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(54) **CONTINUOUS FUEL SUPPLY FOR A COAL GASIFICATION REACTOR**

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(57) **ABSTRACT**

A facility for the continuous supply of a coal gasification plant with finely ground fuel material is disclosed. The fuel is first stored in a storage tank and then fed to a lock hopper system, where it is supplied with gas for the coal gasification reaction. The lock hopper system consists of at least two lock hoppers to achieve that the gas is injected quasi-continuously, and the fuel is then passed to a feed tank in which a constant filling level prevails over a given period of time, so that the fuel is conveyed in a constant, smooth and pressurised flow from this feed tank to the burners. The transfer from at least two lock hoppers to a least one feed tank is carried out by pneumatic dense-flow conveying at solid material densities of at least 100 kg/m^3 and a differential pressure of at least 0.5 bar so that it is possible to arrange the facility components at the same geodetic height or different geodetic heights so as to achieve a space saving and flexible plant construction. The invention also relates to a process for the continuous and uniform supply of finely ground fuel to a coal gasification reactor.

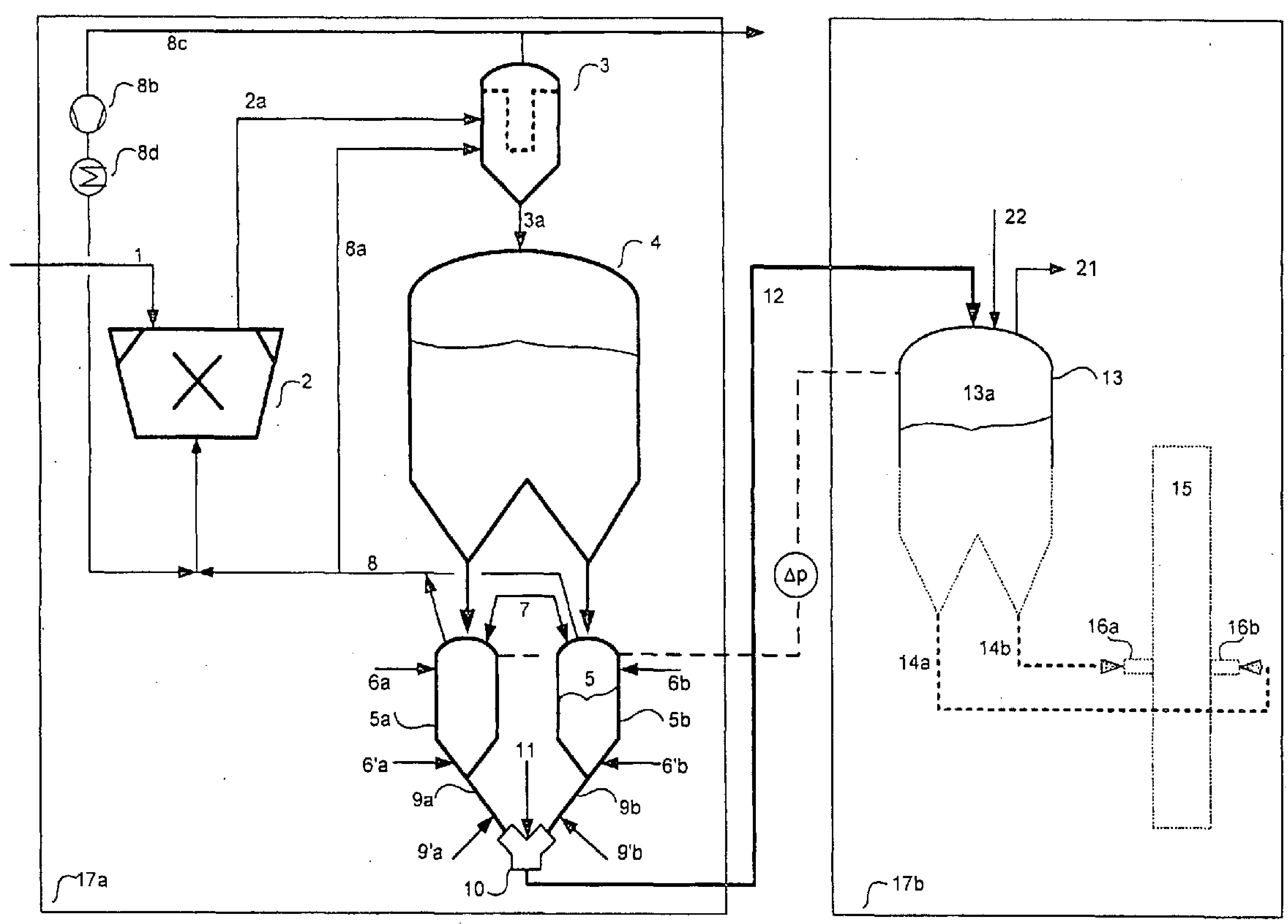

FIG. 1

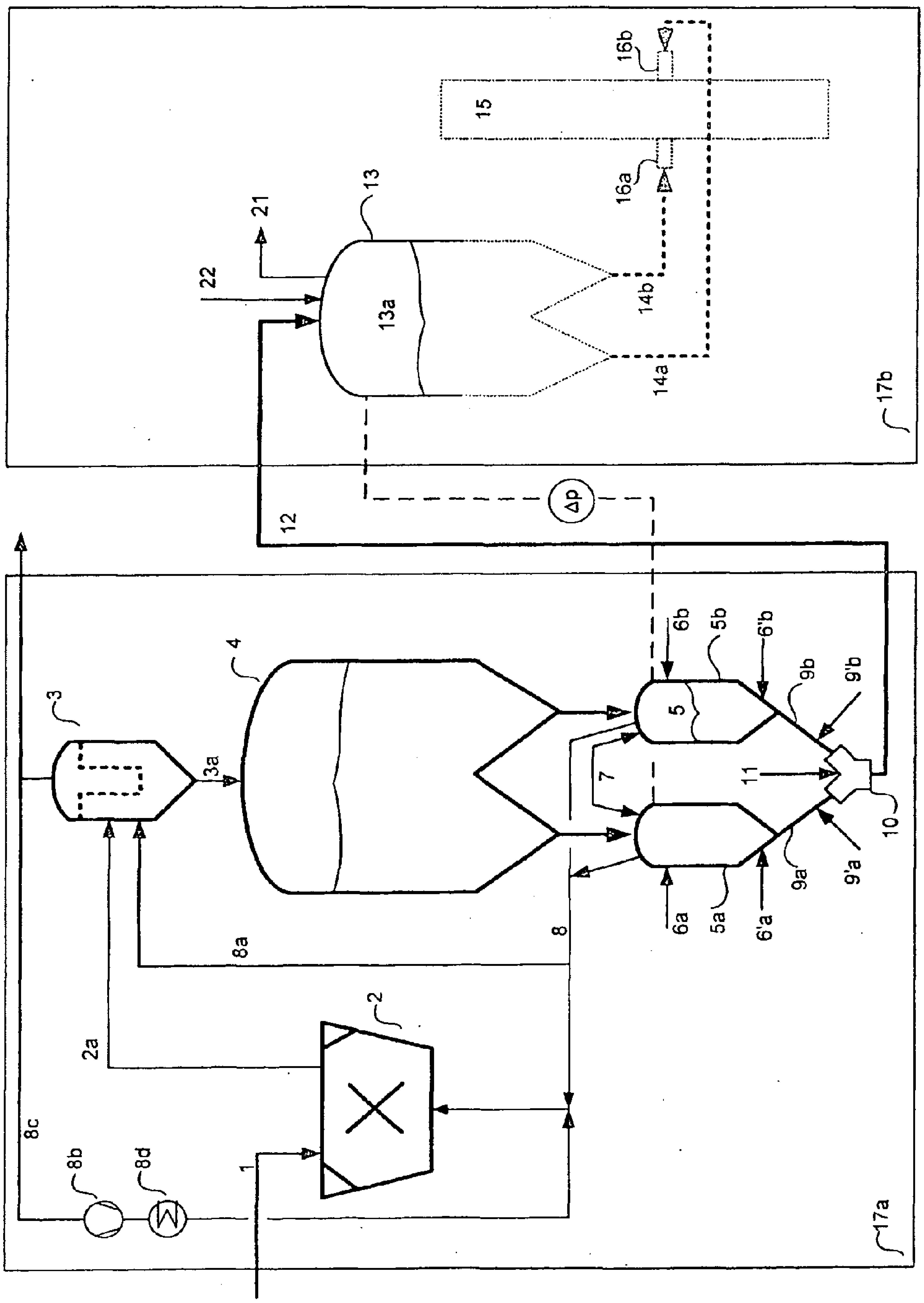
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FIG. 2

