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(54) **Method and apparatus for gasifying or combusting solid carbonaceous material.**

(57) A method and apparatus for gasifying or combusting solid carbonaceous material in a fluidized bed reactor (10). The fine particulates separated from the gases issued from the gasification or combustion are introduced into an ash heating chamber (18), where at least a portion of the ashes contained in the fine particulates is caused to melt at a raised temperature. The fine particulates containing molten ash are circulated through a return duct (46) back to the combustion chamber (12) of the fluidized bed reactor. The return duct is supplied with cooling gas and/or cooling liquid through openings (49) or pores in the wall (48) of the return duct, for cooling and granulating the fine particulates containing molten ash.

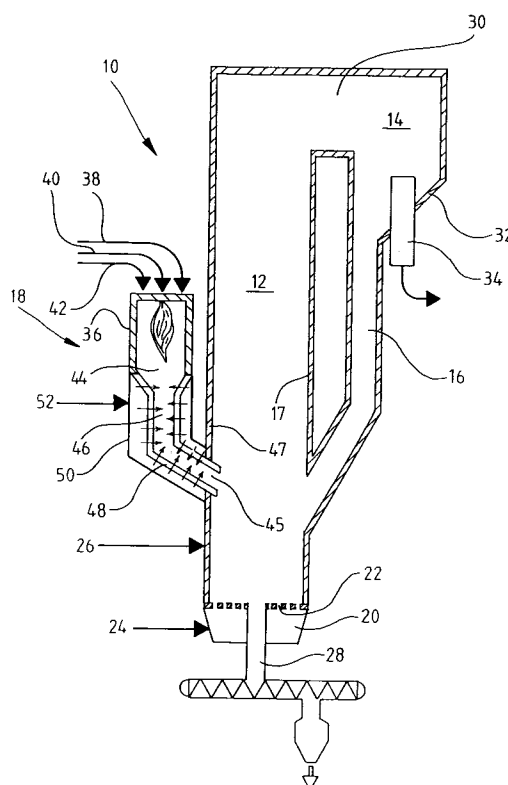


FIG.1

EP 0 545 387 A1

The present invention relates to a method of gasifying or combusting a carbonaceous material in a fluidized bed reactor, in which method the gases resulted from the combustion or gasification are conveyed from the reaction chamber into at least one gas purification stage, in which stage the fine particulates containing ash and carbonized residue are separated from the gases. Thereafter, the separated fine particulates are conducted into an ash heating chamber, where at least a portion of the ash contained in the fine particulates is caused to melt at a raised temperature in the presence of oxygen-containing gas and wherefrom the fine particulates containing molten ash are further conducted via a return duct back to the reaction chamber.

The invention also relates to an apparatus for gasifying or combusting a solid carbonaceous material in a fluidized bed reactor comprising

- a reaction chamber and, combined therewith, an inlet duct for carbonaceous material, feed means for fluidizing gas, and a gas discharge duct,
- a particle separator for separating fine particulates from the gases discharged from the reaction chamber,
- an ash heating chamber for melting the ash contained in the fine particulates separated from the gases in the particle separator, and
- a duct for returning the fine particulates from the ash heating chamber to the reaction chamber.

The invention is especially suitable for gasifying or combusting a solid carbonaceous material in fluidized bed reactors, in which the flow rate of gas is maintained at such a high level that a considerable portion of the solid particles is discharged with the gas from the reaction chamber and which are provided with a particle separator for separating the major portion of these solid particles, i.e., the circulating bed material, and with a duct for returning the separated solid particles to the reaction chamber. From the particle separator the gases are further conducted to a second gas purification stage, in which fine particulates, ash, and unburnt coal, which the particle separator is incapable to separate, are separated from the gas.

Several different methods are employed for gasifying carbonaceous solid fuel, the most important of them being various gasifiers based on the fluidized bed concept. The problem with all gasification means, as also partly with fluidized bed gasifiers, is how to achieve a very high carbon conversion. This problem is particularly significant when fuels with low reactivity, such as coal, are to be gasified. It is also difficult to achieve a high carbon conversion with fuels having a small particle size, such as milled peat.

Poor carbon conversion is principally the result of the comparatively low reaction temperature of fluidized bed gasifiers, which is restricted by the melting temperature of the fuel ashes. Carbon conversion can be significantly improved by increasing the reaction time of the gasification, i.e. by returning the escaped, unreacted fuel to the reactor.

In a circulating fluidized bed gasifier or boiler, the rate of flow of the upwardly directed flow of gas is so high that a substantial amount of solid bed material, entrained with product or flue gases, passes out of the reactor. Most of such outflowing bed material is separated from the gas by separators and returned to the reactor.

