METHANE GAS RECOVERY & USAGE FROM COAL MINES, LANDFILLS …

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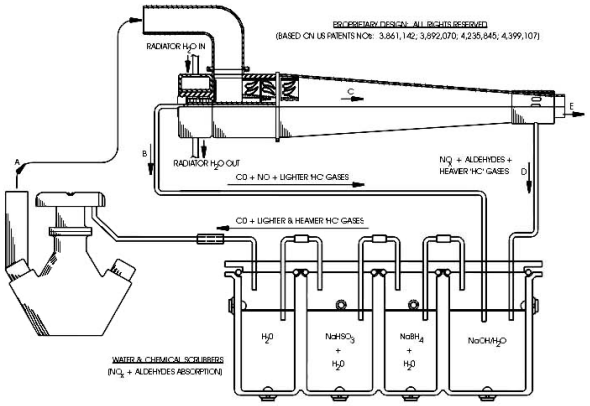
ABSTRACT

The automobiles' exhaust gases consist of large amount of Carbon Monoxide (CO), Hydrocarbons (HC), Nitrogen Oxides (NOx) & Carbon Dioxides (CO_2) gases. The HC, NOx & CO comprise auto-exhaust pollutants. However, Carbon Dioxide (CO_2): the main exhaust gas constituent though not a pollutant gas has been proven to be a Green House Gas (GHG), which prevents the radiation of solar heat from the Earth's heated surface causing *Global Warming*. Also, Methane gas (CH_4) ~ a GHG, 21 times more *warming* than CO_2 is being released in billions of cu. .ft /year by US Coal Mines, Municipal Land Fills and Oil Refinery Distillation Tower Vent Stacks. Thus the Bose-patented "Automobile, Ant-Air Pollution & Energy Conservation System…" US Pat .No: 6,398,851, which had been initially developed to centrifugally separate the combustible HC & CO gases from the auto-exhaust and recycle to the auto-engine, resulting in 15%increase in Fuel Efficiency & 35% reduced Lifecycle Emissions in Retrofitted automobiles; **ref: FIG.1**; has been applied by addition of a Gas Compressor between the exhaust Vents of the said Facilities & the Bose System, to centrifugally separate the 24~45% purity Methane gases emitted, into a 95% purity stream. These gases can be sold to the National Gas Grid at a high rate of Return on Investment: (ROI).

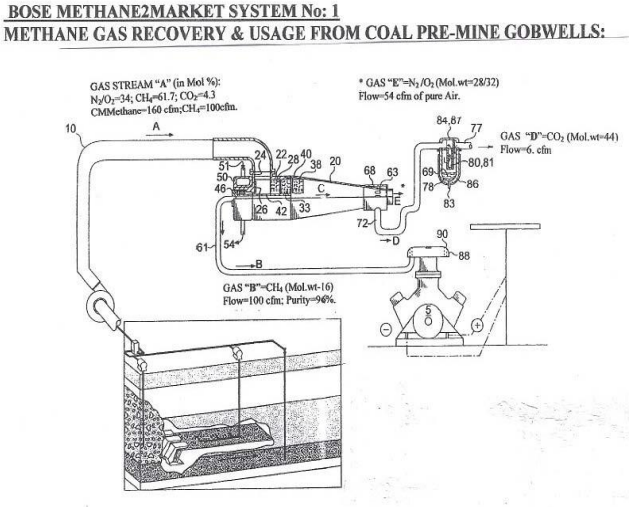
Keywords: *Methane, Greenhousegas, Global warming, Coal Mine, Landfill.*

FIGURE 1*: Automobile Anti-Air Pollution & Energy System*



Prototype Used For US DOE Grant Award Test on a new 6- liter automobile

FIGURE 2



BOSE METHANE2MARKET SYSTEM No: 1 ~FIG. 2: MethaneGas Recovery/Usage From Coal Pre-mine Well

