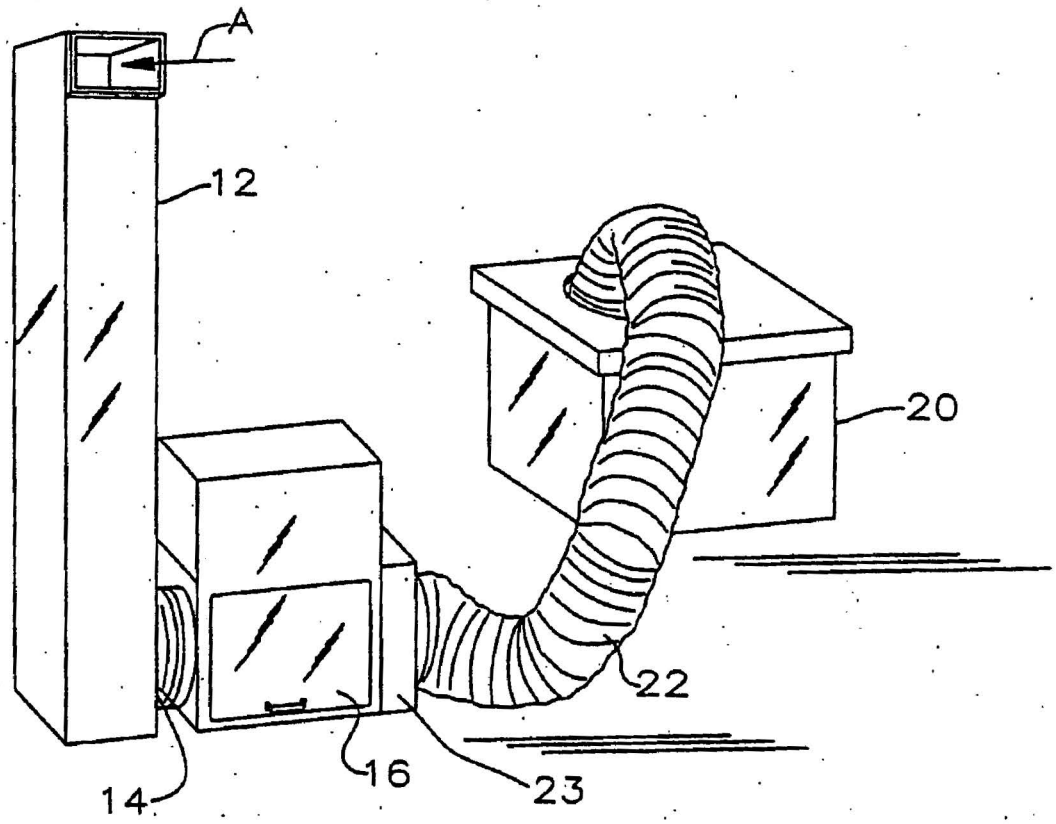