The finest fraction, however, is discharged with gas. Circulating material in the reactor comprises ash, coke and other solid material, such as limestone, possibly introduced into the gasifier, which induces desired reactions such as sulfur capture.

However, separators such as cyclones, which are normally used in circulating fluidized bed reactors have a restricted capacity for separating small particles. Normally hot cyclones can separate only particles up to the size of 50 to 100 μm , and finer fractions tend to escape with the gases. Since the unreacted fuel discharged from the reactor with the gas is mainly coke, from which the volatile (reactive) parts have already been discharged, it would, when returned to the reactor, require a longer residence time than the actual "fresh" fuel. Since the grain size of the returned coke is very small, the returned fine fraction is, however, immediately discharged again from the reaction chamber and thus the reaction time remains too short and the carbon conversion too low. The grain size of the coke becomes continuously smaller during the process, thus increasing the emission of particulates from the cyclone, which results in a low carbon conversion.

Even though small coke particles can be separated from the gases with new ceramic filters, now problems arise. Solid fuels always contain ashes which have to be removed from the system when pure gas is produced. When aiming at an as high carbon conversion as possible, ashes have to be removed so as to avoid discharging large amounts of unreacted carbon with the ashes. The particle size of the ashes, however, always varies within a wide range and fine ashes tend to fly out of the reactor with the fine coke residue.

In order to achieve a high carbon conversion, the following diverse problem has to be solved:

1. Separation of also fine particulates from the gases and return of such to the reactor must be possible, and
2. the carbon contained in the returned particulates had to be made to react and the ashes

have to be separated from the system.

Until now, attempts to solve the problem have been unsuccessful.

It is also common in boiler plants, at fluidized bed combustion, that unburnt coal is easily entrained with the fly ash, especially if poorly reactive fuel is employed or if the boiler plant is under a small load or under an extremely heavy load. Fly ash may contain over 10 % of coal, sometimes even 20 %, which deteriorates the efficiency of the boiler. As known, returning of the fly ash to the combustion chamber would give a lower carbon content in the fly ash, thus improving the efficiency of the boiler.

Fly ash itself is a problematic product. For example, in the U.S.A., only 20 % of the total amount of fly ash can be utilized in the building industry and construction of roads. Final storing causes problems to the power plants. Fly ash is a fairly light material in the volume weight, which means that the residual fly ash requires quite a large storage area. This constitutes a problem in densely populated areas. Furthermore, one has to pay attention to storing of the ashes in such a manner that they do not come into contact with groundwater. Ammonia has been introduced lately into the purification of flue gases and this has added to the fly ash problem. The fly ash treated with ammonia is not applicable to the concrete industry.

The combustion temperatures in the fluidized bed boilers are substantially lower than, for example, in pulverized combustors and the ash properties are quite different. Ashes produced by combustion at lower temperatures are not stable, but depending on the conditions, there may be gaseous, liquid or dusty emissions.

U.S. Patent Publication 4,315,758 discloses a method and apparatus for solving the problem. According to this method, the finest particulates separated from the gas are conducted back to the lower part of the reactor so that oxygenous gas is introduced in the same place in the reactor, thereby forming a high temperature zone in which the recovered fine particulates agglomerate with the particles in the fluidized bed. This method introduces an improvement in the so called "U-gas Process" method.

British Patent GB 2065162 discloses a method and apparatus for feeding the fine material separated from gas to the upper part of the fluidized bed in which the fine particulates agglomerate with particles of the fluidized bed when oxygenous gas is conducted to the same place in the reactor.

The problem with both of these methods is clearly the process control. Both methods aim at agglomeration of the separated fine material to the fluidized bed featuring excellent heat and material

transfer properties. It is of major importance that the main process itself can operate at an optimal temperature, and it is easily disturbed when the temperature needed for agglomeration is not the same as that needed for the main process. Due to the good heat transfer in the fluidized bed, the temperatures tend to become balanced, which causes new problems. On one hand, the temperature of the fluidized bed tends to drop below the optimal agglomeration temperature in the area of agglomeration and, on the other hand, the temperature of the entire fluidized bed tends to rise over the optimal temperature of the main process.

Because the size of particles contained in the fluidized bed varies considerably, it is difficult to control the agglomeration in the reactor so that production of ash agglomerates of too large a size could be prevented. Ashes stick to large as well as small bed particles and ash agglomerates of too large a size are easily formed, which impede or prevent ash removal and the gasifying process has consequently to be interrupted. Furthermore, agglomeration in the reactor itself causes local overheating, which in turn leads to abrasion of refractories.