Methane gas (CH_4) and coal are formed together during "Coalification", a process in which biomass is converted by biological / geological transformation into underground coal deposits. Methane is stored within such coal seams and is released when pressure within a coal bed is released as a result of natural erosion or mining. Thus, an average of 48 Billion cu. ft /year of CH_4 @ 15~30% purity, is released by the 40 largest US Coal mines.[1]. Because CH_4 gas is explosive in concentrations of 5 ~ 15% in air, only concentration of 1~2% is allowable in working areas of all US Coal mines. In order to ensure this, degasification of all Coal Mines is imperative, before actual & during Mining Operations. The best & commonly used method is to bore "Gob Wells" from the surface to the target seam, prior to mining. As mining advances under the "Well", the methane-charged strata surrounding the well fractures, and releases the methane into the well at sub-atmospheric

pressure. Methane gases from the Gob Wells or Abandoned Coal Mines' Vent Stacks are extracted and compressed by a Gas Compressor (Item 10) and directed to the Bose System' free-wheeling gas turbine (Item 33), for driving it at a very high speed. The expanding compressed gas exiting from the gas turbine blades, create a high-speed convoluting gas mass which further increases its rotational speed, as it flows through the adjoining Vortex cone of the Bose System. Because of the molecular weight differences between the Gob Well gas constituents ~ Gas "B" comprising Methane ~ CH_4 (Mol. wt=16 and purity=96%), Gas "D" comprising CO_2 (Mol. Wt = 44) and Gas "E" comprising N_2 /O_2 (Mol. Wt= 28/32), there is a 3-way centrifugal stratification of the Gob Well gases.

Thus, Gas "B" which is highly combustible Methane gas, is convoluting at the core and escapes through the hollow shaft of the turbine as Flow "B", and is burnt in the Internal Combustion Engine which drives an Alternator (Item 5). The Electricity thus generated is transmitted to its nearest National Grid for revenue. The second (middle) strata comprises Gas Flow "E" which is Air~ N_2/O_2. This is released to the atmosphere.

Where as, the outermost strata ~ Gas "D" comprises the heaviest incombustible gases ~ CO_2. This gas is released to the atmosphere. Thus, the Recovery of significant volume of Methane gas at around 96% purity, which is commercially saleable, as Natural Gas to the National Gas Grid or Generate and Sell Electricity by operating a gas-powered, Internal Combustion Engine-driven Alternator, results in a High Return on Investment (ROI) for the Bose System. *Currently, most Coal Mine Vent Stack Gases are being "Flared" as the Methane being released is of low purity: 15-30% and un-utilizable commercially.*

