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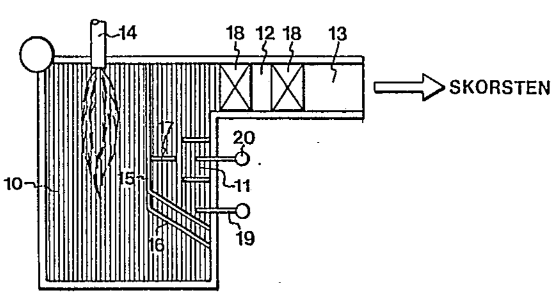
(54) **Combustion apparatus.**

(57) A combustion apparatus has a combustion chamber (10), a reactor space (11) and a convection part (12) disposed downstream thereof. The reactor space is provided in a high-temperature zone of the combustion apparatus and has a turbulence or gas-agitation promoting design or built-in structure (23). Injection devices (19, 20) open into the reactor space. The fluid flow design of the reactor space is such that the combustion gases will have a residence time of at least 0.3 s in the reactor space.

FIG.2



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Description

COMBUSTION APPARATUS

The present invention relates to a combustion apparatus of the type comprising a combustion chamber and convection parts disposed downstream thereof and connected to an exhaust system for generated combustion gases, and further comprising a reactor space which is provided in a high-temperature zone of the flow path of the combustion gases between said combustion chamber and said convection parts, and which has a turbulence or gas-agitation promoting design or built-in structure.

Such an apparatus is known from Swedish Patent Specification SE-B-436,791. The combustion apparatus according to this patent specification has a reactor space in a high-temperature zone immediately following the combustion section. The reaction zone accommodates turbulence means for agitating gases. Also, there is provided a device for adjusting the supply of combustion air to the reactor space disposed downstream of the combustion section.

The constantly growing environmental consciousness places ever increasing demands on the purification of exhaust gases from combustion plants. Thus, many attempts have been made in order to remove sulphur dioxides by injecting e.g. bentonite into the flow of exhaust gases. Attempts have also been made to conduct the flue gases through catalysts for reducing nitrogen oxides, so as to obtain nitrogen gas, carbon dioxide and water.

Examples of the prior art technology relying on the injection of different treatement agents into the flue gas flow are German Patent Publication DE-A-3,709,393, US Patent Specifications US-A-4,154,803 and US-A-4,325,924, PCT Publications WO87/02023, WO87/ 02024 and WO87/02025, and Patent Abstracts of Japan, Vol 8, No 207 (M-327), No 59-95315 (published on June 1, 1984).

In the known methods, the catalytic reduction of nitrogen oxides takes place at low temperatures. Research has however indicated that such a treatment may give rise to harmful reaction products in the flue gases, such as carcinogenic substances. Moreover, the devices hitherto used have however not provided a sufficient reduction of nitrogenous gases.

In view of the above, the present invention has for its object to improve the reduction in combustion apparatus of the above-mentioned type.

According to the invention, this object is achieved by means of a combustion apparatus of the type stated in the introduction to this specification, which is designed in the manner recited in the main claim. The subclaims state particularly advantageous embodiments of the invention.

The invention is thus based on the insight that by injecting e.g. urea in aqeuous solution along with substances activating and promoting the reduction, it is possible to reduce nitrogen monoxide and nitrogen dioxide into N_2, with the formation of hydrogen and carbon dioxide, if it is ensured that the injected substances are sufficiently thoroughly mixed with the flue gases and maintained in contact therewith at temperatures of about 1100° C down to about 800° C for a time required for the reaction. For achieving the latter condition, the reactor space must be given such a fluid flow design that the residence time of the combustion gases in the reactor space is at least 0.3 s, preferably 0.5 s or more.

In a particularly advantageous embodiment of the invention, the injection devices have at least two outlets which open into the reactor space at a distance from each other along the flow path of the combustion gases.

The first of the two outlets is preferably disposed adjacent the upstream end of the reactor space, while the second outlet is disposed approximately midway between the upstream and downstream ends of the reactor space. To achieve optimum admixture, the outlets preferably are atomiser nozzles. Each outlet may have several nozzles, especially if the passageway through the reactor space has a substantial width.

As mentioned above, the reactor space should have a turbulence or gas-agitation promoting design or built-in structure. Turbulence and gas agitation can be increased by mounting baffles, guide vanes, projections on the walls etc, but a particularly advantageous turbulence and gas-agitation promoting effect is obtained if the gases, in or adjacent the inlet of the reactor space, are conducted through a turbine blade wheel-like construction imparting a rotary or whirling motion to the gases.

The invention will be described in more detail hereinbelow with reference to the accompanying drawings showing a few examples of the invention. Fig. 1 is a flow diagram of a combustion apparatus according to the invention. Figs. 2-6 show different examples of apparatus according to the invention.

