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(54) Benævnelse: **Fremgangsmåde og system til formaling af kul i inaktiv og ikke-inaktiv drift**

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The invention relates to a method for coal grinding in inert operation or in non-inert operation according to claim 1 and to an installation for coal grinding in inert operation or in non-inert operation according to claim 9.

The invention is suitable in principle for all coal grinding plants, in which raw coal is ground to coal dust in inert operation or in air driven operation. Coal grinding installations are used in different branches of industry, for example in installations for hot gas generation, fluidised bed combustion and in coal gasification plants. Coal grinding is also carried out in the cement industry in the production of cement and in the steel and smelting industry and in non-ferrous metallurgical processes which comprise PCI (Pulverised Coal Injection) installations.

Methods and installations for coal grinding are described in the prior art of DE 10 2005 040 519 B4, which is orientated towards a method and a device for grinding and simultaneous drying of hot and wet raw materials, in particular cement clinker, slag and aggregates. DE 30 06 470 A1 relates to a device for operating a coal grinding and drying installation using a ball or roller mill and inert hot gases from a hot gas generator and EP 0 579 214 A1 relates to a grinding – drying process for raw brown coal in an air swept roller mill with the supply of cold gas, in particular cold and / or ambient air. DE 36 39 206 C1 discloses a method for regulating a bowl roller mill for producing coal dust for coal dust firing and US 4597537 A describes a vertical mill which can be used inter alia for coal grinding and is orientated towards the improvement of the classifying process.

In addition the method and the installation can be used for novel power station technologies, such as for example the oxycoal process. The method and the installation are also suitable for the operation of hot gas generators and for briquette production.

In order to produce coal briquettes so-called "young coals", that is to say soft brown coals, hard brown coals and sub-bituminous coals with a water content of from approximately 10% to approximately 75% and a proportion of volatile components of from approximately 35% to approximately 60% (i.waf) are generally used.

In a known method for briquette production (*VORWEG GEHEN – RWE-POWER; PHV-SU*) previously broken-up raw coal is reduced after preliminary screening in a hammer mill and then subjected to further screening. The wet material passes on a fine coal conveyor via a bunker to a tubular dryer. The dried fines are subsequently fed to a briquetting press. The coal portions separated in the preliminary and further screening are used as boiler coal in a power station. A disadvantage is to be seen in the drying of the fine coal after the coal grinding with the aid of an external energy carrier and the necessary screenings.

A binderless briquetting method is known from WO 90/10052, wherein already reduced, wet fine coal is fed with the aid of a feed conveyor belt together with already dried fine coal and previously heated fine material from a separator to a briquetting press above a gas mixing chamber of a hot gas generator and then fed to an entrained flow drying tube and heated in a reducing or respectively inert atmosphere to 25° to 200°C. After a cyclone, in which the fine coal is separated, it is then fed via a feed compressor to the briquetting press. The inert gas is fed proportionally as return gas to the gas mixing chamber and to the burner of the hot gas generator. The whole installation is operated at an overpressure and a heat exchange takes place between the briquettes or reduced briquettes with the wet fine material before drying in the entrained flow drying tube.

In a Powerpoint presentation the aforementioned BCB process (Binderless Coal Briquetting Process) is modified in that the fine coal dried in the entrained flow drying tube supplied by the hot gas generator is separated in a cyclone battery into a coarser, briquettable particle size range and into a fine material. The dry gas is removed. The fine material is fed to the burner of the hot gas generator as a fuel under overpressure and the hot gases produced in the hot gas generator reach the entrained flow dryer tube. No assertions are made concerning the particle size of the fine material and a super fines portion. The proportion of super fines or respectively the grain structure has an effect, however, upon the density, compressability, etc. and can considerably reduce the quality of the briquettes produced therefrom.

It is an object of the invention to create a method and an installation for coal grinding in inert or air driven operation which guarantee in an energy efficient manner the provision of coal dust in a particle size corresponding to the respective use and simultaneously the production of hot gases for the grinding – drying process.