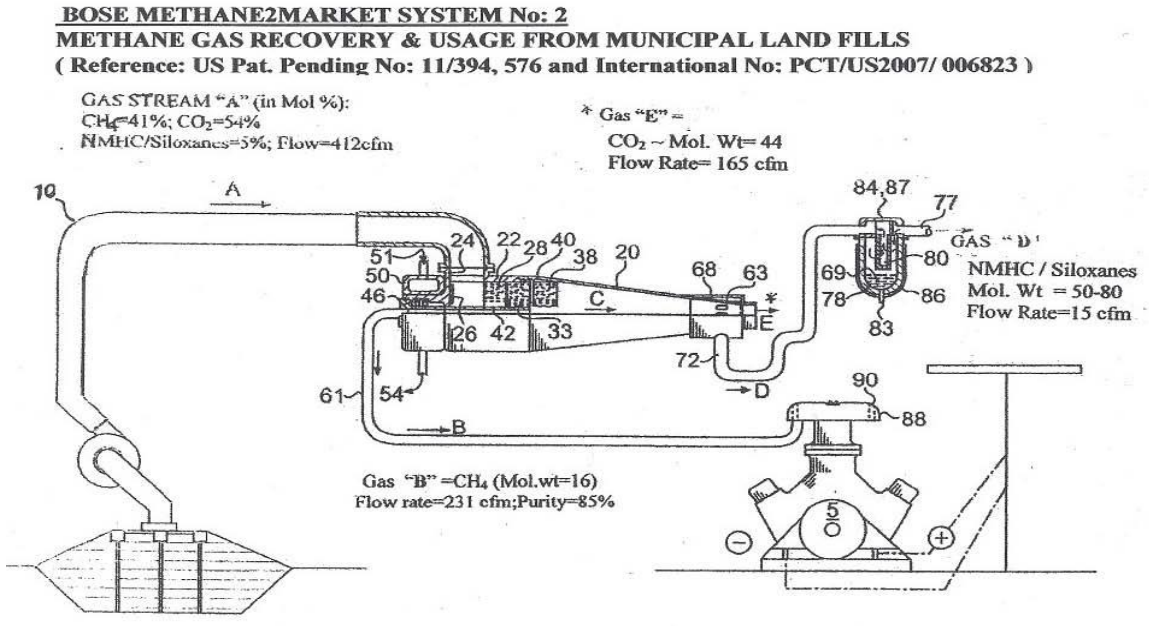
FIGURE 3

BOSE METHANE2MARKET SYSTEM No: 2~ FIG. 3: MethaneGas Recovery/Usage From Municipal Landfills

Exhaust gases from the Municipal Landfill's Vent Stacks are extracted and compressed by a Gas Compressor and directed to the Bose System's free-wheeling gas turbine, for driving it at a very high-speed. The expanding compressed gas exiting from the gas turbine blades, create a high-speed convoluting gas mass which further increases its rotational speed, as it flows through the adjoining Vortex cone of the Bose System. Because of the molecular weight differences between the exhaust gas constituents ~ Gas "B" comprising Methane~CH_4 (Mol. Wt= 16 and purity =85%), Gas "D" comprising Non-Methane Hydrocarbons (NMHC), Siloxane particles (Mol.wt=50-80) and Gas "E" comprising Carbon Dioxide-CO_2 (Mol. wt =44), there is a 3-way centrifugal stratification of the Exhaust Gases.

Thus, Gas "B" which is highly combustible Methane Gas, is convoluting at the core and escapes through the hollow shaft of the turbine as Flow "B", and is burnt in the Internal Combustion Engine which drives an Alternator (Item 5). The Electricity thus generated is transmitted to its nearest National Grid for revenue. The second (middle) strata comprises Gas Flow "E" which is CO_2. This is released to the atmosphere.

Where as, the outermost strata ~ Gas "D" comprises small amount of incombustible Non-Methane Hydrocarbons (NMHC) and "Siloxane" particles. These are passed through an Air Filter Assembly (Item 86), in order to trap the particles and release the NMHC gases. Thus, the Recovery of significant volume of Methane Gas at around 85% purity, which is commercially saleable as Natural Gas to the National Gas Grid or Generate and Sell Electricity by operating a gas-powered Internal Combustion Engine-driven Alternator (Item 5), resulting in a High Return on Investment for the Bose System. *Currently, most Municipal Land Fill's Vent Stack Gases are being "Flared" as the Methane being emitted is of low purity: 15-30% and un-utilizable commercially.*