US Patent 3,847,566 discloses one solution in which high carbon conversion is sought by burning the fine material escaping from the gasifier in a separate combustion device. Coarser, carbonaceous material taken from the fluidized bed reactor is heated with the heat released from combustion. This carbonaceous material is returned to the fluidized bed reactor after the heating. In this manner, i.e. by heating bed material outside the fluidized bed, the heat required for the gasification is generated. The gases, flue gas and product gas, released from the combustion and gasification have to be removed from the system in two separate processes both including a separate gas purification system. As can be seen, the arrangements of this method require quite complicated constructions and result in the process control becoming difficult.

The problem with the above-mentioned methods resides in the difficult process conditions where agglomeration conditions have to be controlled. This calls for expensive materials and cooled constructions.

US Patent Publication 4,929,255 discloses a method of improving the carbon conversion without the drawbacks above. According to that method, fine particulates separated from the gas in a gas purification stage of a circulating fluidized bed reactor are agglomerated at a high temperature to the circulating bed material prior to returning the solid particles to the reaction chamber.

An object of this invention is to provide a simple method and apparatus for improving the

carbon conversion.

Another object of the invention is to provide a method and apparatus by means of which the finest carbonaceous particulates separated from the product or flue gas are optimally returned to the reactor in such a form that the carbon contained in the particulates can be exploited and the ashes be separated in the process.

A still further object of the invention is to provide a method and apparatus for gasifying and combusting a solid carbonaceous material, in which method the drawbacks in the process control described above have been minimized.

It is a characteristic feature of the method according to the invention for gasifying or combusting solid carbonaceous material in a fluidized bed reactor, in which method particulates separated from the exhaust gases are heated in an ash heating chamber and returned via a return duct to the reaction chamber, that cooling gas or cooling liquid is introduced into the return duct for cooling and granulating the ash-containing particulates.

Correspondingly, it is a characteristic feature of the apparatus according to the invention for gasifying or combusting a carbonaceous material in a fluidized bed reactor that the return duct leading from a separate ash heating chamber to the reaction chamber is provided with means for introducing cooling gas or cooling liquid into said return duct.

Cooling is provided preferably by introducing cooling gas or cooling liquid into the return duct through the walls thereof, whereby a film of gas or liquid is formed on the duct walls, protecting the walls by preventing the molten ash from sticking thereto. Cooling medium may be conducted through the walls, for example, through openings made therein or by making at least a portion of the return duct of porous material permeable to gas or liquid.

The temperature of the fine particulates is raised to over 1000°C, preferably to 1000 - 1300°C, in the ash heating chamber by conducting oxygenous gas into the flow of particulates and by combusting carbonized residue contained in the particulates. Other fuels may also be employed in heating combustion. In this way, at least a portion of the ashes contained in the fine particulates forms sticky particulates, which are caused to agglomerate, i.e., to granulate prior to being returned to the reaction chamber.

The ash heating chamber is preferably of an uncooled structure, the lower section thereof being provided with a discharge opening for particulates so that the molten ash formed in the chamber flows by gravity directly to the return duct, where melt drops are caused to cool by mixing cooling gas or cooling liquid therewith.

Granulation and return of the fine particulates according to the invention is especially suited to circulating fluidized bed reactors, where the flow rate of particles is maintained at 2 to 10 m/s, the temperature at 750 to 1000°C and the gas pressure at 1 to 50 bar.

Gasification in a circulating fluidized bed reactor is in some ways different from gasification in a conventional bubbling fluidized bed reactor. In a circulating fluidized bed reactor, the upwardly directed flow rate of gas flow is so high that a large amount of solid bed material is raised along with the gases to the upper part of the reactor and further out of the reactor, where it is returned after the gas separation. In such a reactor, the important reactions between the gases and solid material are effected over the entire area of the reactor while the suspension density is even in the upper part of the reactor 0.5 to 30 kg/kg of gas, most commonly 2 to 10 kg/kg of gas. In a bubbling fluidized bed, where the flow rate of the gas is typically 0.4 to 2 m/s and the suspension densities in the upper part of the reactor about 10 to 100 times lower than in the circulating fluidized bed reactor, the gas/solid material reactions are mainly effected in the lower part of the reactor i.e. in the bed.

The coarse solids entrained with the gases exhausted from the reaction chamber of a circulating fluidized bed reactor are separated from the gas in the separator of the reactor and, the major part thereof is returned as untreated circulating mass via a return duct directly to the reaction chamber. Thereafter follows a second stage, in which the gases discharged from the first separator are purified of mainly finer carbonaceous particulates, for example, in a filter, wherefrom at least a portion of the fine particulates, agglomerated at a raised temperature according to the invention, is returned to the reaction chamber.

Agglomeration increases the grain size of the fine particulates to such an extent that the residence time of the particulates becomes longer in the reactor and the carbon conversion is improved. If the grain size of the returned particulates is increased sufficiently, the ash particles can be removed from the reactor at an optimal stage, whereby the carbon contained in ash grains has reacted almost completely.