In terms of the method the object is achieved through the features of claim 1 and in terms of the device through the features of claim 9.

Useful and advantageous embodiments are contained in the sub-claims and follow from the description of the figures.

A core idea of the invention can be seen in that coal dust produced in a grinding – drying process and separated in a separating unit from the drying and carrier gases is fed at least proportionally to a classifier in order to separate ultra fine dust or respectively a super fines portion from the coal dust as the ground product through classification and then to use this super fines portion for the provision of the necessary heat for the grinding - drying process and thus to save other

energy carriers, in particular premium energy carriers such as natural gases, oils, synthesis gases.

Through the arrangement of a classifier means after the separating unit this subsequent classifying process is decoupled from the gas conveying process, in particular in the mill and in the separating unit. The decoupling of the classifying process from the gas conveying process is advantageous particularly having regard to safety.

According to the invention the super fines portion separated in a static or respectively mechanical classifier from the ground product is used for combustion in a hot gas generator for solid fuels in order to provide the drying energy required for the grinding – drying process.

Insofar as a super fines portion is purposefully removed from the coal dust as a ground product and corresponding to the requirements is fed at least proportionally to a hot gas generator with a solid fuel burner for combustion, with the coarser coal dust arising in the classifier a coal dust portion is available, which no longer has the disadvantageous super fines portion which generally impairs the use and further processing, for example briquetting.

In particular according to the invention the fuel is removed in an extraordinarily efficient manner to produce the hot drying and carrier gases required in the grinding – drying process directly from the grinding – drying circuit. A separate fuel supply from externally, which requires additional transport and / or storage means, is avoided. As the super fine coal from the process of coal grinding itself is used in the hot gas generator the pre-drying and preparation of external coal necessary in an external fuel supply can also be omitted, which leads to a lower energy requirement.

It is advantageous that the micro fines portion of the coal dust separated according to the invention in the mechanical or static classifier can be separated with a particle size required for a solid fuel burner of a hot gas generator.

The particle size of the coal dust fines fed to the solid fuel burner of a hot gas generator generally amounts to approximately 10%R90µm.

In principle the use of solid fuels in a hot gas generator is determined by the parameters granulation structure, volatile components content and ash content of the brown coals or hard coals used. The lower the proportion of volatile components the finer the coal dust must be ground. High ash contents, for example up to 45%, can lead to complications in the combustion process on account of the associated lower calorific value. Measures must therefore be taken for a corresponding flame formation.

It is useful if the micro fines portion separated in the classifier has a fineness in the range of from approximately 50%R90µm to approximately 1%R90µm.

It has been found that a further important value is the d_{50} value which should amount to 10 to 30 µm at a content of volatile components in the coal of from approximately 25 to 30%. In case of a higher proportion of volatile components the grain distribution can be coarser.

Hot gas generators with a solid fuel burner which is fired with dust-form fuels and is also described as a dust burner are known and described for example in DE 197 06 077 A1 and DE 197 25 613 A1.

DE 102 32 373 B4 discloses a hot gas generator, in which coal dust, for example brown coal dust, is combusted. The coal dust having been mixed with combustion air is supplied in fluidised form in order to generate hot gases from 200°C to 900°C.

It is advantageous that the coal dust micro fines can be fed to a coal dust burner of a hot gas generator with a burner quarl and a subsequent perforated jacket. The perforated jacket consists of a plurality of perforated sheet cylinder portions. The gas arising in the separating unit is fed as return gas at about 100°C to the hot gas generator and passes via an annular channel of the perforated jacket and via annular openings and holes in the perforated jacket (LOMA) into the flue gas stream of the LOMA combustion chamber (DE 197 06 077 A1) and can be heated to a temperature in the range of from 150°C to over 700°C. The use of a LOMA combustion chamber with a solid fuel burner guarantees the compliance with the legally prescribed threshold values for CO and NO_x in the gases discharged proportionally to the environment.

In principle all classifiers which supply the necessary grain spectrum of the super fines for a hot gas generator with solid fuel burner are suitable for the inventive separation of the fines portion from the ground material of the grinding – drying process.

