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(54) Method and plant to gasify solid fuels containing non-combustible meltable materials.

(57) Method and plant to gasify solid fuels, which are advantageously solid urban wastes, wood wastes and wood chips, solid combustible wastes of an industrial origin, biomasses of an agricultural origin, tyres, peat, lignite, coal and analogous or like materials, the method being obtained with a gasification plant (10) comprising from above downwards a charging silo (11) including a higher portion and a narrower lower portion (26) communicating directly with a vertical furnace (12), the vertical furnace (12) comprising a lower terminal zone (15) connected and joined to an upper terminal zone (16) of a pyrolysis zone (28), which contains at its lower end a system to collect and discharge ashes, the lower terminal zone (15) of the furnace (12) and the upper terminal zone (16) of the pyrolysis zone (28) being connected to a powders separation chamber (13), which is connected to an outlet duct (47) and to an interspace (17) that surrounds the charging silo (11), in which method at least part of the distilled gases generated in the charging silo (11) is recovered in the higher portion of the charging silo (11) and is intensely recycled through ducts (19) from that higher portion of the charging silo (11) to the lower portion (26) of the charging silo (11), whence at least part of the recycled gases is sent to the pyrolysis zone (28) of the furnace (12) through a conduit (27).

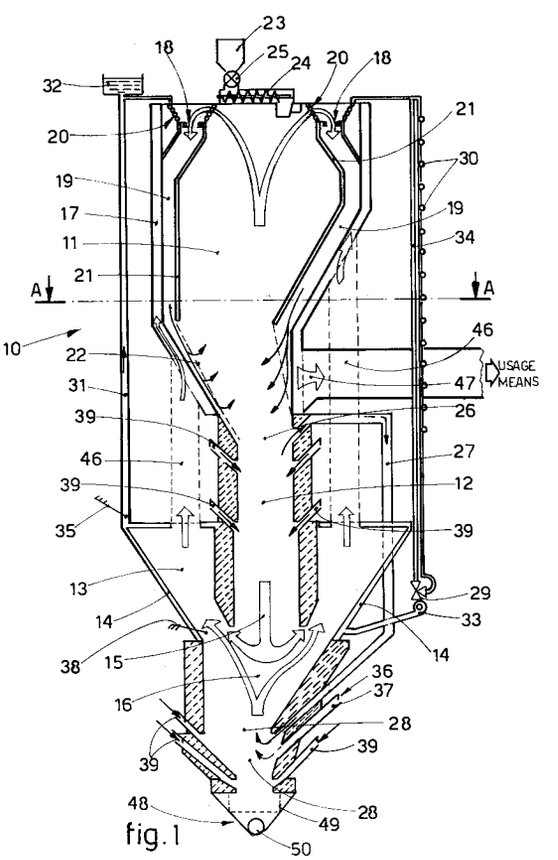

fig.1

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This invention concerns a method to gasify solid fuels containing non-combustible meltable materials and concerns also a gasification plant which employs such method, as set forth in the respective main claims.

To be more exact, the invention concerns a method for the intensified gasification of solid fuels that is suitable to produce fuel gas with working systems which are less polluting for the exterior environment and provide a greater yield from the point of view of output.

The gasification method according to the invention enables solid fuels to be gasified which contain non-combustible meltable materials, such as glass and metals for instance, at the same time preventing the formation of lumps of such meltable materials which might cause blockage of the gasification plant itself.

The method concerns in particular, but not only, the gasification of solid urban wastes and, in general, the gasification of solid low-cost products such as wood wastes, wood chips, solid combustible wastes of an industrial origin, biomasses of an agricultural origin, tyres, peat, lignite, coal and other materials.

The state of the art covers a plurality of methods and apparatuses to produce gas from solid fuels. Among such methods can be listed applications in the fields of road transport, heating and lighting and the incineration and disposal of solid urban wastes.

The methods and gasification plants of the state of the art entail problems linked mainly to environmental pollution since the solid fuels reaching the combustion zone of the production process are still full of volatile parts and generate products which are hard to dispose of or are dangerous owing to their toxicity.

This is due to the fact that the evaporation of those volatile parts also takes place in the combustion zone, and the heat needed for this conversion lowers the maximum temperature attainable there, with a resulting decrease of the maximum efficiency obtainable with the gasification process.

Among the substances hard to dispose of we may include the various types of tars, while dioxin may be present as a harmful substance produced by combustion.

Other types of products may have undesirable characteristics, for instance evil-smelling products such as creosote or the like.