By agglomerating the particulates outside the actual fluidized bed reactor, where the coarsest circulating particles are considerably smaller in size than the coarsest fluidizing particles in the reactor itself, formation of particles of too large a size is avoided, which particles might be discharged from the reactor along with the ashes thereby leaving the carbon insufficient time to react completely.

In such processes where the higher the temperature for purification of the gas the better, fine

particulates can also be separated from the product gas by employing several consecutively connected cyclones, cyclone radiators or high-heat filters or other equivalent means which are also capable of separating hot particles.

On the other hand, for example, connected with a combined power plant, it is advantageous to use the hot product gas having a pressure of 1 to 50 bar for superheating steam and not to separate the fine particulates from the product gas until the gas has cooled to a lower temperature, such as 850 °C. In this case, the purification of the gas is also easier to accomplish. At a lower temperature, the gas does not include to a harmful extent fine fumes which are difficult to separate and which easily clog, for example, pores of ceramic filters. Furthermore, hot fumes are chemically extremely aggressive and impose great demands on materials. The method according to the present invention is therefore most suitable for combination power plant applications because the carbon conversion of the fuel is high, the product gas is pure and well applicable to gas turbines and, furthermore, the overall heat economy is improved by superheating of the steam.

The method of the invention has, for example, the following advantages:

- A high degree of carbon conversion is achieved by the method.
- Agglomeration of fine carbon can be effected in a controlled manner not disturbing the process conditions in the gasifier or boiler.
- With a circulating fluidized bed concept, the cross section of the reactor can be clearly smaller than with a so-called bubbling fluidized bed reactor.
- Thanks to the smaller cross section and better mixing conditions, there is an essential decrease in the need for fuel feed and ash removal devices in comparison with the so-called bubbling bed.
- Capture of sulfur contained in the fuel with inexpensive lime can be effected in the process.
- Reactions between solids and gases take place over the entire area of the reactor section and separator.
- The equipment described above does not require expensive special materials.
- As the various stages of the process, e.g. gasification and agglomeration, are performed in various devices, the process control can be carried out optimally with regard to the total result.
- Inert ashes are received.
- Problems with storing fly ash are reduced.

The invention will be further described below, by way of example, with reference to the accom-

panying drawings, in which two embodiments of the present invention are illustrated as follows:

Fig. 1 is a schematic illustration of a gasifying means according to the invention, and

Fig. 2 is a schematic illustration of a combusting means according to the invention.

Fig. 1 illustrates a gasifying plant 10, comprising a circulating fluidized bed reaction chamber 12, separator 14 for circulating mass, return duct 16 for circulating mass, and agglomerating means 18 for fine particulates. The lower section of the reaction chamber is provided with a windbox 20, distributor 22 for fluidizing gas, feed conduit 24 for fluidizing gas, feed conduit 26 for solid carbonaceous material and a discharge duct 28 for ashes.

The separator for circulating mass is in communication with the upper section of the reaction chamber through a discharge duct 30. The embodiment shown in Fig. 1 is a so-called flow-through cyclone, but other types of cyclones are also applicable. The flow-through cyclone has an inclined bottom 32 and the lower part of the bottom is connected to the circulating mass return duct 16. The bottom of the separator is provided with a gas discharge duct 34.

The agglomeration means 18 for fine particulates comprises a cylindrical ash heating chamber 36 disposed at the side of the reaction chamber. The ash heating chamber is of uncooled structure, manufactured from, e.g., ceramic material or as a refractory structure. The upper section of the chamber is provided with a feed conduit 38 for fine particulates, feed conduit 40 for oxygen-containing gas and, if required, a feed conduit 42 for extra fuel. Conduits 38, 40 and 42 may also be disposed in other places in the chamber. The lower section of the ash heating chamber is in communication with a return duct 46 via an opening 44, and the return duct again is in communication with the reaction chamber.

The walls 48 of the return duct 46 are made from porous material permeable to gas and/or liquid. The material may be, for example, porous ceramic material. If liquid, e.g., water is used as a cooling medium, the return duct walls may also be made from metal provided with openings. The return duct is encased with a gas-tight enclosure 50, which is provided with an inlet conduit 52 for the cooling agent.

The gasifying plant according to the invention operates so that solid, carbonaceous material to be gasified is introduced into the reaction chamber via the conduit 26 and this material is fluidized by means of fluidizing gas flowing through the distributor 22. The fluidizing gas may be, e.g., air, whereby the fluidizing gas also serves as the

gasifying medium needed for the gasification. The temperature of the reaction chamber is maintained at about 750 to 1000 °C.