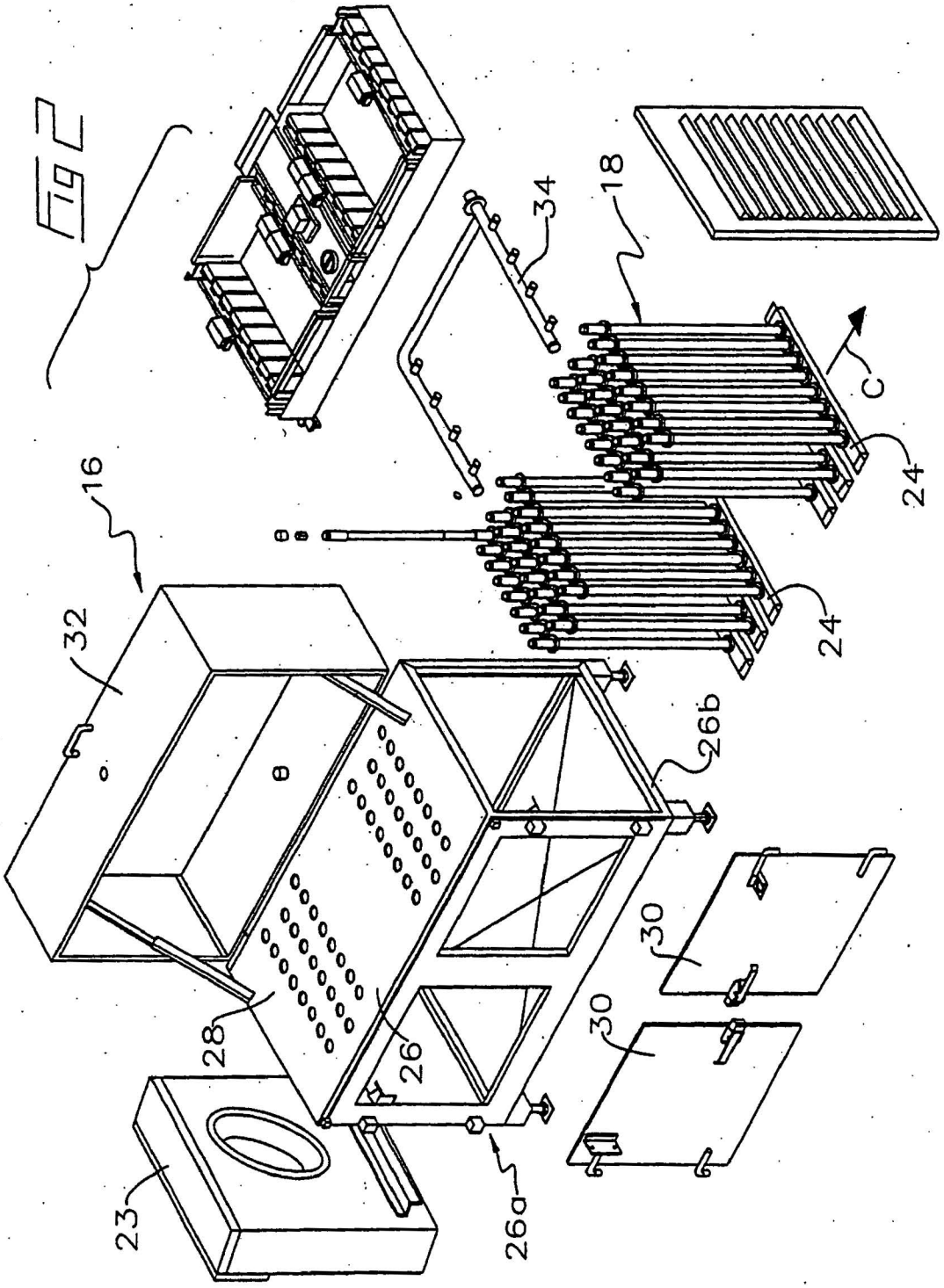


