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# Abstract of the CPCE's first patent in continuation

First patent in continuation was filed in USPTO on March 16, 2020, with the registration code of US16/820,610 and the priority date February 21, 2013. The first filing was amended as of June 08, 2020. At the present time only excerptions of this patent is publicly disclosed.

Abstract

The disclosure of the process invention in continuation to the US14/392,066 appertains to Advanced Combustion in post-combustion carbon capture, wherein the CO2-containing flue gas, said CO2-Stream, is cleaned from harmful constituents, recirculated, oxygenized and employed for combustion for the fossil fuels, also referred to Flue Gas Oxy-Fueling, in order to obtain a CO2-rich gas upstream to CO2-CC with significantly less gas flow rate subject to further processing to the CO2-CC section of CPCE.

The flue gas recirculation and oxy-fueling enables to supplant the nitrogen-rich intake air for combustion, thus the combustion and ergo the CO2-Stream no longer is burdened with nitrogen. For instance the typical flue gas constituents of existing fossil power plants changes its constituents and throughput entirely post integration of CPCE's Advanced Combustion to ca. 27% of the original flux in the coal power plant, or to only 6% of the gas turbine power plants, while the concentration of the CO2 can be reached up to ca. 92% in coal power plants, or respectively to ca. 80% in the gas turbine power plants.

| CO2-Stream to CO2-CC | Current state of flue gas in conventional combustion (1 | | Integration of Advanced Combustion (2 | |
|---|---|---|---|---|
| Flue gas constituents | Coal power plants | Gas turbine plants | Coal power plants | Gas turbine plants |
| Nitrogen | 70% | 76% | 0% | 0% |
| Oxygen | 5% | 14% | 8% | 12% |
| Carbon dioxide | 12% | 4% | 91.8% | 79.0% |
| Water moisture | 11% | 5% | 0.11% | 0.05% |
| Nobel gases, as "Argon" | 1% | 1% | 0.05% | 0.87% |
| Carbon monoxide | 0% | 0% | 0.01% | 0.00% |
| Flue gas stream in $Nm^3/h$ | 1200000 | 1100000 | 325000 | 64000 |
| Reduction of gas flow in % | - | - | **Ca. 27%** | **Ca. 6%** |

1) Pollutants like NOx, SOx, Mercury, Antimuon, Black Carbon, ash and soot in normal mode of operation not considered. These pollutants are removed and disposed of in the scrubber of the parent patent.
2) Refers to Advanced Combustion to the flue gas downstream of the scrubber.

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In addition to other advantageous processing, the preparation of $CO_2$-rich flue gas along with the other $CO_2$-, and $CO_2$-$O_2$-containing gas streams (referred to CO2-Sidestreams) paves the way to process them via gasification, whence high temperature process heat can be generated for CO2-HR and CO2-PG section for AC, then DC power generation to supply the electrolysis in the HPLTE-SG section, yet in addition to generation of syngas in [$3CO/3H_2$] ratio by the chemical gasification reactions, referenced with the chemical reactions (7) and (8) in the patent:

(7) $2CH_4 + O_2 + CO_2 \longrightarrow 3CO + 3H_2 + H_2O$

(8) $CH_4 + H_2O \longrightarrow CO + 3H_2$

The integrated high temperature heat recovery from the gasification of the $CO_2$-enriched flue gas enables the CPCE to superheat supercritical $CO_2$ working media and superheat saturated steam from the downstream plants (e.g. for methanol, gasoline, etc.) to drive various turbines for power generation.

The integration of CPCE's Advanced Combustion can also lead to higher gross efficiency of the existing or the new plants, i.e.

a) The Advanced Combustion after integrated in a new fossil fuel fired power plant -i.e. coal, crude oil, biomass, waste carbonaceous material and natural gas- constitutes a Dual-Combined Cycle, wherein the heat recovery section is consisting of a combination of the classic Rankin Cycle with steam as working fluid and with the First Bairamijamal Cycle with the carbon dioxide as working fluid. The Dual-Combined Cycle leads to a gross thermal efficiency in the margin of 65% to 75%.

b) Respectively, The Advanced Combustion after implemented in a new gas turbine TripleCombined Cycle constitutes the (i)classic Brayton Cycle; (ii)with the HERSG of the classic Rankin Cycle; and (iii)the First Bairamijamal Cycle are combined together that leads to a gross thermal efficiency in the margin of 80% to 85%.

This continuation process patent also presents processing to prepare a $CO_2$-rich CO2-Stream for the pre-combustion carbon capture downstream of gasification and gas cleaning process; or from the secondary CO2-Stream that stems from the cathodic syngas [$CO/2H_2$] downstream of HPLTE-SG of patent parent, then downstream of the HP/IP-water shift converters in [CO2/3H2] composition, whereas the $CO_2$-rich CO2-Stream from either pre-combustion process is routed to the CO2-CC for $CO_2$ cooling and condensation section of the US14/392,066 to obtain liquid carbon dioxide for re-use as new fossil energy resource.

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# The five sections of CPCE post-combustion $CO_2$ capture & utilization