The flow rate of the particles in the reaction chamber is maintained high, e.g., 2 to 10 m/s, whereby a portion of the bed material contained in the chamber passes, entrained with the gas, via duct 30 to the separator 14. The bed material comprises, e.g., inert bed material, ashes, coke, and reagents related to gas purification if required. In the separator, coarse solids are separated from the gas and returned via return duct 16 to the lower section of the reaction chamber. The reaction chamber and the separator are preferably internally lined with refractory material. Hot gases together with the small amount of particulates contained therein, typically about 0.1 to 2 % of the solids flow issuing from the reactor, are conducted through duct 34 to a heat recovery unit if any.

Partly purified and possibly cooled gases contain both ashes and unburnt coal which are harmful to the subsequent processes. This so-called fly ash is separated from the gas with filters or other separators capable of separating also fine particulates. This is not shown in Fig. 1. The gas purified in this manner is further conducted to the point of operation.

The fine particulates which have been separated from the gas are introduced into the agglomeration means 18 for granulating the ashes to a more suitable grain size and for recirculating the carbonized residue. The particulates are introduced through the feed conduit 38 into the ash heating chamber 36, which is simultaneously supplied with oxygen-containing gas through conduit 40, for providing combustion and heating.

The chamber 36 may be supplied with extra fuel through conduit 42 if the carbon content of the returned fine particulates is insufficient for raising the temperature to the desired level. The extra fuel may be, e.g., carbonaceous material to be gasified in the gasifier. The product gas from gasification may also serve as extra fuel in the ash heating chamber.

Because the amount of fine particulates is essentially smaller than the entire amount of the bed material and because generally the temperature of only fine particulates is raised in the agglomerating means, a controlled recycling of particulates is possible without impeding the actual main process in the reaction chamber. Agglomeration of the fine particulates outside the reaction chamber facilitates the choice of the agglomeration temperature in accordance with the ashes yet having no harmful effect on the gasifying process in the boiler, whereas the temperature of the reaction chamber can rarely be adjusted to suit the agglomeration to be effected in the reaction chamber itself without im-

peding the gasification process.

When being mixed with cooler cooling gas or liquid, molten fly ash from the ash heating chamber solidifies and forms hard and dense, coarse particles, typically 2 to 20 mm in size. The ashes agglomerated in this way are passed to the reaction chamber through the opening 45 in the wall 47 thereof. Coarse ash grains may be separated in the reaction chamber and discharged together with normal settled ashes through the ash discharge duct 28.

Fig. 2 discloses a combustion plant, where carbonaceous fuel is combusted in a circulating fluidized bed reactor and the fly ash is according to the invention returned in the agglomerated form to the reactor. The items of Fig. 2 which correspond to those in Fig. 1 have been given the same reference numbers.

The combustion plant illustrated in Fig. 2 comprises a reaction chamber 12, where fuel introduced thereinto through conduit 26 is combusted in a circulating fluidized bed. The reaction chamber is preferably formed as a water wall construction 13 and the upper section of the chamber is provided with heat transfer surfaces 15. Coarse particles are separated in separator 14 from the gases discharged from the reaction chamber, and the gases are conducted through conduit 34 to heat exchanger 52 for cooling the gases. The cooled gas is further conducted to a filter 54, where the fly ash is separated from the gas. From the filter, the purified gases are discharged from the system through conduit 56.

The fly ash separated from the gas in the filter is led through conduit 38 into the ash heating chamber 36, where at least partial melting of the ash is provided by supplying oxygen-containing gas through conduit 40. The chamber 36 is of refractory construction.

The molten ash and other fine particulates flow downwardly from the ash heating chamber to the return duct 46. The walls of the return duct are provided with openings 49 for feeding cooling agent to the return duct from the enclosure 50 encasing said return duct. Pressurized cooling agent is introduced into the enclosure through conduit 52. The cooling agent may be, e.g., purified circulating gas from conduit 56 or other inert gas having a temperature which is sufficiently low for cooling the gas. The cooling agent may also be liquid, e.g., water, which is sprayed through openings 49 into the molten ash.

The ashes to be agglomerated are heated by oxidating the carbonized residue of the ashes or other extra fuel, e.g., the fuel employed in the combustion plant. Oxygenating takes place in a separate chamber which is preferably arranged at the side of the actual reaction chamber. In some

arrangements it is possible to introduce all the fuel into the boiler through the agglomeration means and to regulate the temperature of the agglomeration means by the amount of the oxygen-containing gas. Prior to introduction into the reactor, the molten ash is cooled and granulated in the chamber, e.g., by means of a film of gas or liquid, which is brought into the chamber through the chamber wall made from, e.g., ceramic, porous material.

The ash heating chamber according to the invention may be used as a starter combustor if desired, whereby fluid or gaseous extra fuel is combusted in the chamber in oxygenating conditions. The temperature of the actual reaction chamber is raised by hot flue gases.