A static or mechanical classifier, wherein a secondary circuit is avoided, can preferably be used having regard to safety aspects. For example the gearless mechanical separator, which is described in BULLETIN 774 R of the Williams Patent Crusher & Pulverizer Company, USA and in US 2 913 109 A, is suitable. Fan blades rotate in a closed classifying chamber and produce a rising air flow, in which the fine material, separated by means of rotating classifying vanes, of the classifying material fed from above onto a distributor plate is carried upwards and falls downwards to a fine material outlet on the outer housing wall while the coarse grain freed from the fine material passes downwards to a coarse material outlet. For this classifier merely a small sealing air fan is necessary. The possible

setting of a desired particle size of the fine material with the aid of an adjustable opening of the inner housing and via the speed of the fan blades, the classifier vanes and the distributor plate is advantageous. Depending upon the type of coal the classification can thus be adjusted corresponding to the requirements upon the desired particle size of the micro fines of the coal dust.

In terms of the device the object is achieved through an installation for coal grinding in inert operation or in non-inert operation with a mill for carrying out a grinding – drying process and production of coal dust as well as with a separating unit for separating the coal dust from the gas and with a hot gas generator with solid fuel burner for heating the return gas and producing hot gases for the grinding – drying process in that a classifier for the separation of super fines from the coal dust as well as a silo for receiving the separated super fines and a connecting line with a removal means and a dosing means for the super fines for supply to the solid fuel burner of the hot gas generator are disposed after the separating unit.

The type of mill used for the grinding of the wet raw coal which is generally previously broken up is an air swept mill, in which the grinding – drying process can be carried out. It is possible to use for example roller mills, pendulum roller mills, hammer mills and ball-and-race mills. Preferably a hammer mill can be used if a product with a larger particle size is desired, which is advantageous for example in briquette production. If a finer material is required, for example for PCI plants, coal gasification plants and for the operation of hot gas generators, vertical air swept roller mills are advantageous as they can grind the coals to < 30%R90µm.

As a separating unit for separating the ground product or the coal dust from the carrier gas a filter, for example a bag filter, can be used or also a cyclone or respectively a cyclone battery can be used. By means of a rotary feeder and a corresponding transport means a defined portion of the coal dust arising in the separating unit can be fed to the classifier for separation of the super fines for the hot gas generator.

The coal dust not fed to the classifier passes via a conveying means to the intended place of use or for further processing, for example to a briquetting press, a PCI installation or for coal gasification.

The inventive method and the inventive installation can be used in coal gasification plants, PCI plants in the steel and smelting industry and in non-ferrous metallurgical processes as well as in general heat-based installations. The synthesis gas produced in the coal gasification is used in the energy producing industry and increasingly frequently also in the petrochemical industry. To date synthesis gas has been channelled off as an energy carrier for the grinding – drying process,

which, with consumptions of between 10 and 30 MW (approx. 3300 m^3_N/h to 11,000 m^3_N/h, calorific value: approximately 11,000 kJ/m^3_N) represents a considerable loss for the actual application. The inventive use of a portion of the coal dust produced for the hot gas generation is thus advantageous from an economic viewpoint.

In the steel and smelting industry the blast furnace gas is used increasingly frequently in power stations for power generation built specifically for this purpose. Accordingly the use of the self produced coal dust can also be advantageously applied in this branch of industry for hot gas generation.

The inventive use of a part of the produced coal dust with the aid of the additional classifier and the supply and feed means of the fluidised fines portion to the carbon burner of the hot gas generator is associated with a significant increase in the degree of efficiency in comparison with the relatively low investments required.

The invention is explained in further detail below by reference to a single drawing, which shows:

an inventive installation for carrying out the inventive method by reference to the example of the production of coal dust for briquette production.

The coal grinding in inert operation takes place in a mill 5 which is a hammer mill in this example. Wet, previously broken-up coal reaches this mill 5 via a conveying means 1 with magnetic separators, a breeches chute 2 and a bunker 3 with screw conveyor base 4 which simultaneously acts as a dosing means. The wet raw coal supplied can have a temperature in the range of from approximately -20°C to approximately +20°C and a moisture in the range of from 10% to 75%.