Fig 1

Fig 2



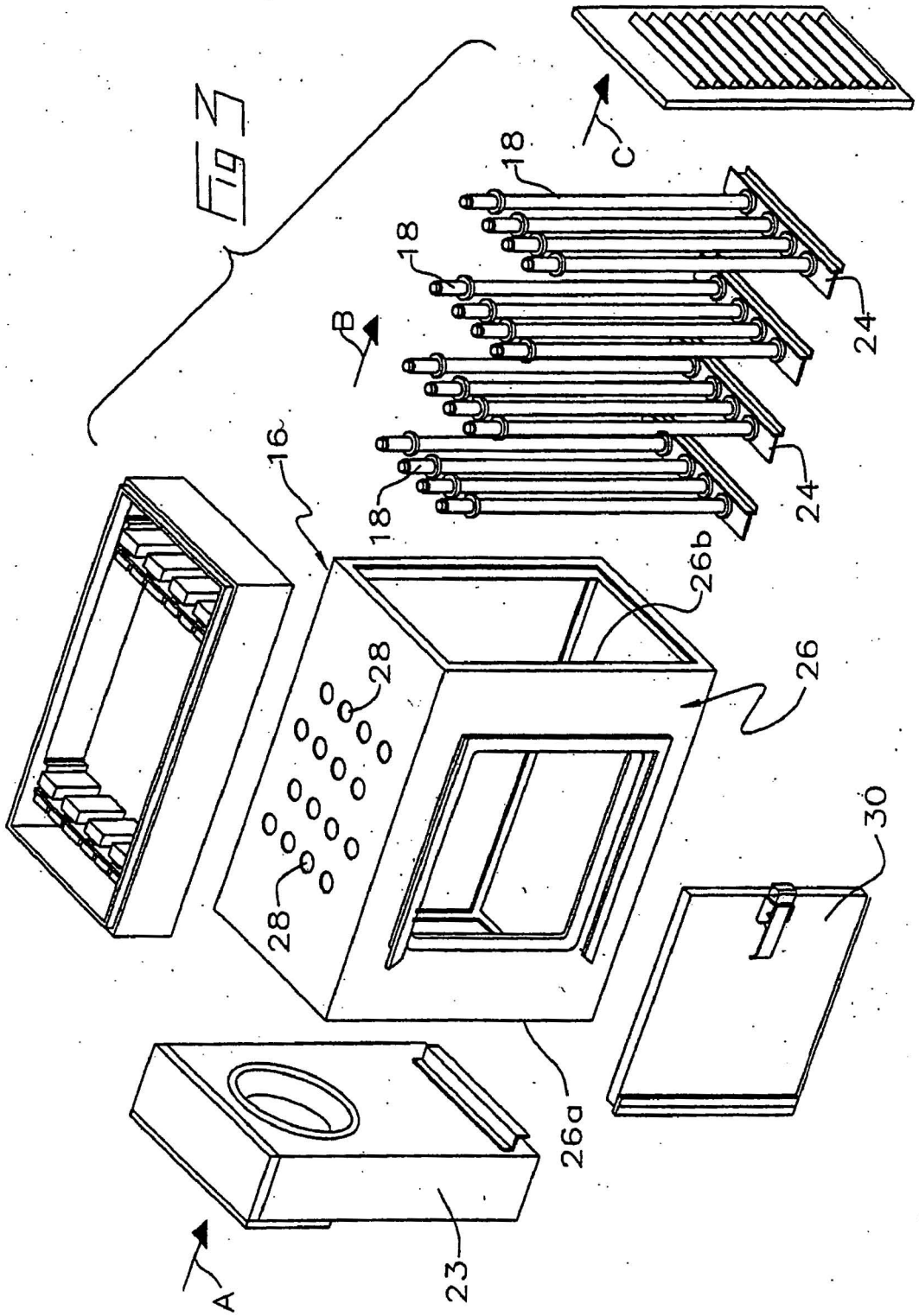


Fig 3
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A

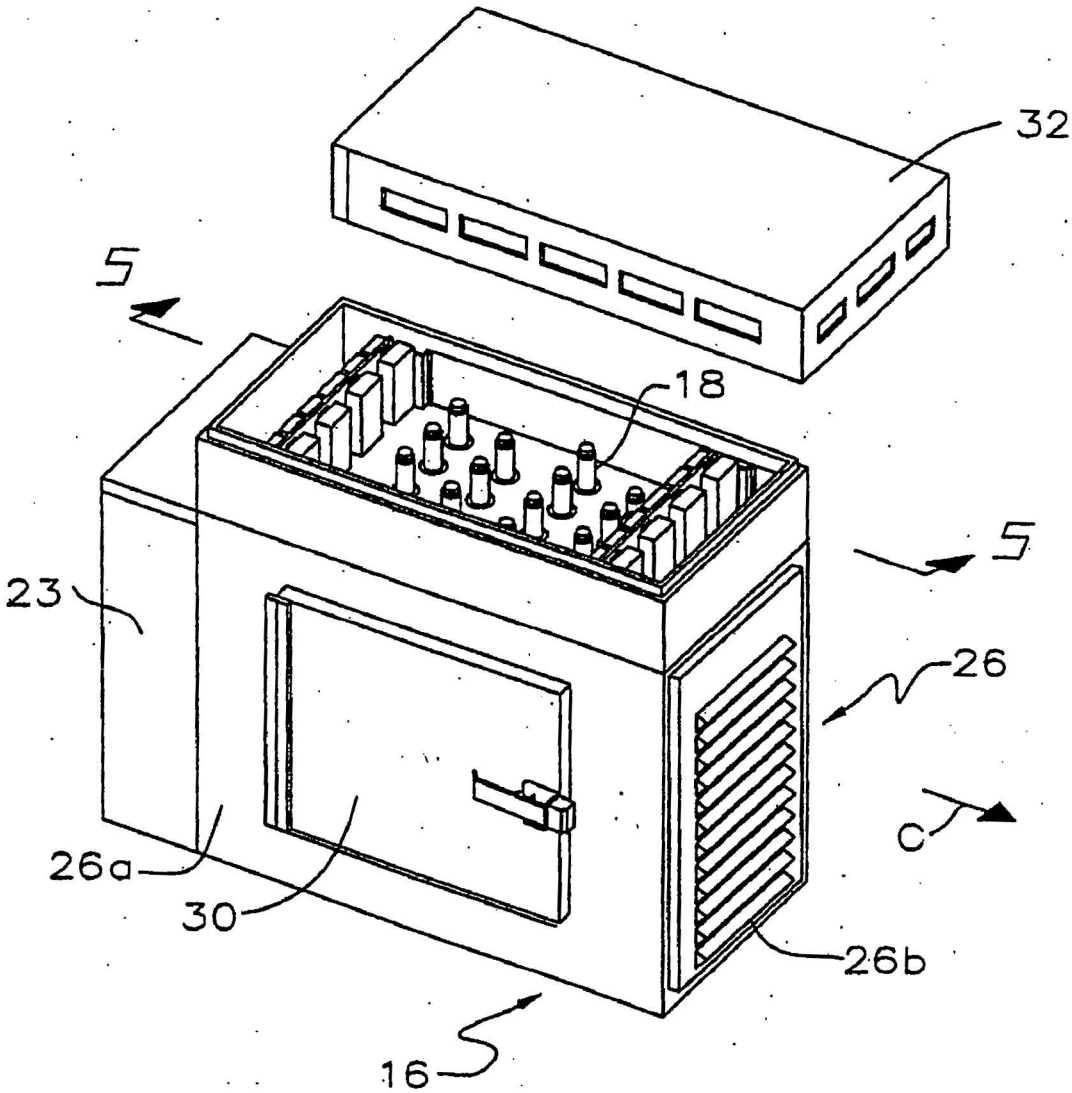

Fig 4

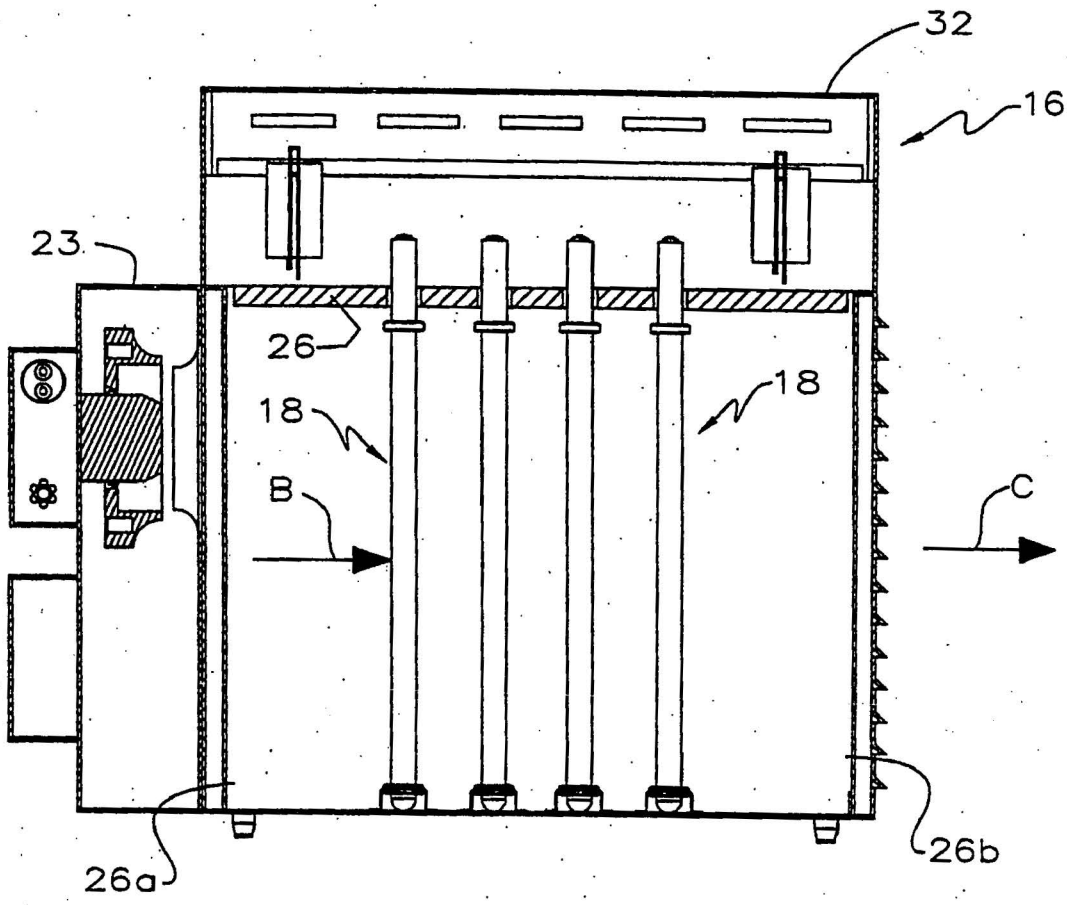

Fig 5

ODOR CONTROL THROUGH AIR-FACILITATED INJECTION OF HYDROXYL RADICALS

CROSS REFERENCE TO RELATED APPLICATION

[0001] The application claims priority from U.S. Provisional Patent Application No. 60/416,913, filed Oct. 9, 2002 and from Canadian Patent Application No. 2,417,346, filed Jan. 24, 2003.

FIELD OF THE INVENTION

[0002] This invention relates to a process and apparatus to decontaminate volumes of air and achieve odor control, such as elimination of sulphuric fumes produced at wastewater treatment plants, the corresponding lift stations and collection systems, as well as in other industrial and commercial work sites.

BACKGROUND OF THE INVENTION

[0003] One way to dispose of noxious gasses emitted by industrial manufacturing processes and in the treatment and disposal of organic and inorganic wastes is simply to allow the fumes to vent freely into the atmosphere. However, increasingly, environmental regulations and the weight of public opinion in opposition to the practice require the proper elimination of such offensive odors. Conventional odor elimination includes the use of wet-scrubbing, a technique by which odorous gasses are funneled into a treatment vessel and treated by a chemical mist or shower prior to the release of the treated air stream into the atmosphere. Another conventional technology involves the use of biological media filters, which are large containment structures built above-ground or underground, and filled with layers of various naturally absorbing materials, such as bark mulches, etc., and particular bacteria cultures. A contaminated air stream is collected and piped into the biofilter, with the air then finding its way out, now odorless, into the atmosphere.

[0004] Another conventional method in use, in particular in smaller sites, is the utilization of various kinds of activated charcoal. Fumes are channeled through a vessel containing a fresh load of charcoal, which by adsorption removes a range of volatile compounds from the air stream, rendering it odorless.