It is not an intention to limit the invention to the gasifier or combustion plant described in the above examples. The invention is applicable, e.g., to such gasifying reactors that do not employ oxygen-containing gas to bring about gasification but the temperature of the material to be gasified in them is raised in some other way.

Claims

1. A method of gasifying or combusting solid carbonaceous material in a fluidized bed reactor so that
 - the carbonaceous material is introduced into the reaction chamber of the fluidized bed reactor and gasified or combusted therein,
 - the gases issued from the gasification or combustion are passed from the reaction chamber to at least one gas purification stage, in which stage the gases are cleaned of the fine particulates which contain ashes and carbonized residue,
 - the separated fine particulates are introduced into an ash heating chamber, where at least a portion of the ashes contained in the fine particulates are caused to melt at a raised temperature in the presence of oxygen-containing gas,
 - the fine particulates containing molten ash are conveyed from the ash heating chamber via a return duct to the reaction chamber,**characterized** in that
 - the return duct is supplied with cooling medium, such as gas and/or cooling liquid, for cooling and granulating the particulates containing molten ash.
2. A method as recited in claim 1, **characterized** in that cooling medium is supplied as a gas or liquid film to the walls of the return duct.
3. A method as recited in claim 2, **characterized** in that cooling gas or cooling liquid is introduced into the return duct through the porous walls thereof.
4. A method as recited in claim 2, **characterized** in that cooling gas or cooling liquid is supplied to the return duct through the openings in the walls thereof.
5. A method as recited in claim 1, **characterized** in that the fine particulates containing molten ash are conducted from an uncooled ash heating chamber through a discharge opening in the lower section thereof to a return duct disposed below the ash heating chamber, wherefrom the fine particulates are allowed to flow down to the reaction chamber by gravity.
6. A method as recited in claim 1, **characterized** in that the solid carbonaceous material is gasified in a circulating fluidized bed reactor.
7. A method as recited in claim 1, **characterized** in that the solid carbonaceous material is combusted in a circulating fluidized bed reactor.
8. A method as recited in claim 1, **characterized** in that the ash heating chamber is supplied with oxygen-containing gas for at least partial combustion of the carbonized residue and at least partial melting of the ashes contained in the fine particulates.
9. A method as recited in claim 8, **characterized** in that air is supplied to the ash heating chamber.
10. A method as recited in claim 1, **characterized** in that the ash heating chamber is supplied with the same solid carbonaceous fuel which is gasified or combusted in the reaction chamber.
11. A method as recited in claim 1, **characterized** in that the temperature of the fine particulates is raised to over 1000 °C in the ash heating chamber.
12. A method as recited in claim 1, **characterized** in that the return duct is supplied with purified and cooled flue gas issued from the fluidized bed reactor.
13. A method as recited in claim 1, **characterized** in that the gas issuing from the reaction chamber is cooled prior to separating fine particulates from the gas.

14. A method as recited in claim 1, **characterized** in that

- solid carbonaceous material is gasified or combusted in a circulating fluidized bed reactor having a reaction chamber where the flow rate of particles is maintained at 2 to 10 m/s, the temperature at 750 to 1100 °C and the gas pressure at 1 to 50 bar, and where the major part of the coarse solids entrained with the gases which are discharged from the reaction chamber are separated from the gases in a separator and returned untreated to the reaction chamber,
- fine particulates are in a second stage separated by a filter from the gases discharged from the reactor, and that
- the fine particulates separated by the filter are introduced into an ash heating chamber.

15. An apparatus for gasifying or combusting solid carbonaceous material in a fluidized bed reactor, which comprises

- a reaction chamber and connected therewith an inlet duct for carbonaceous material, feed means for fluidizing gas, and a gas discharge duct,
- a particle separator for separating fine particulates from the gases discharged from the reaction chamber,
- an ash heating chamber for at least partial melting of the ash contained in the fine particulates separated in the particle separator, and
- a duct for returning fine particulates from the ash heating chamber to the reaction chamber,

characterized in that

the return duct is provided with means for supplying cooling gas and/or cooling liquid to the return duct.

16. An apparatus as recited in claim 15, **characterized** in that the return duct is at least partly formed of porous material, wherethrough cooling gas may be supplied to the return duct.

17. An apparatus as recited in claim 15, **characterized** in that the walls of the return duct are provided with openings, wherethrough cooling gas may be supplied to the return duct.

18. An apparatus as recited in claim 15, **characterized** in that the ash heating chamber is of uncooled structure and that it is provided

with feed means for oxygen-containing gas.

19. An apparatus as recited in claim 15, **characterized** in that the fluidized bed reactor comprises a circulating fluidized bed reactor, where the gas discharge duct of the reaction chamber is in communication with a separator for separating the bed material from the gases exhausted from the reaction chamber and where the separator is in communication with a duct for returning the separated bed material to the reaction chamber.