As appears from Fig. 1, a combustion apparatus according to the invention has a combustion chamber 10, a reactor 11 and a convection part 12 connected to a chimney 13. The reactor is placed in such a manner in relation to the combustion chamber and the convection part that the temperature of the flue gases is about 1100°C when entering the reactor, and about 800°C when leaving the reactor.

Fig. 2 shows an example of an apparatus according to the invention. This combustion apparatus consists of a tube boiler having a combustion chamber 10, a reactor part 11 and a convection part 12. The combustion chamber accommodates one or more gas or oil burners 14 with a downwardly directed flame. The reactor 11 is separated from the combustion chamber 10 by a cooled partition 15 which consists of wall-forming tubes and which, at the transition between the combustion chamber and the reactor chamber, is bent apart so as to form a grid 16. In the reactor space 11, there are provided inwardly directed projections 17 serving to produce turbulence and agitation in the flow of flue gases. In the convection part, there are mounted tube assemblies 18 forming conventional superheaters and preheater units. The reactor space 11 accommodates injection devices with a first set of injectors 19 adjacent the inlet of the reactor space and a second set of injectors 20 approximately half-way up to the convection part 12. The reactor space has such a design that the residence time of the combustion gases therein will be sufficiently long for a complete reaction to take place. In the illustrated embodiment, the dimensions are such that the residence time of the combustion gases in the reactor space becomes at least 0.3 s, advantageously 0.5 s or more.

Fig. 3 shows a further example of an apparatus according to the invention. In this case, the reactor space 11 is provided above the roof of the combustion chamber and is angled by means of a partition 21 which may be cooled. Such an angled design of the reactor space produces agitation which can be further increased by built-in structures similar to those shown, e.g. in Fig. 2.

Fig. 4 shows a further embodiment where the reactor space 11 is separated from the combustion chamber 10 by a partition 15. The walls of the reactor space are provided with inclined guide vanes or baffles 23 which increase the agitation and produce the required turbulence.

Fig. 5 shows yet another embodiment according to the invention. This embodiment differs from those previously described, primarily in that the transition between the combustion chamber 10 and the reactor space 11 consists of turbulence-generating means in the form of a built-in structure 22 having a turbine-blade-like design in order to impart a rotary motion to the flue gases at the inlet to the reactor space 11. In this case, the agitation in the reactor space 11 is further increased by deflecting the rotating gas flow on its way to the convection part 12. Also in this case, it is of course possible to use additional agitation-promoting built-in arrangements.

Fig. 6, finally, shows a power plant boiler of considerable dimensions, in which the reactor space consists of the upper part of the combustion chamber 10, i.e. the part above the injection devices 19. The injection devices 19 are arranged at such a distance from the convection part that a sufficient residence time in the reactor space is achieved before the entry of the combustion gases into the convection part 12.

Claims

1. A combustion apparatus comprising a combustion chamber (10) and convection parts (12) disposed downstream thereof and connected to an exhaust system (13) for generated combustion gases, and further comprising a reactor space (11) which is provided in a high-temperature zone of the flow path of the combustion gases between said combustion chamber (10) and said convection parts (12), and which has a turbulence or gas-agitation promoting design or built-in structure (17, 22, 23), **characterised** in that injection devices (19, 20) for injecting an agent for treating the combustion gases are provided in the reactor space (11) which has such a fluid flow design that the residence time of the combustion gases in the reactor space is at least 0.3 s.

2. Combustion apparatus as claimed in claim 1, wherein the injection devices (19, 20) have at least two outlets (19, 20) opening into the reactor space (11) at a distance from each other along the flow path of the combustion gases.

3. Combustion apparatus as claimed in claim 2, wherein the injection devices (19, 20) have two outlets (19, 20), the first (19) of which is disposed adjacent the upstream end of the reactor space (11) and the second (20) of which is disposed approximately midway between the upstream and downstream ends of the reactor space.