Such methods and gasification plants have widely varying conformations and working principles.

US-A-4,175,929 discloses a process to gasify coal whereby in a step after the gasification all the polluting substances contained in the gas so produced are substantially eliminated. For this purpose the gas from the gasification plant is passed through scrubbing and condensation steps in which the gas is purified.

DE-A-3.523.765 discloses a method and device to gasify carbonous material, whereby the gas, distilled in a traditional manner by partial combustion of the solid fuel, is delivered to an oxidation zone free of solid materials and is burned there almost completely.

FR-A-7.830.787 concerns a method and device to produce gas from wood by using the combined principle of production of gas by a gasification plant and of water gas, by means of air, of water vapour and tar vapour.

WO-A-8.002.563 discloses a method for the complete gasification of carbonous material by means of forced pyrolysis, whereas WO-A-8.100.112 describes a process and plant to gasify solid fuels whereby the gasification is performed in three separate stages.

DE-A-3.327.203 discloses a method and apparatus to gasify solid wastes whereby the gas leaving the distillation zone as a distilled gas with water vapour is sent back to the melting zone to be burnt at least partly.

IT-A-83.352 discloses a method and device to gasify solid fuels whereby the gases of pyrolysis and the distillation products which form in the gasification step are taken up to be wholly or partly pre-combusted before being sent for complete combustion in the actual combustion zone. Moreover, in this last method the volatile products still contained in the fuel gases leaving the gasification plant are separated for pre-combustion before being delivered to the combustion zone of the gasification plant.

EP-A-0433547 discloses a method and apparatus to gasify solid wastes by the simultaneous application of direct flame and inverted flame to the solid fuel.

EP-A-0055440 discloses the introduction of materials from above into a charging silo and a substantially vertical descent of the materials therefrom to a furnace; it also provides for the gases in the furnace to lap the charging silo before reaching their outlet.

US-A-4,306,506 discloses the introduction of materials from above into a charging silo and a substantially vertical descent of the materials therefrom to a furnace; it discloses also the recovery of the gases in the upper part of the silo and the injection of the gases at the base of the silo after they have been mixed with air drawn from the exterior.

US-A-4,309,195 discloses the introduction of materials from above into a charging silo and a substantially vertical descent of the materials therefrom to a furnace; it discloses also that the gases

in the furnace, before reaching their outlet, lap the charging silo; it arranges also the recovery of the gases in the upper part of the silo and the injection of the gases at the base of the silo after they have been mixed with air drawn from the exterior.

The methods and devices of the state of the art overcome a plurality of problems but still do not enable satisfactory yields of energy to be achieved.

Moreover, serious problems arise with the known gasification plants when the solid fuel materials to be gasified contain non-combustible meltable materials such as glass and metals, for instance. These problems are mainly due to the fact that widely differing temperatures exist during the gasification treatment in the various zones of the gasification plant through which the material undergoing the treatment passes.

In fact, the temperature near the inlets of air with oxidizing flame may reach 1500°-1600°c, whereas in the reducing flame zones far from the air inlets the temperature may go down to 500°-600°C.

The non-combustible meltable material passes from high temperature zones in which it melts to lower temperature zones in which it solidifies, thus forming lumps which cause jamming and the resulting blockage of the regular flow of the solid material to be gasified.

The present applicants have studied, tested and obtained this invention so as to obviate the shortcomings of the state of the art and to achieve further advantages.

This invention is set forth and characterized in the respective main claims, while the dependent claims describe variants of the respective ideas of the main solutions.

The method to gasify solid fuels according to the invention makes use of the recovery of heat contained in the combustible gases produced by the gasification plant so as to heat the solid fuels and to gasify the volatile parts of the same while these solid fuels are still held in the charging silo of the gasification plant.

The gasification method according to the invention gives precedence to the recovery of heat to be recycled in the process and to the reduction of non-productive absorption of heat during the process, so as to obtain not only a greater yield of energy but also a gas possessing greater calorific power per cu.metre.

The method of gasifying solid fuels according to the invention performs an action of evaporation and distillation of the volatile parts contained in the solid fuels while the latter are still in the charging silo of the gasification plant.

In this way the carbonization and coking of the solid fuels are facilitated even before the beginning of the traditional treatment for their partial oxidising combustion and thereafter reducing combustion.

Moreover, by means of the method for gasification of solid fuels according to the invention the requirement of combustion-supporting air needed for the reactions which take place during the gasification is reduced, and therefore reduces also the quantity of nitrogen contained in the gas produced, which thus has a greater calorific power and raises also the efficiency of the method.