In order to realise the grinding – drying process in the mill 5 hot gases 8 are fed from a hot gas generator 12 with a temperature of approximately 450°C to the mill 5. By means of a pipeline 13 the coal dust – gas mixture is fed from the mill 5 to a separating unit 6 which is a bag filter in this embodiment. The coal dust 14 separated from the drying and carrier gases reaches a conveying means 7, for example a discharge screw conveyor, and is fed for further processing in a briquetting press (not shown).

A partial flow 15 of the ground product, that is to say of the coal dust 14 from the separating unit 6, is channelled off in order to separate from it a coal dust portion which can be used in the hot gas generator 12. The partial flow 15, which has a temperature in the range of from 70°C to 120°C, passes in a line 18 via a slide valve 16 and a rotary feeder 17 into a classifier 10.

This classifier 10 is a mechanical or respectively static classifier which is suitable for separating a super fines portion 20 from the partial flow 15 of the coal dust 14, which super fines portion 20 can be combusted in the solid fuel burner of the

hot gas generator 12. The fineness can be approximately 50%R90 µm to approximately 1%R90µm.

The super fines portion 20 passes after the classifier 10 into a silo for super fines 9 and from here via a rotary feeder 21 and a dosing unit 22 in a feed line 23 to the hot gas generator 12 or respectively to its solid fuel burner. The coarse grain reaches a conveying means 19 and can be fed together with the coal dust 14 from the separating unit 6 to the briquetting means (not shown).

The process gases 11 separated in the separating unit 6 are fed to the hot gas generator 12 at least proportionally as return gases 25. The hot gas generator 12 is usefully provided with a LOMA combustion chamber and the return gases 25 are heated in this combustion chamber from a temperature of approximately 100°C to approximately 700°C and then fed to the mill 5 as a drying and carrier gas.

The whole installation is operated in underpressure. The oxygen content of the inert or reducing drying and carrier gases 8 is maximum 12%. The safety-relevant CO and O_2 values of the process gas within the installation are observed. A proportion of the gases 11 separated in the separating unit 6 is discharged via a flue (not shown) into the environment.

For the start-up process and the shutting-down of the installation and an emergency stop it is necessary to keep the installation inert. The oxygen content in the process gas may not exceed the maximum admissible oxygen threshold concentration of the coal to be respectively prepared.

It is necessary for the inertisation to provide corresponding inertisation gases. The use of CO_2 or nitrogen is usual.

Self-inert grinding installations which as independent coal refining plants are not to be operated as part of a composite installation and for example do not have nitrogen available as in the steel and smelting industry from air decomposition installations must provide these gases by additional purchases. This requires storage capacities and separate equipment, which is a burden on the economy of the process. The required volume flows of inert gas are considerable (several 100 m^3/h according to installation size). For normal operation an inert gas production can be integrated into the whole process. Boiler installations operated with oil or gas are suitable for example, of which the heat can serve for heating purposes of buildings and for hot water preparation. The waste gas arising here has an O_2 content of 1 to 2% and is thus highly suited for the inertisation of the installation in the start-up process and for shutting down as well as for emergency stops. The necessary redundancy can be achieved via CO_2 in banks of cylinders.

Patentkrav

1. Fremgangsmåde til kulformaling i inaktiv og ikke-inaktiv drift, hvori en male-tørreproces af det tilførte rå kul udføres i en luftbestrøget mølle (5), hvori varme gasser (8) tilføres fra en hedgasgenerator (12), hvorefter blandingen af kulstøv (14) og gas (11) skilles i et udskilleraggregat (6), og kulstøvet (14) tilføres den tiltænkte anvendelse eller til yderligere forarbejdning, mens gassen (11) føres tilbage i det mindst proportionalt som returgas (25) til hedgasgeneratoren (12), **kendetegnet ved, at** kulstøvet (14) fra udskilleraggregatet (6) helt eller delvist tilføres en sigte (10), og de fineste korn (20) skilles fra kulstøvet (14) i sigten (10), hvilke fineste korn (20) helt eller delvist tilføres hedgasgeneratoren (12) til forbrænding og opvarmning af returgasserne (25), og de hede gasser (8) fra hedgasgeneratoren (12) ledes igen til møllen (5) for male-tørreprocessen.