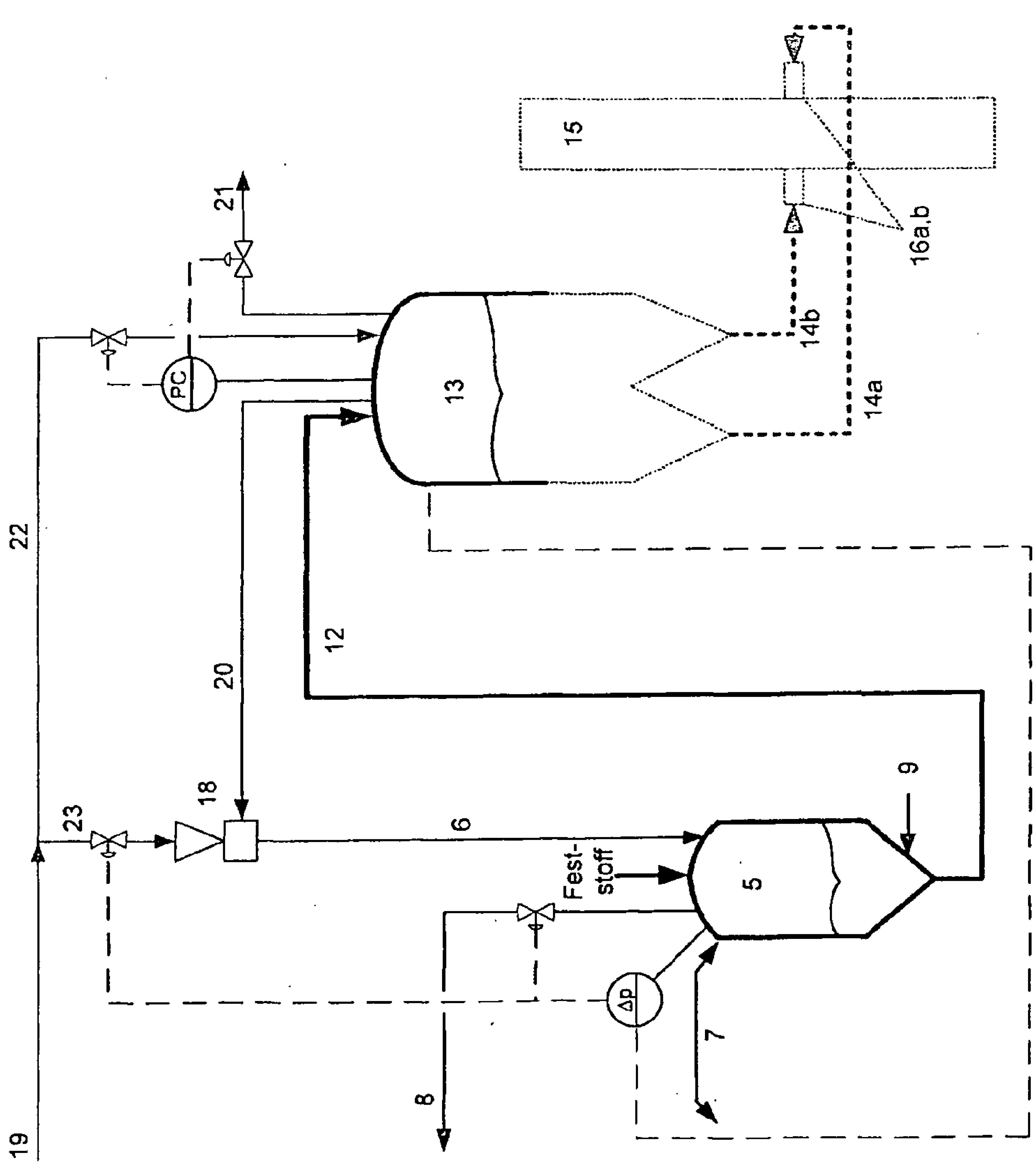


FIG. 3