Owing to the greater heat made available in the gasification process following upon the recovery of heat already achieved in the charging silo of the gasification plant, the gas thus produced is also better owing to the greater quantity it contains of unburnt or pyrolysed distillates or distillates subjected to cracking.

With the method of gasifying solid fuels according to the invention a part of the sensible heat contained in the hot gas produced by the gasification is removed advantageously by a liquid, such as oil, or water, or steam, which circulates in an appropriate circuit or Perkin's type tubes.

This liquid circulates advantageously in an interspace machined in the outer sidewall surrounding and delimiting the chamber for separation of the hot gases generated by gasification of the solid fuel and removes heat.

The liquid thus heated circulates in an endless circuit and has the task of heating the distillation gases which are recirculated in the mass of solid fuel held in the charging silo.

The heat thus removed from the gas produced by the gasification is employed to heat and dry beforehand the solid fuels held in the charging silo of the gasification plant and causes the evaporation of the volatile parts of those fuels and thus generates distilled gases which are recirculated intensely within the charging silo.

In the gasification method according to the invention any excessive heat of the liquid being circulated can also be employed not only to preheat the combustion-supporting air but also to dry beforehand any solid fuel containing excessive humidity before that fuel enters the gasification plant.

Such excessive heat can also be employed for other uses such as heating the environment, heating other liquids, etc. or else can be dispersed to the exterior environment with the help of heat exchangers operating by air and/or a liquid.

Furthermore, in the gasification method according to the invention the hot gas produced by the gasification is brought indirectly into contact with the solid fuel material.

In fact, the gas produced by the combustion is delivered into an interspace which surrounds fully the outer sidewall of the charging silo before being sent to usage means.

In this way the sensible heat of the gas is yielded through the sidewalls of the charging silo to the solid fuel material and causes the volatile parts of that material to evaporate.

The gas produced is sent from this interspace to the usage means connected to the gasification plant.

The distilled gas thus obtained is conveyed and redistributed continuously in the mass of solid fuel contained in the charging silo by means of fans; this circulation of distilled gases may reach as much as 10-20 thousand cu.metres per hour per tonne per hour of solid gasified fuel.

The silo is equipped with a suitable fan, which recirculates continuously within the silo the gaseous fluid generated therein by means of ducts or interspaces.

This re-circulation involves a considerable quantity of that fluid and the above indication of 10-20 thousand cu.metres per hour per tonne of fuel per hour corresponds in practice to a speed of about 4-5 metres per second within the mass in the silo.

This enables a considerable quantity of heat to be collected from the gas leaving, the quantity amounting even to about 300,000 Kcal or more per tonne of treated fuel; this heat is re-distributed in the mass itself and assists evaporation of the volatile parts.

By means of this contrivance only a fraction of the fuel enters the furnace while still in the solid state, and this fuel is already pre-heated with heat recovered from the gas leaving.

In this way the temperature of the solid fuel rises to a greater extent and more evenly than in the traditional methods and causes the volatile parts of the fuel to evaporate and distil and carbonizes or cokes the carbonous part of the fuel.

Moreover, with the gasification method according to the invention a part of the gases coming from distillation of the volatile parts is taken for immission into the zone of greater negative pressure of the gasification plant, this zone coinciding generally with the lower part of the plant.

Thus, this part too of the gas coming from the distillation undergoes a pyrolysis or cracking action, the effects of which can be modulated by regulating the quantity of air immitted into the gasification plant.

Furthermore, with the method the temperature of the gas just produced is lowered at once, thus hindering the inverted reaction which would bring the carbon monoxide and hydrogen thus obtained to form carbon and water again, with unavoidable unfavourable results in the subsequent use of the gas thus produced.

Moreover, as is known in the state of the art, the gasification plants have to be equipped with safety devices able to prevent the explosion of the plant itself when an explosive mixture of air and gas is formed within the plant itself.

In such a case, in particular, the aspiration pipes of the combustion-supporting air in the apparatus employing the gasification method according to the invention are equipped with non-return valves which, besides preventing the exit of gas from the gasification plant, permit the mixture of gas and air to flare up without bringing the gasification plant under pressure or indeed causing it to explode.

Moreover, the gasification plant according to the invention is suitable to gasify solid fuels containing non-combustible meltable materials such as glass or metals.

This purpose is achieved by creating within the gasification plant a zone having at all times a temperature higher than the melting temperature of the non-combustible meltable materials.