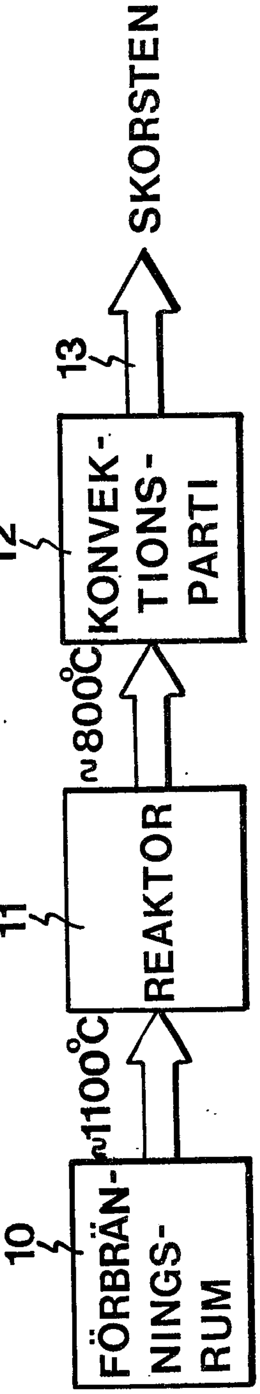
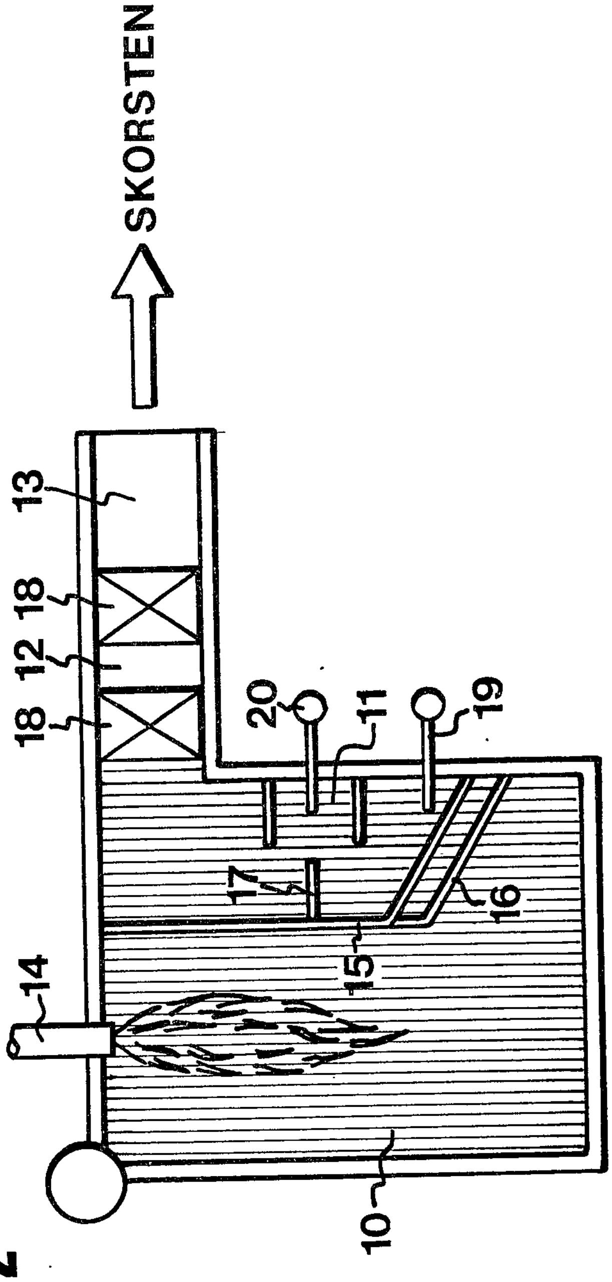

10
FÖRBRÄN-
NINGS-
RUM
~1100°C
11
REAKTOR
~800°C
12
KONVEK-
TIONS-
PARTI
13
SKORSTEN

FIG.1


SKORSTEN
13
18
12
18
20
11
19
14
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10