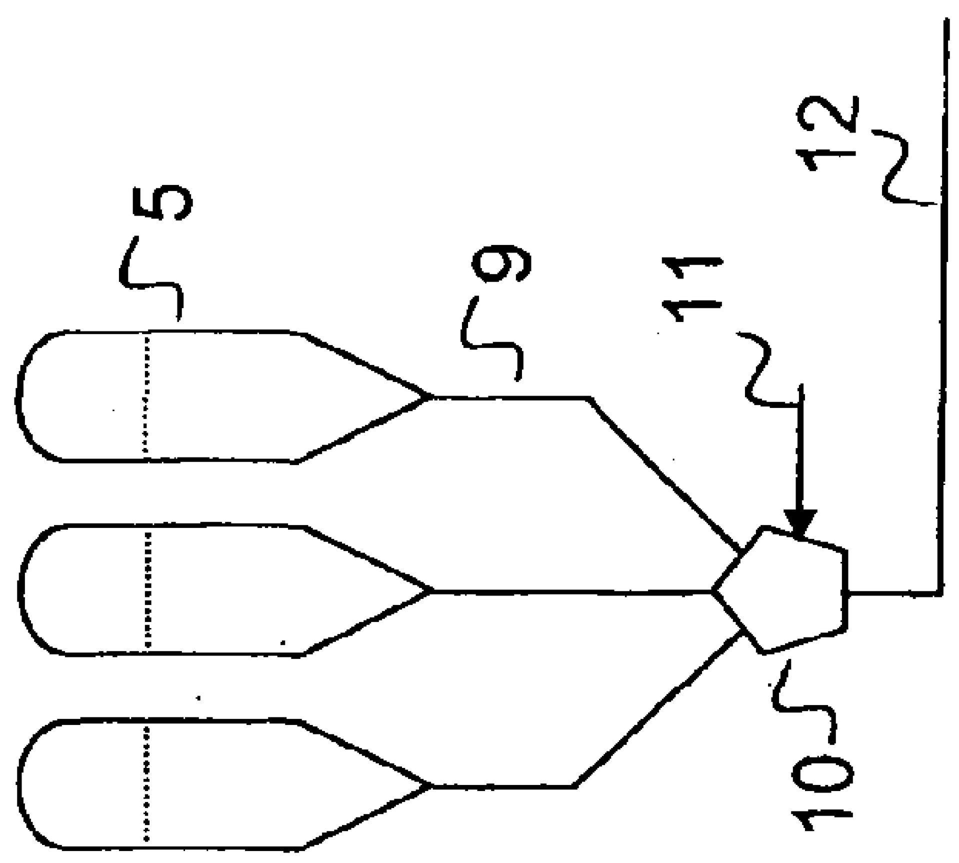


FIG. 4

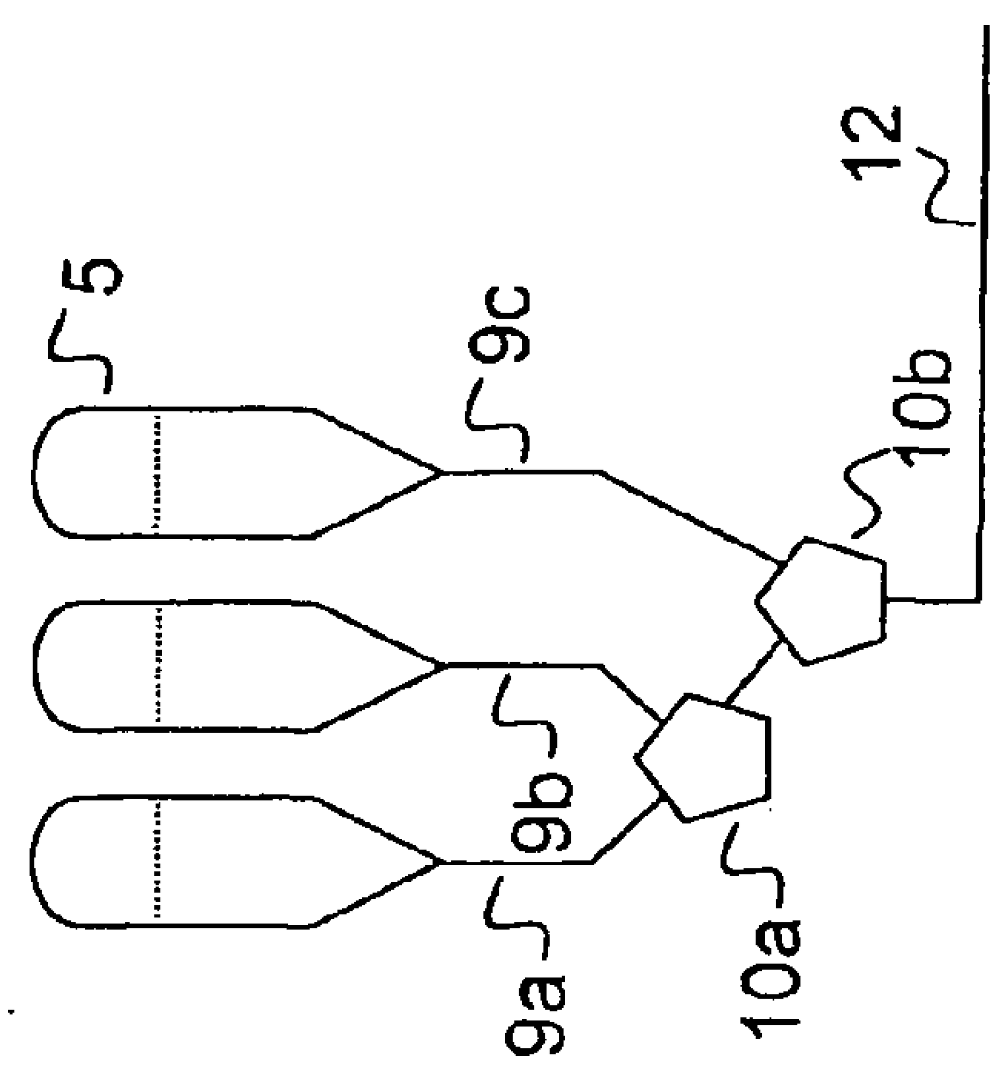