This higher temperature zone is advantageously inclined so as to collect these molten materials and take them in the molten state to the discharge outlet located in the lower part of the gasification plant.

According to a variant the higher temperature can be maintained in the zone of the melting and sliding of these molten materials by means of the introduction of solid fuel possessing a greater calorific power.

According to another variant the plant to gasify solid fuels containing meltable materials is not of an intensified type, and the internal recovery of heat and the prior gasification of the volatile parts of the solid fuel are independent from the melting of such materials.

The attached figures, which are given as a non-restrictive example, show a preferred embodiment of the invention as follows:

- Fig.1 is a lengthwise section of an apparatus which employs the method according to this invention;
- Fig.2 is a cross section along the line A-A of the gasification plant of Fig.1;
- Fig.3 is a diagram of a section of the intake of the pipe feeding air to the gasification plant according to the invention;
- Fig.4 is a diagram of an apparatus for the gasification of solid fuels containing non-combustible meltable materials;
- Fig.5 shows a cross section along the line B-B of the gasification plant of Fig.4.

In the figures the reference number 10 indicates generally a gasification plant employing the method according to this invention.

The gasification plant 10 according to the invention consists substantially of a charging silo 11, a furnace 12 and a chamber 13 for separation of

powders.

The gasification plant 10 shown in the figures is of a type with a quadrangular cross section, but the considerations cited in the following description are valid also for gasification plants 10 having a circular cross section or any other desired shape.

In this example the solid fuel is fed from above to the charging silo 11 by means of a hopper 23 cooperating with a worm 24, both of which are positioned higher than the charging silo 11.

To prevent any undesired entry of air into the gasification plant 10 a star-shaped rotary valve 25 is fitted in this case to control the outlet of the hopper 23.

The gas produced by the gasification is collected in the powders separation chamber 13 positioned so as to surround the lower part of the furnace 12 of the gasification plant 10.

In the plant 10 according to the invention the powders separation chamber 13 is surrounded on its outside by an interspace 14, in which a cooling liquid, advantageously oil, circulates so as to cool the hot gas produced and to heat the solid fuel held in the charging silo 11.

The gas produced by the gasification and leaving the lower end zones 15 and 16 of the furnace 12 enters the powders separation chamber 13 and undergoes a first cooling by the oil circulating in the oil circulation interspace 14.

The partly cooled gas is conveyed through flues 46 into an interspace 17, which surrounds fully and delimits the charging silo 11 and serves for the circulation of the gas.

The gas is further cooled and releases heat through the inner sidewall of the gas circulation interspace 17 to the fuel material held in the charging silo 11. The interspace 17 is equipped with an outlet duct 47 through which the gas produced is delivered to various usage means.

In this example there are in the upper part of the charging silo 11 means 18 to recirculate the distilled gas, which consist, for instance, of a plurality of centrifugal fans that aspirate the evaporated and distilled gases contained in the upper portion of the charging silo 11 above the solid fuel: these fans 18 inject these gases downwards into the mass of solid fuel through ducts 19 which convey the distilled gases.

In this way the greatest possible use is made of the recovery of the sensible heat of the distilled gas passing through the distilled gas conveyor ducts 19 and of the gas produced by gasification and passing through the gas circulation interspace 17 and also of the oil circulating within the oil circulation interspace 21.

The distilled gas conveyor ducts 19 may be included in various numbers and be arranged peripherally about the charging silo 11.

In the example of Fig.2 the charging silo 11 has a quadrangular cross section and the conveyor ducts 19 are four in number and are positioned in the corners of the charging silo 11.

In this case the distilled gas conveyor ducts 19 include in their lower part a terminal segment 22 consisting of perforated sheet so as to provide more openings for passage of the distilled heating gases, which rise from below to the top of the charging silo 11, thus passing through the mass of solid fuel contained therein and being aspirated by the recirculation means 18.

In this way the distilled gases recirculated within the combustible mass in the charging silo 11 have the purpose also of displacing the solid fuel fed to the furnace 12 and of preventing that fuel becoming aggregated together and of assisting gasification of the same.

In the gasification plant 10 according to this invention the oil is circulated in appropriate radiant tubes 20 arranged at the upper inlet of the distilled gas conveyor ducts 19 and in the oil circulation interspace 21 of the same distilled gas conveyor ducts 19.

In this way the distilled gases recirculated within the combustible mass are further heated, and the heat is distributed evenly and continuously in the mass of solid fuel held in the charging silo 11.