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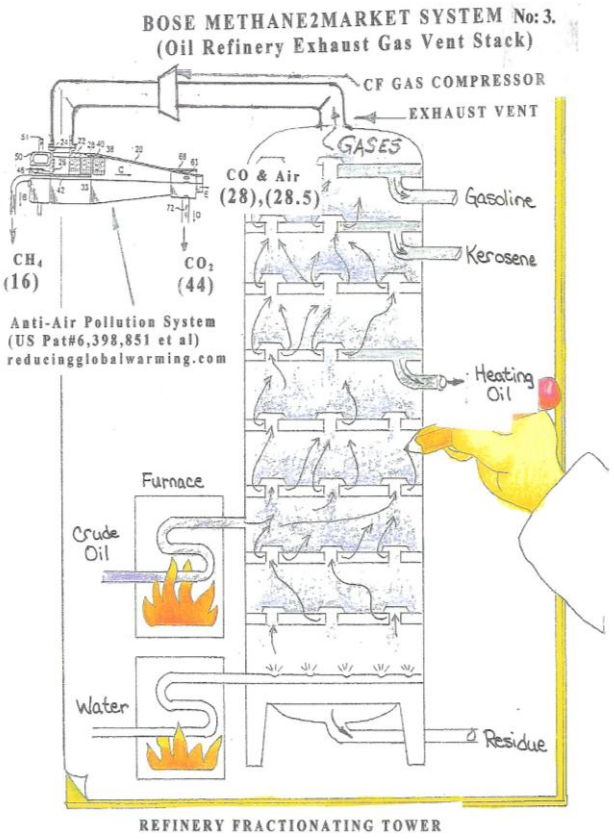
BOSE METHANE2MARKET SYSTEM No: 3 ~FIG. 4
MethaneGas Recovery/ Usage From Oil Refinery Vents

Exhaust gases from the Oil Refinery Distillation Tower Vent Stacks are extracted and compressed by a Gas Compressor and directed to the Bose System's free-wheeling gas turbine, for driving it at a very high-speed. The expanding compressed gas exiting from the gas turbine blades, create a high-speed convoluting gas mass which further increases its rotational speed, as it flows through the adjoining Vortex cone of the Bose System. Because of the molecular weight differences between the exhaust gas constituents ~ Gas "B" comprising Methane ~ CH_4 (Mol. Wt= 16 and purity =90%), Gas "D" comprising CO_2 (Mol. wt = 44) and Gas "E" comprising Carbon Monoxide - CO and Air (Mol. wt = 28/28.5), there is a 3-way centrifugal stratification of the Exhaust Gases.

Thus, Gas "B" which is highly combustible Methane Gas, is convoluting at the core and escapes through the hollow shaft of the turbine as Flow "B", and is burnt in the Internal Combustion Engine which drives an Alternator (Not shown). The Electricity thus generated is transmitted to its nearest National Grid for revenue. The second (middle) strata comprises Gas Flow "E" which is CO and Air.. This is released to the atmosphere.

Where as, the outermost strata ~ Gas "D" comprises largely of Carbon Dioxide ~ CO_2 and "Carbon" particles. These are passed through an Air Filter Assembly (Not shown), in order to trap the particles and release the CO_2 gases. Thus, the Recovery of significant volume of Methane Gas at around 90% purity, which is commercially saleable as Natural Gas to the National Gas Grid or Generate and Sell Electricity by operating a gas-powered Internal Combustion Enginedriven-Alternator (Not shown), resulting in a High Return on Investment for the Bose System No:3. *Currently, most Oil Refinery Distillation Tower Vent Stack Gases are being "Flared" as the Methane being released is of low purity: 15-30% and un-utilizable commercially.*