FIG. 5

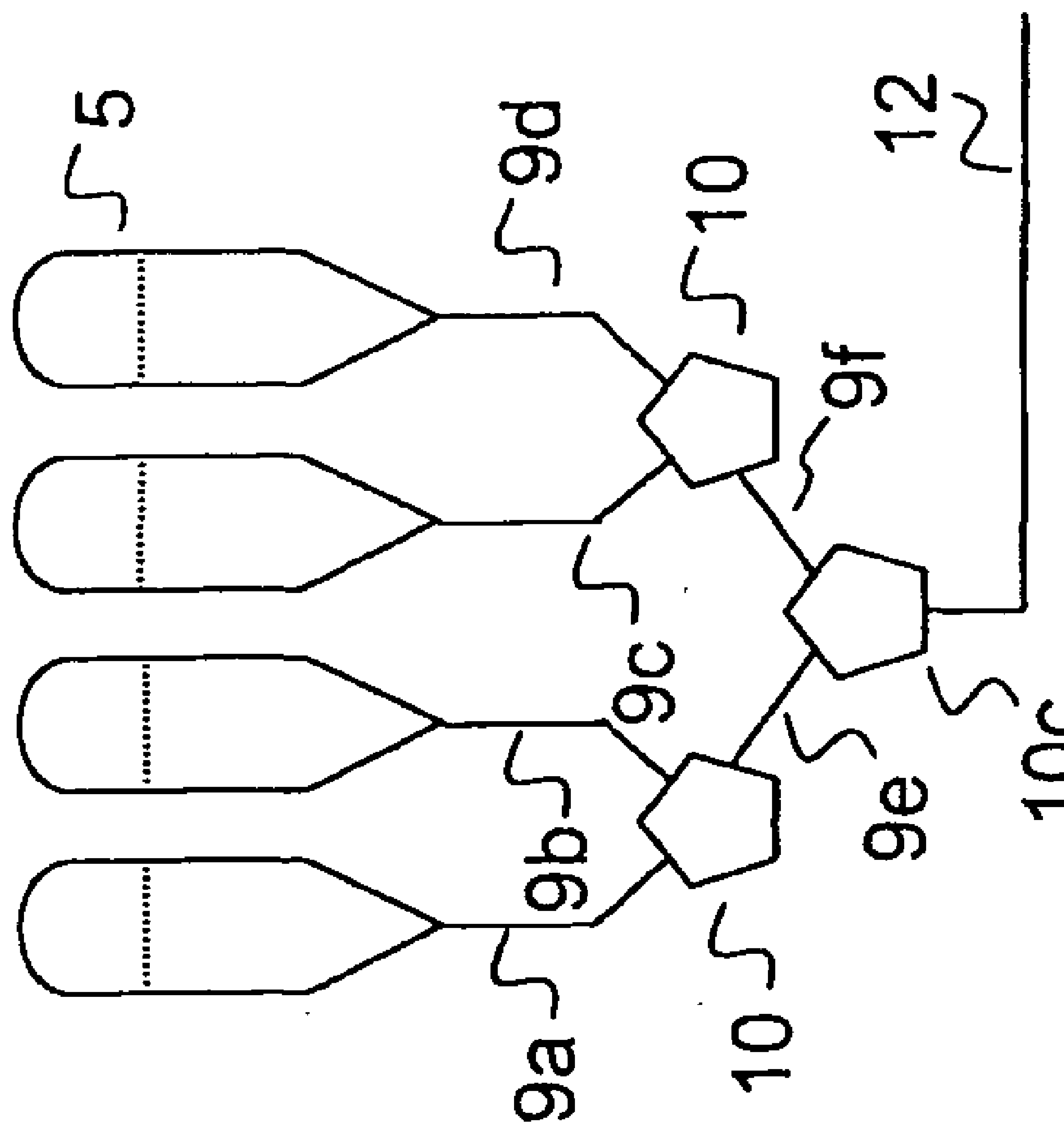