The outcome is an appreciable increase in the temperature of the solid fuel within the charging silo 11 so as to cause evaporation and distillation of the volatile parts, and this fact enables the carbonous part of the solid fuel to be carbonized or coked, thus increasing the overall yield of the successive gasification process carried out in a traditional manner.

A part of the distilled gas produced in the charging silo 11 is aspirated from the bottom portion 26 of the charging silo 11 and is conveyed in a conduit 27 to a pyrolysis zone 28 of the furnace 12.

In fact this pyrolysis zone 28 of the furnace 12 is kept under a greater negative pressure, and the gas immitted therein undergoes an action of pyrolysis or cracking, which can be modulated by regulating as required the quantity of air to be introduced from the exterior.

In this example the regulation of the flow of the immitted combustion-supporting air through the pipe 37 into the pyrolysis zone 28 near the outlet of the conduit 27 is carried out by acting on a valve 36 fitted to the pipe 37 and can be adjusted to suit the temperature of the gas leaving the lower end zones 15-16 of the furnace 12.

In particular, if the temperature of the gas leaving the lower end zones 15-16 of the furnace 12 is too low, the valve 36 is opened to a greater extent to make possible a partial or full combustion of the part of the distilled gases re-immitted through the

conduit 27 into the pyrolysis zone 28 of the furnace 12.

If the temperature of the gas leaving the lower end zones 15-16 of the furnace 12 is high enough, the valve 36 is closed, with occurrence of cracking.

This regulation of the flow of combustion-supporting air can be automated by controlling the valve 36 regulating the combustion-supporting air by means of a thermal probe 38 which monitors the temperature of the gases entering the powders separation chamber 13.

In this example the circuit of the cooling oil consists of a delivery tube 31, which conveys the oil from the interspace 14 surrounding the powders separation chamber 13 to an expansion vessel 32. Thence the oil, after being cooled by passing through the radiant tubes 20 and the oil circulation interspaces 21 of the distilled gases conveyor ducts 19, reaches a re-circulation pump 33 through a return pipe 34.

In this case the maintaining of the temperature of the oil circulating in the interspace 14 within the maximum permitted temperature is achieved by fitting a three-way valve 29 which distributes the flow of oil also onto a battery of radiators 30, which disperse any excessive heat into the outside environment.

The regulation of the three-way valve 29 can be governed by a thermostat 35 fitted, in this case, to the oil circuit delivery tube 31.

A further recovery of energy can be achieved in a known manner by pre-heating the combustion-supporting air at the expense of the cooling oil circulating in the oil circulation interspace 14 or else by making use of the sensible heat of the produced gas leaving the gasification plant 10 through the gas discharge outlet 47 before that gas is sent to the usage means.

A known system 48 to collect and discharge ashes is included at the bottom of the gasification plant 10 according to the invention and consists, for instance, of a grill 49 subjected to intermittent vibration and suitable to retain the fuel and to allow the passage of the ashes to a discharge means positioned below, a worm 50 for instance.

Fig.4 shows a gasification plant 110 especially suitable for gasifying solid fuels containing non-combustible meltable materials. This gasification plant 110 to gasify solid fuels containing non-combustible meltable materials consists substantially of a main charging silo 51, a possible secondary charging silo 52, a furnace 53 and a device 54 to collect, discharge and remove the molten material.

In this case the main charging silo 51 to feed solid fuel material to be gasified is positioned vertically, whereas the underlying portion consisting of the furnace 53, which in this example has a five-sided section, comprises a channel 54 to collect molten material.

In this example the channel 54 to collect molten material consists of two sidewalls 55a-55b of the furnace 53, which form between them an angle of about 60° on a horizontal plane; these sidewalls 55a-55b are kept at a high temperature to prevent solidification of the sliding molten material.

This collection channel 54 is sloped in relation to the vertical in such a way that it collects the molten material from the furnace 53 and enables that material to slide to a discharge outlet 59.

Where the solid fuel possesses a very low calorific power or in situations where a back-up of heat is required to keep the collection channel 54 of the molten materials at a suitable temperature, the secondary charging silo 52 is included.

The furnace 53 is fed by this secondary charging silo 52 as required with a charge of solid fuel having a higher calorific power. In this case the furnace 53 comprises upper 56 and lateral 57 inlets for air and also inlets 58 for hot gases produced by distillation of the volatile substances contained in the solid fuel, as indicated above in greater detail.

Fig.5 shows also flues 46 to covey the hot gases produced, in view of a further recovery of heat within the gasification plant 10.