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** sigteprocessen i sigten (10) frakobles gasføringsprocessen.

3. Fremgangsmåde ifølge krav 1 eller 2, **kendetegnet ved, at** de fineste korn (20) udskilles til forbrænding i hedgasgeneratoren (12) i en sigte (10), som er udformet som en statisk eller mekanisk sigte.

4. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** de fineste korn (20) med en partikelstørrelse i området fra ca. 50% R90µm til ca. 1% R90µm udskilles i sigten (10).

5. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** de fineste korn (20) med en partikelstørrelse på ca. 10% R90µm udskilles i sigten (10).

6. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** de fineste korn (20) udskilt i sigten (10) ledes i fluidiseret from til hedgasgeneratorens (12) faststofbrænder.

7. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** de fineste korn (20) tilføres fra sigten (10) til en silo for de fineste korn (9) og fra denne via en rotationsføder (21) og en doseringsenhed (22) i en tilførselsledning (23) i fluidiseret form til hedgasgeneratoren (12).

8. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** kulstøvets grove korn, som forekommer i sigten (10), ledes til en transportør (19) og kombineres med kulstøvet (14) fra udskilleraggregatet (6).

9. Anlæg til kulformaling i inaktiv eller i ikke-inaktiv drift, med en luftbestrøget mølle (5) til udførelse af male-tørreprocessen og frembringelse af kulstøv (14), et udskilleraggregat (6) til udskillelse af kulstøvet (14) fra gassen (11) og en hedgasgenerator (12) med faststofbrænder til opvarmning af returgasserne (25) og tilførsel som en hed gas (8) til møllen, **kendetegnet ved, at** en sigte (10) til udskillelse af de fineste korn (20) fra kulstøvet (14) og en silo (9) til de fineste korn til modtagelse af de udskilte fineste korn (20) er arrangeret efter udskilleraggregatet (6), og at siloen (9) til de fineste korn er tilsluttet en faststofbrænder i hedgasgeneratoren (12) gennem en tilførselsledning (23) med en udtagsindretning (21) og en doseringsindretning (22) for tilførsel af de udskilte fluidiserede fineste korn (20).

10. Anlæg ifølge krav 9, **kendetegnet ved, at** sigten (10) er en mekanisk eller statisk sigte uden et sekundært gaskredsløb og udformet på sådan måde, at det optimale arbejdsområde ligger i granuleringsområdet (2) af kulstøvets finkornfraktion (20) for hedgasgeneratorens (12) faststofbrænder.

11. Anlæg ifølge krav 9 eller 10, **kendetegnet ved, at** møllen (5) for male-tørreprocessen er en luftbestrøget mølle, for eksempel en lodret valsemølle, pendelrullemølle, hammermølle eller ringvalsemølle.

12. Anlæg ifølge et af krav 9 til 11, **kendetegnet ved, at** udskilleraggregatet (6) er et filter, for eksempel et posefilter eller en cyklon eller et cyklonbatteri, og at der er arrangeret en skydeventil (16) og en rotationsføder (17) for tilførsel af en foruddefineret andel af kulstøvet (14) i en ledning (18) mellem udskilleraggregatet (6) og sigten (10).

13. Anlæg ifølge et af krav 9 til 12, **kendetegnet ved, at** der efter udskilleraggregatet (6) er arrangeret en transportør (7) til transport af kulstøv (14) for den tiltænkte anvendelse, for eksempel til et PCI-anlæg, til kulforgasning eller briketering.