FIGURE 4

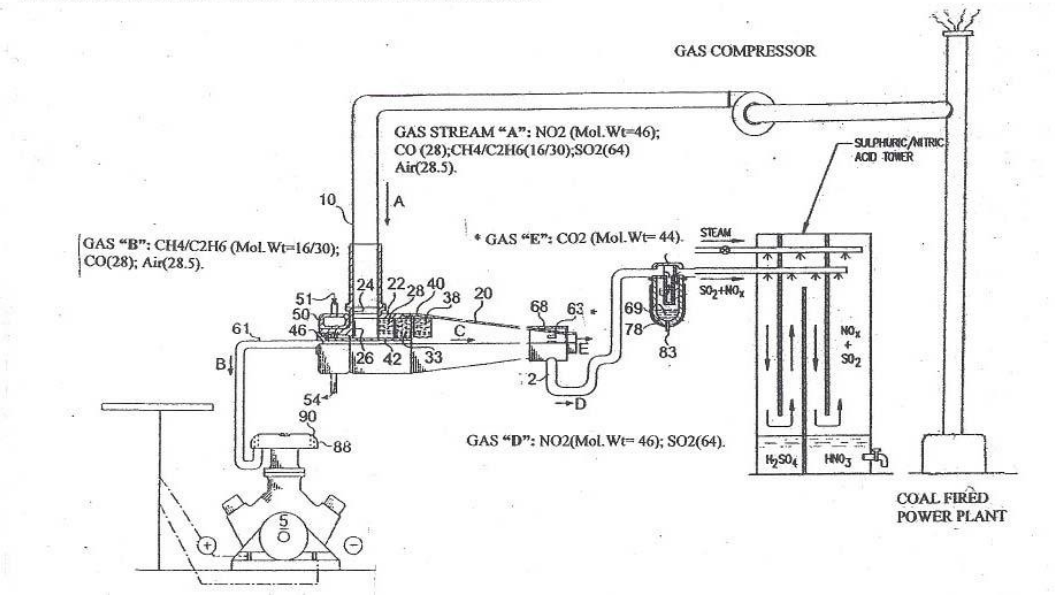


BOSE SYSTEM APPLICATION No: 4 ~ FIG. 5:
Energy Recovery & CO2 Capture & Sequestration (CCS) System For Coal-fired Power Plant Stack Gases.

Exhaust gases from the Coal-fired Power Plant Vent Stacks are extracted and compressed by a Gas Compressor and directed to the Bose System's free-wheeling gas turbine, for driving it at a very high-speed. The expanding compressed gas exiting from the gas turbine blades, create a high-speed convoluting gas mass which further increases its rotational speed, as it flows through the adjoining Vortex cone of the Bose System. Because of the molecular weight differences between the exhaust gas constituents~ Gas "B" comprising CH_4, C_2H_6, CO, Air (Mol. Wt= 16 and 30), Gas "D" comprising NO_2 and SO_2 (Mol.

FIGURE 5

BOSE SYSTEM APPLICATION No: 4.
ENERGY RECOVERY & CO_2 CAPTURE & SEQUESTRATION (CCS) SYSTEM FOR COAL-FIRED POWER PLANT VENT STACK GASES:



wt. between 46 & 64) and Gas "E" comprising Carbon Dioxide – CO_2 (Mol. wt = 44), there is a 3-way centrifugal stratification of the Exhaust Gases.

Thus, Gas "B" which are combustible Methane , Ethane, CO Gas, is convoluting at the core and escapes through the hollow shaft of the turbine as Flow "B", and is burnt in the Internal Combustion Engine which drives an Alternator: (Item5). The Electricity thus generated is transmitted to its nearest National Grid for revenue. The second (middle) strata comprises Gas Flow "E" which is basically 90% purity CO_2 , which is liquefied and sequestered in Tanks, for subsequent chemical usage and revenue generation.

Where as, the outermost strata ~ Gas "D" comprises the heaviest incombustible and pollutant gases ~ ~NO_2 and SO_2. These gases are piped to the "SULFURIC/NITRIC ACID TOWER" for interaction with high temperature steam (H_2O) for dissolving into Sulfuric and Nitric Acid. These acids can be chemically purified and commercially sold. Thus, all bye-products of the Bose System No:3 are commercially saleable, resulting in a High Return on Investment (ROI) for the Bose System Application No:4. *Currently, some* Coal-fired Power Plant Companies are installing huge Mono-Ethylene-Amine (MEA) Absorption Towers to absorb and de-sorb the CO_2 gases being vented, at an unacceptably High Investment Cost, as well as, Operations & Maintenance Cost. Bose System No: 4 is estimated to provide significantly better CO_2 Capture Costs, as compared to the MEA Tower System.

REFERENCE

[1] Identifying Opportunities For Methane Recovery at U.S. Coal Mines : Profiles of Selected Gassy Underground Coal Mines : 1997 – 2001 : EPA 430-K -04-003 ~ Published - U.S. Environmental Protection Agency , July 2004.