In the gasification plants 10-110 it is also necessary to fit safety systems to ducts 39 feeding air to the furnace 12 so as to prevent formation of an explosive mixture of gas and air within those ducts 39, for instance in the case of a sudden stoppage of the gasification plant 10.

In this case the safety means (Fig.3) are provided by placing the aspiration intakes of the ducts 39 feeding the air above terminal outlets 40 of the ducts introducing the air, whether that air is heated or not.

At the point of the junction between the terminal outlet 40 of the duct introducing the air and the intake of the air aspiration duct 39 is fitted a rotary non-return valve 41, which permits the entry of aspirated air during the working of the gasification plant 10 and prevents the entry of air and the exit of gas when the plant 10 is halted.

The rotary valve 41 shown in Fig.3 consists of a lid 45 hinged on a pivot 43, which is fitted to the upper part of the air aspiration duct 39.

In the event of a stoppage of the gasification plant 10 the lid 45, resting by gravity on the intake of the air aspiration duct 39, prevents the entry of further air into the gasification plant 10.

In this case, to improve the engagement seal of the rotary valve 41, the lid 45 in its closed position abuts against a peripherally arranged packing 42.

To ensure that the air remaining in the initial segment of the aspiration duct 39 at the moment of a sudden stoppage of the gasification plant 10 can

flare out freely and mingle with the gas produced without bringing under pressure, or indeed causing an explosion of, the gasification plant 10, the lid 45 of the rotary valve 41 rests against two lateral sides 44, which too are hinged on the pivot 43.

Thus, in the event of an explosion the pressure wave acting on the lid 45 displaces towards the outside of the gasification plant 10 the lid 45 and the lateral sides 44, which both oscillate on the pivot 43, thus preventing the bringing under pressure of the gasification plant 10 according to the invention.

By adjusting suitably the weight of the lid 45 of the individual rotary valves 41 it is possible to achieve regulation of the flow of combustion-supporting air fed to the furnace 12 through the various air-aspiration ducts 39.

Claims

1. Method to gasify solid fuels, which are advantageously solid urban wastes, wood wastes and wood chips, solid combustible wastes of an industrial origin, biomasses of an agricultural origin, tyres, peat, lignite, coal and analogous or like materials, the method being obtained with a gasification plant (10) comprising from above downwards a charging silo (11) including a higher portion and a narrower lower portion (26) communicating directly with a vertical furnace (12), the vertical furnace (12) comprising a lower terminal zone (15) connected and joined to an upper terminal zone (16) of a pyrolysis zone (28), which contains at its lower end a system to collect and discharge ashes, the lower terminal zone (15) of the furnace (12) and the upper terminal zone (16) of the pyrolysis zone (28) being connected to a powders separation chamber (13), which is connected to an outlet duct (47) and to an interspace (17) that surrounds the charging silo (11), the method being characterized in that at least part of the distilled gases generated in the charging silo (11) is recovered in the higher portion of the charging silo (11) and is intensely recycled from that higher portion of the charging silo (11) to the lower portion (26) of the charging silo (11), whence at least part of the recycled gases is sent to the pyrolysis zone (28) of the furnace (12) through a conduit (27).

2. Gasification method as in Claim 1, whereby at least part of the distilled gases produced in the charging silo (11) and sent to the pyrolysis zone (28) of the furnace (12) is mixed with external air in a quantity governed by a thermostat (38).

3. Gasification method as in Claim 1 or 2, whereby the gases coming from the lower terminal zone (15) of the furnace (12) and from the upper terminal zone (16) of the pyrolysis zone (28) into the powders separation chamber (13) lap the outer walls of the chamber (13), which contain an interspace (14) in which diathermal oil circulates, this heated diathermal oil being employed to heat the distilled gases sent into the charging silo (11) and also the solid fuel held in the charging silo (11).

4. Plant to gasify solid fuels, which are advantageously solid urban wastes, wood wastes and wood chips, solid combustible wastes of an industrial origin, biomasses of an agricultural origin, tyres, peat, lignite, coal, etc. the gasification plant (10) comprising from above downwards a charging silo (11) including a higher portion and a narrower lower portion (26) communicating directly with a vertical furnace (12), the vertical furnace (12) comprising a lower terminal zone (15) connected and joined to an upper terminal zone (16) of a pyrolysis zone (28), which contains at its lower end a system to collect and discharge ashes, the lower terminal zone (15) of the furnace (12) and the upper terminal zone (16) of the pyrolysis zone (28) being connected to a powders separation chamber (13), which is connected to an outlet duct (47) and to an interspace (17) that surrounds the charging silo (11), the plant being characterized in that it comprises:
   - ducts (19) to convey distilled gases, the ducts (19) including at least partly an interspace (21) for diathermal heating oil, the ducts (19) to convey distilled gases connecting the higher portion of the charging silo (11) to the lower portion (26) of the charging silo (11),
   - ducts (39) to feed air in cooperation with the vertical furnace (12),
   - an interspace (14) to circulate and heat diathermal oil, this interspace (14) surrounding at least partly the powders separation chamber (13), and
   - an intake and conveying conduit (27) which connects the lower portion (26) of the charging silo (11) to the pyrolysis zone (28).