[0005] The application of ozone, usually generated from the electric-arc ionization of either ambient oxygen, or with the aid of pure oxygen, is also found in the prior art, either as a stand-alone technique or as a complement to others, for example in tandem with the use of activated charcoal. Ozonation in the prior art then is the oxidization of odorous gas molecules into simpler, less noxious and less odorous forms. Its use however has cost and health safety drawbacks. In the prior art, ozonation of closed chambers, such as the wet wells of lift stations, has been tried. High concentrations of ozone are generated to flood, virtually by force of gravity, the air portion of the chamber as the ozone is produced. Air movement has to be minimal so as to not disturb the electric arc within the generator. Workmen should not be present in the chamber due to the high concentration of ozone in the air.

[0006] Also in prior art, a different technological approach, photocatalytic oxidation has been tried. Photocatalytic oxidation is a process of gas oxidization that utilizes photon energy emitted from ultraviolet (alternatively referred to herein as UV) light lamps, either of the low pressure or of the medium pressure variety, operating at wavelengths ranging roughly between 170 and 255 nanometers, but favoring the former end (also known as the UV-Vacuum range). Photon energy catalyses a chain of photochemical reactions that lead to four contemporaneous processes: the photolysis of oxygen in the form of O_2; the photolysis of the oxidizing agent O_3 (ozone) formed during the UV irradiation of oxygen; the photolysis of water molecules (H_2O); and the photolysis of pollutant molecules and decay products. The ozone that is produced during the first photolytic reaction, the photolysis of oxygen, occurs with the intervention of UV light at the 185 nm frequency. This ozone acts then more as a catalyst for further reactions than as an oxidant itself, and ultimately most remaining ozone is degraded back to stable O_2 by the action of UV light at 254 nm. The intervening ozone in tandem with the photolysis of water molecules in the ambient air together lead to the production of hydroxyl radicals (OH—) thusly: $O+H_2O \rightarrow OH—$ and $O_3+H_2O+h_v \rightarrow O_2+H_2O_2$ followed by $H_2O_2+h_v \rightarrow OH—$ (where h_v stands for the energy from UV light).

[0007] Hydroxyl radicals are highly efficient oxidants, more so than ozone, and react more quickly with volatile molecules. The molecules of contaminant gases that make up nuisance odors (including a broad range of compounds such as hydrocarbons or VOCs, solvents, ammonia, sulphurous and chlorinated compounds) are degraded in two ways: First, contaminated gases are degraded directly by the action of UV photons, to the extent that their particular UV absorption coefficient allows as different gasses break down at different wavelength and energy levels. Second, contaminant gases are degraded under the oxidizing effect of the hydroxyl radicals, which break down the odorous compounds by attacking the molecular bonds, starting with double bonds. Each breakdown process itself releases a number of OH— active radicals, which in turn go to work on the next degrading reaction, in a self-reinforcing mechanism that ultimately leads to the complete mineralization of the pollutant molecules into carbon dioxide, water vapor and mineral acids or elemental forms of sulfur, chlorine and nitrogen.

[0008] A variation of photocatalytic oxidation, dubbed Advanced Photocatalytic Oxidation (APO) has been also applied. It is defined by the complementary utilization of any of ozone, hydrogen peroxide H_2O_2 or reactive material surfaces such as titanium dioxide TiO_2 in tandem with the UV energy. While APO is deemed to yield higher oxidation performance, it comes also with higher costs to operate and bulkiness to the apparatus.

[0009] By way of examples of the prior art of which applicant is aware; Delta Marine International of Fort Lauderdale, Fla. U.S.A. provide for the injection of ozone into for example black water holding tanks, wherein ozone is injected into the offending tank's headspace. Also in the prior art, applicant is aware of U.S. Pat. No. 6,287,465 which issued Sep. 11, 2001 to Watanabe et al for an Ozone Deodorizer, Watanabe describing the use of an ozone generator and introducing an ozone and water mixture by an atomizer nozzle into a waste water treatment vessel. Applicant is also aware of U.S. Pat. No. 6,076,748 which issued Jun. 20, 2000 to Resch et al. for an Odor Control Atomizer