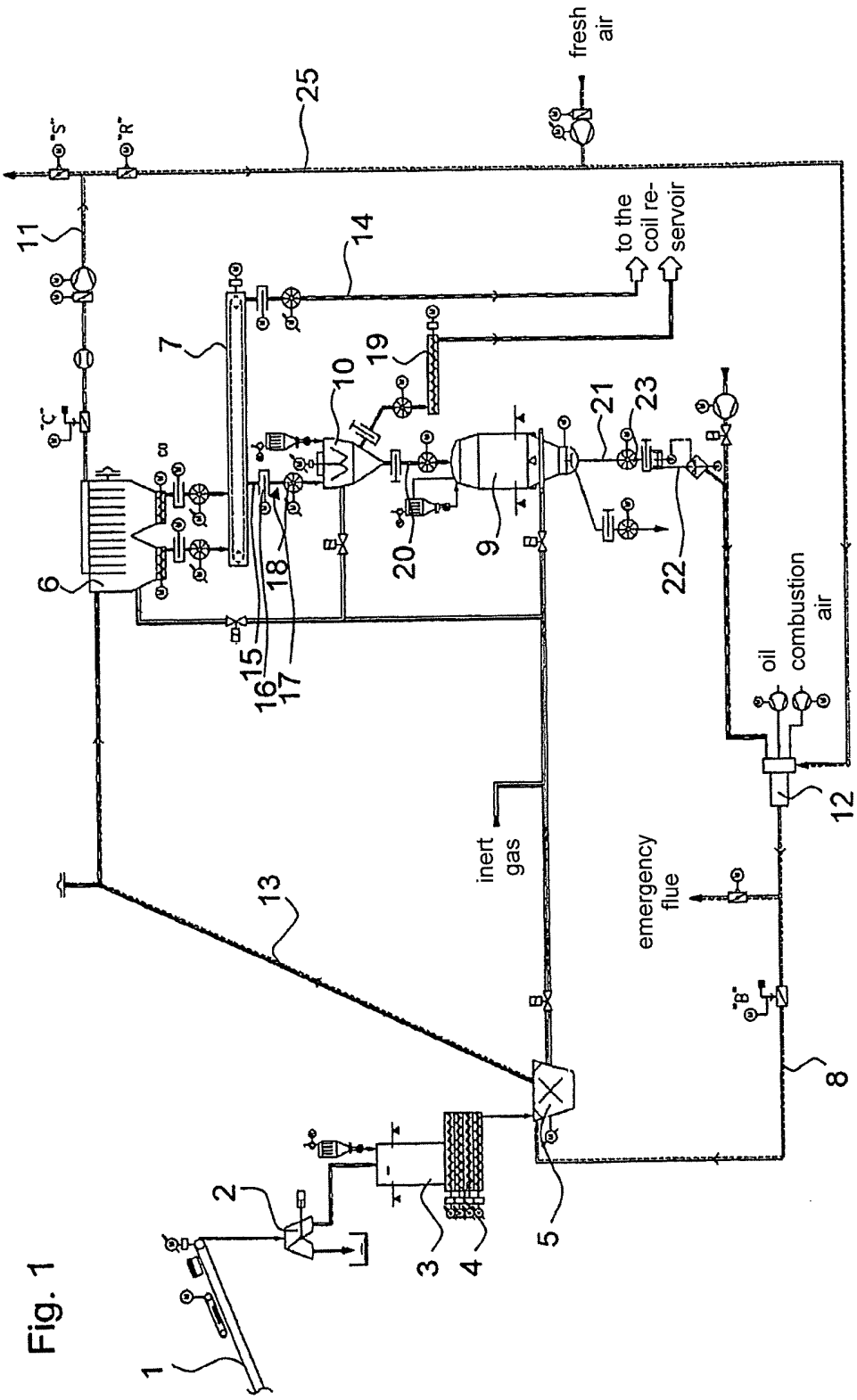

fresh air
25
"S"
"R"
11
14
to the coil re-servoir
7
19
10
21
23
"C"
20
9
22
6
18
15
16
17
oil
combustion air
12
inert gas
13
emergency flue
"B"
8
2
3
4
5
1

Fig. 1