5. Plant to gasify solid fuels as in Claim 4, in which the ducts (19) conveying the distilled gases are assisted by at least one fan (18) having a high capacity and power.

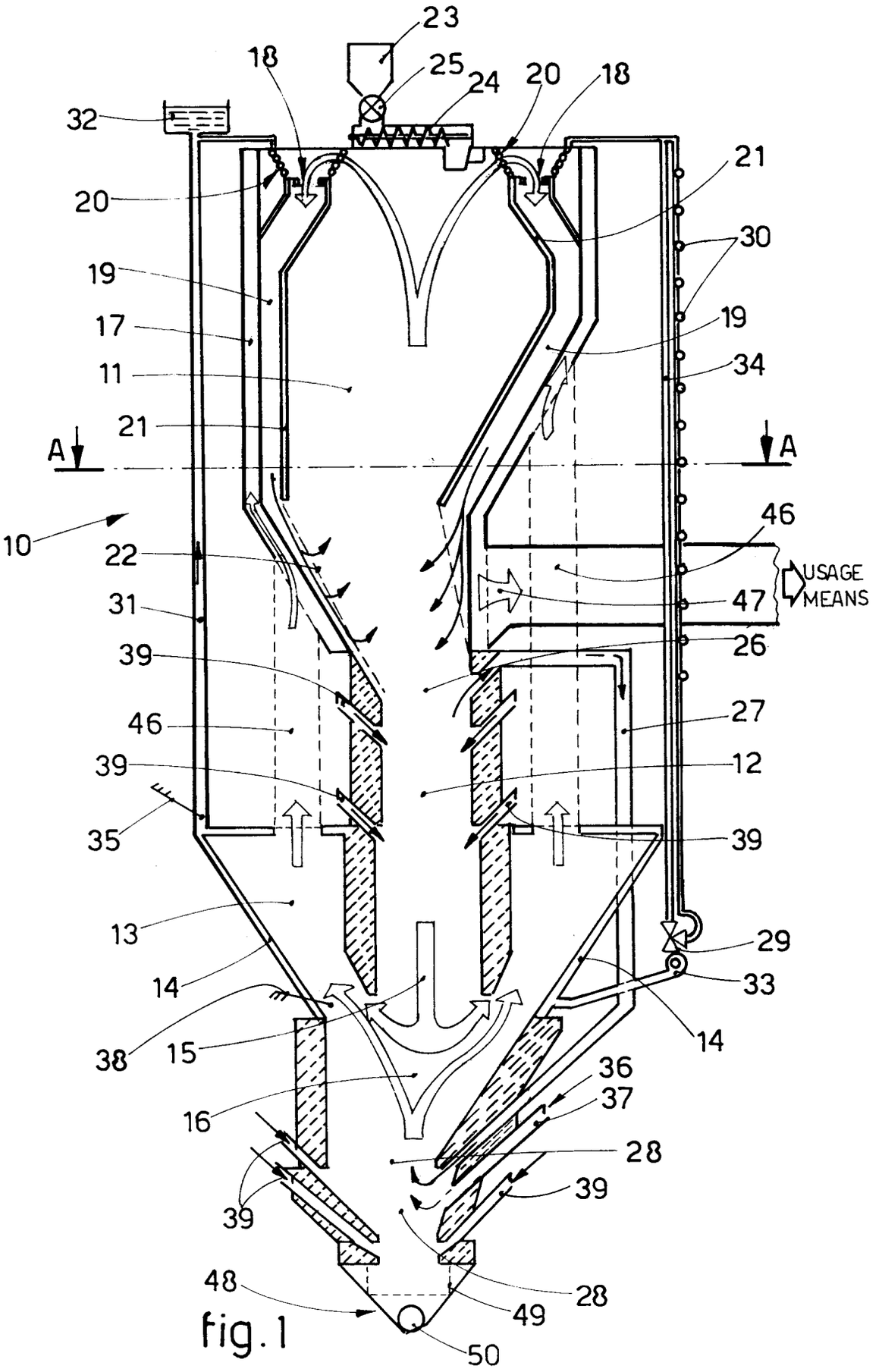
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fig. 1