20. An apparatus as recited in claim 15, **characterized** in that the ash heating chamber is mainly cylindrical, made from ceramic material or as a refractory construction, the upper section thereof being provided with feed means for fine particulates and oxygen-containing gas and the lower section thereof with a return duct made from porous, ceramic material.

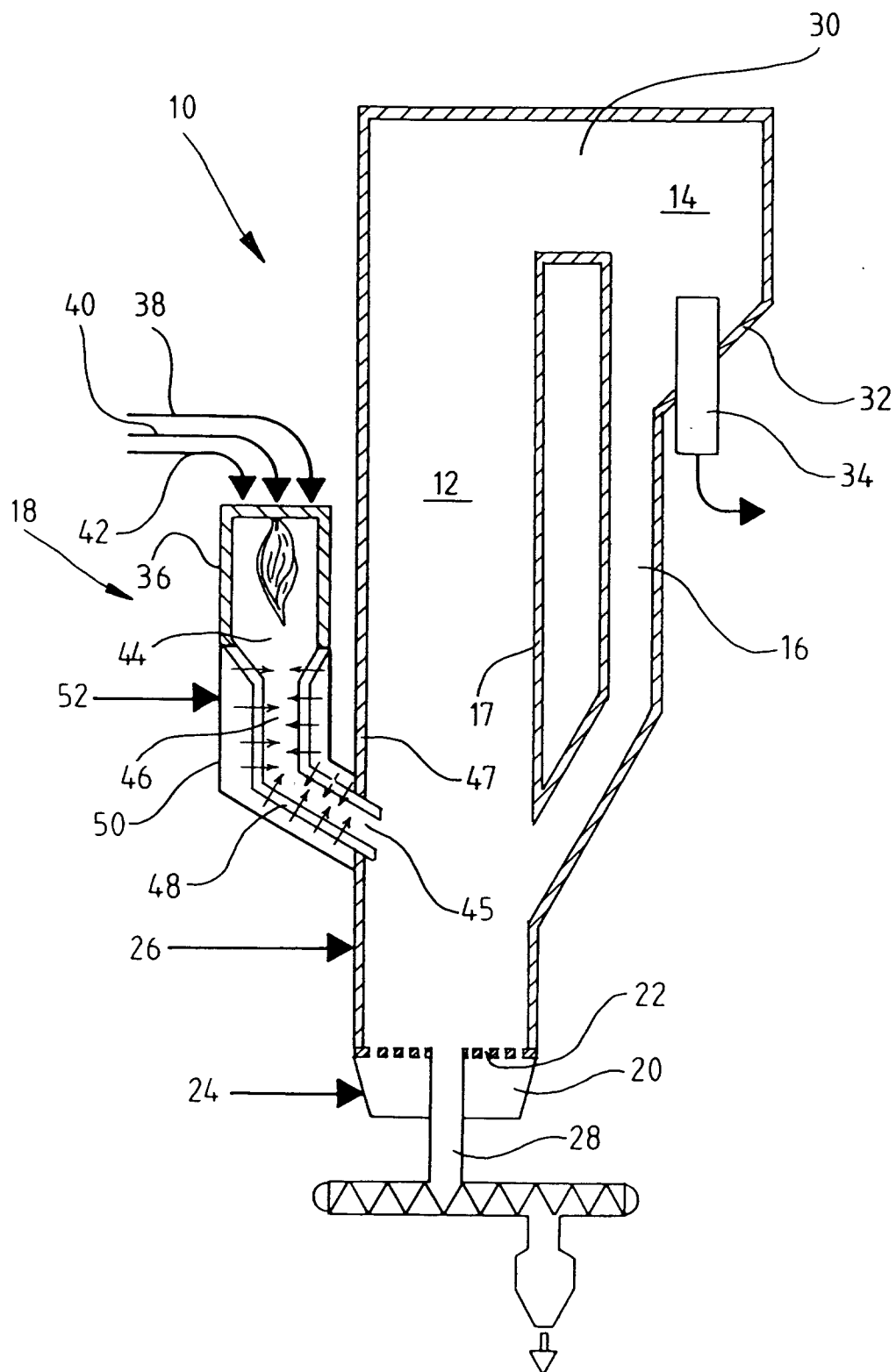


FIG.1

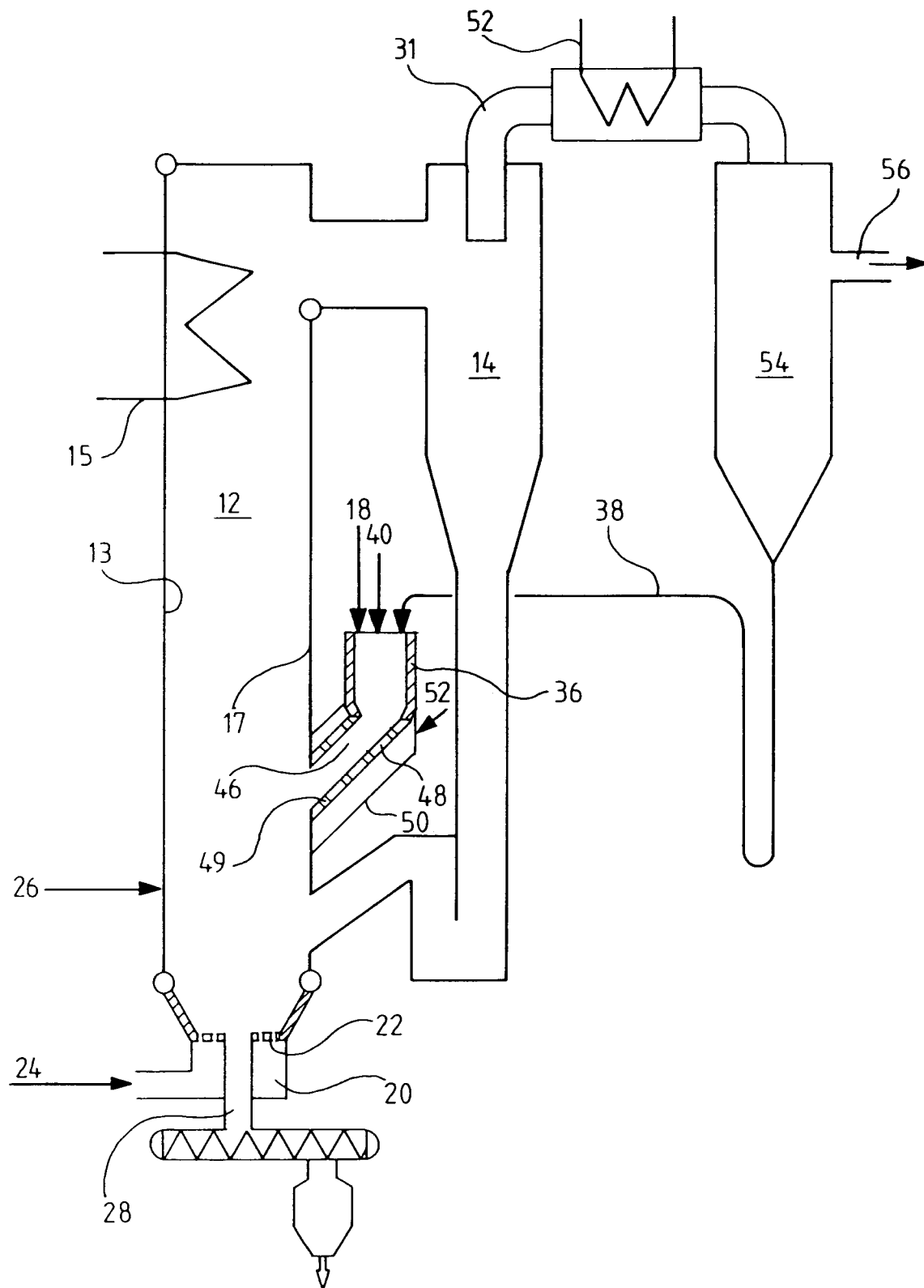


FIG. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 12 0575

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 173 782 (CREUSOT LOIRE) * page 7, line 21 - line 32 * * page 9 - page 11; claims 1-9 * ---	1,6,7,8, 15,18,19	C10J3/54 C10J3/56 C10J3/84 F23C11/02
D,Y	EP-A-0 304 931 (AHLSTRÖM) * page 7 - page 8; claims 1-21 * ---	1,6,7,8, 15,18,19 5,9,11, 13,14,20	
A	DE-A-2 643 298 (DAVY BAMAG) * page 28, paragraph 30 -paragraph 1 * ---	1,2	
A	EP-A-0 223 619 (FRAMATOME) * column 4, line 17 - line 57 * ---	1,2,4, 15,17	
A	EP-A-0 094 098 (WESTINGHOUSE ELECTRIC) * page 3, line 3 - page 5, line 25 * ---	1,2,3,4, 15,16,17	
A	EP-A-0 108 234 (RHEINISCHE BRAUNKOHLE) * page 7; claim 1 * ---	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	EP-A-0 384 454 (AHLSTRÖM CORP.) * column 12 - column 14; claims 1-15 * -----	1,15	C10J F23C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 FEBRUARY 1993	Examiner WENDLING J.P.
CATEGORY OF CITED DOCUMENTS			
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