FIG.2

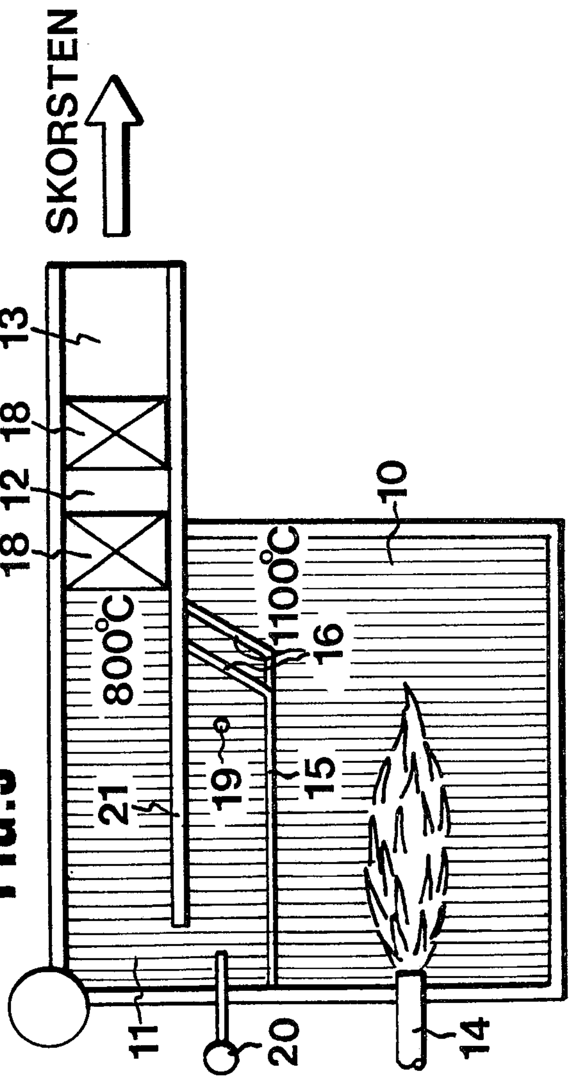

FIG.3

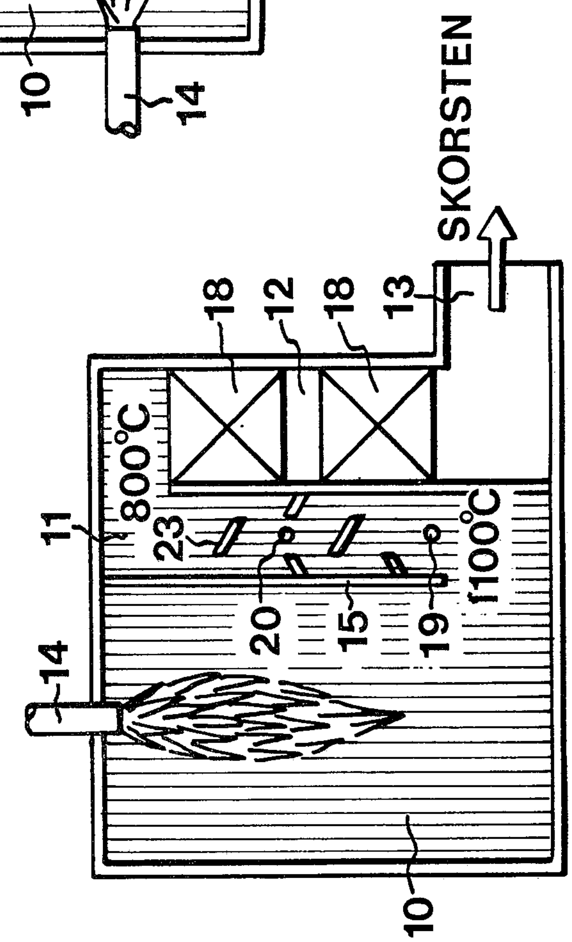

FIG.4

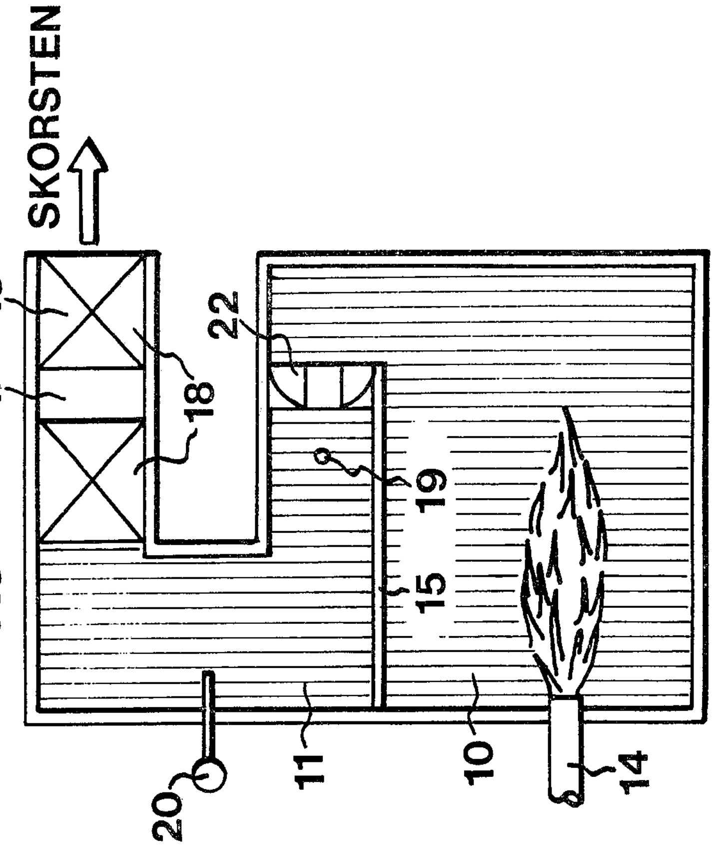

FIG.5

FIG.6