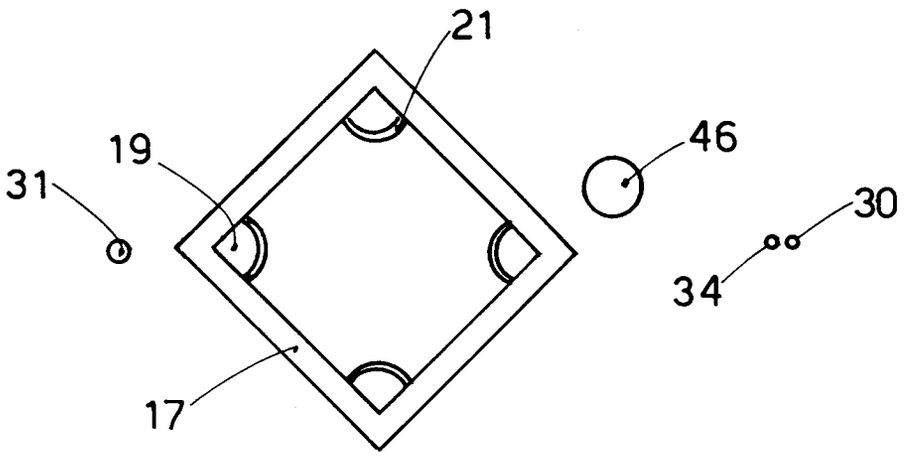

fig. 2

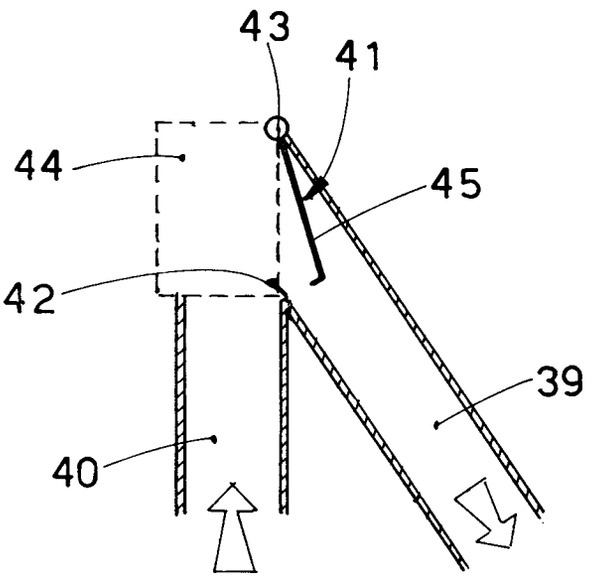

fig. 3

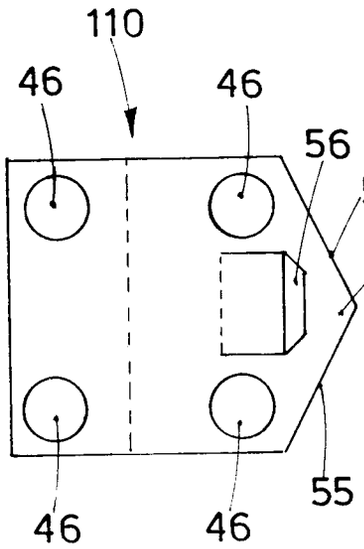
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fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 92 11 3622

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)
D,A	US-A-4 306 506 (ROTTER) * column 3, line 50 - column 5, line 14 *	1,2,4	C10J3/26 C10J3/66
A	FR-A-885 704 (DAIMLER-BENTZ) * page 2, line 40 - page 3, line 44 *	1,2	
D,A	US-A-4 309 195 (ROTTER) * column 3, line 58 - column 5, line 36 *	1,2,4	
D,A	EP-A-0 055 440 (KERNFORSCHUNGSANLAGE JÜLICH) * page 19, line 21 - page 26, line 14; figure 2 *	3,4	
D,A	DE-A-2 436 268 (KIRCHGASSNER) * page 14 - page 18; claims 1-8 *	1,3,4	
A	BE-A-865 649 (LAMBIOTTE)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

C10J
C10B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 DECEMBER 1992	WENDLING J.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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