FIG. 6

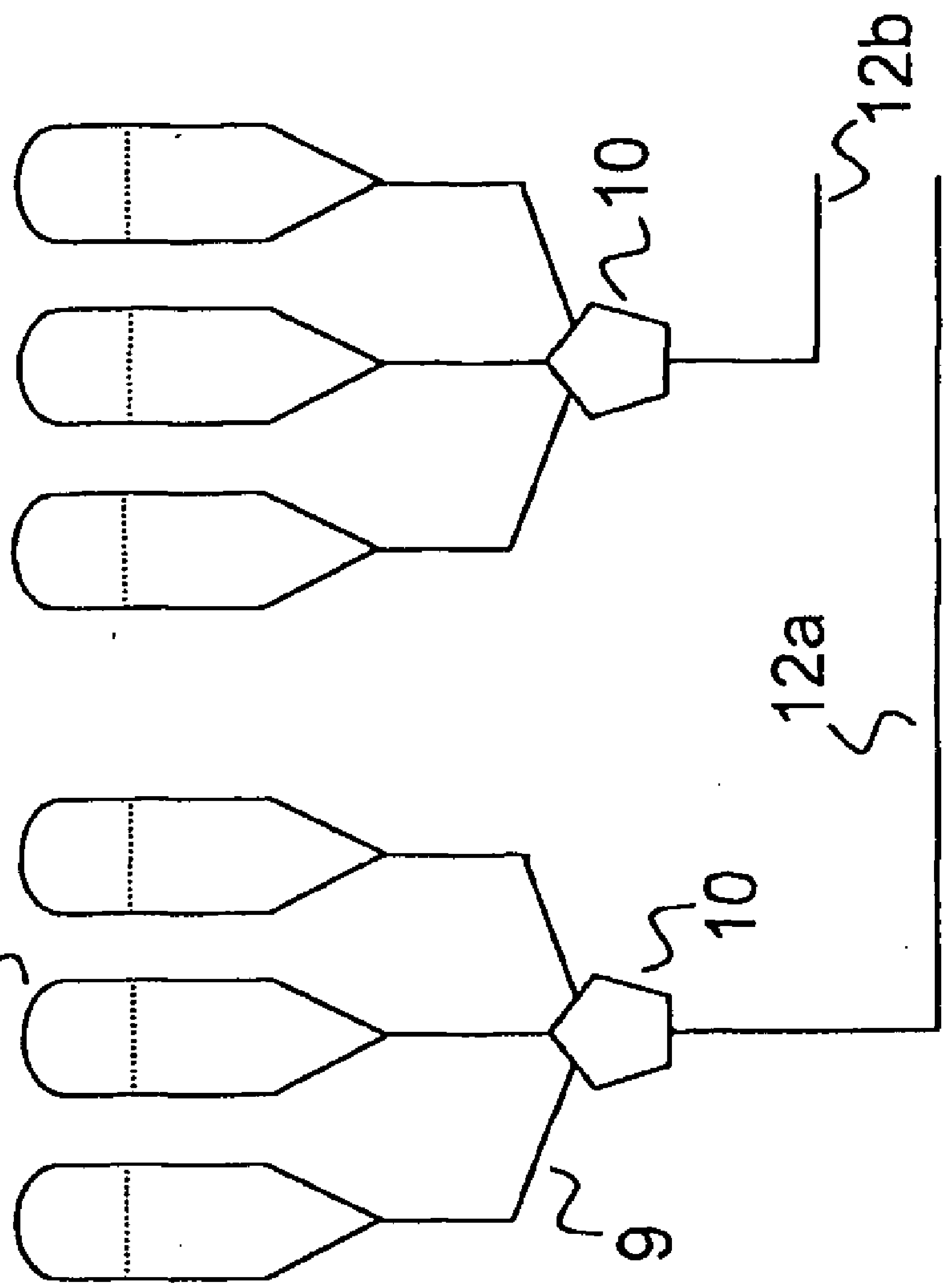


FIG. 7

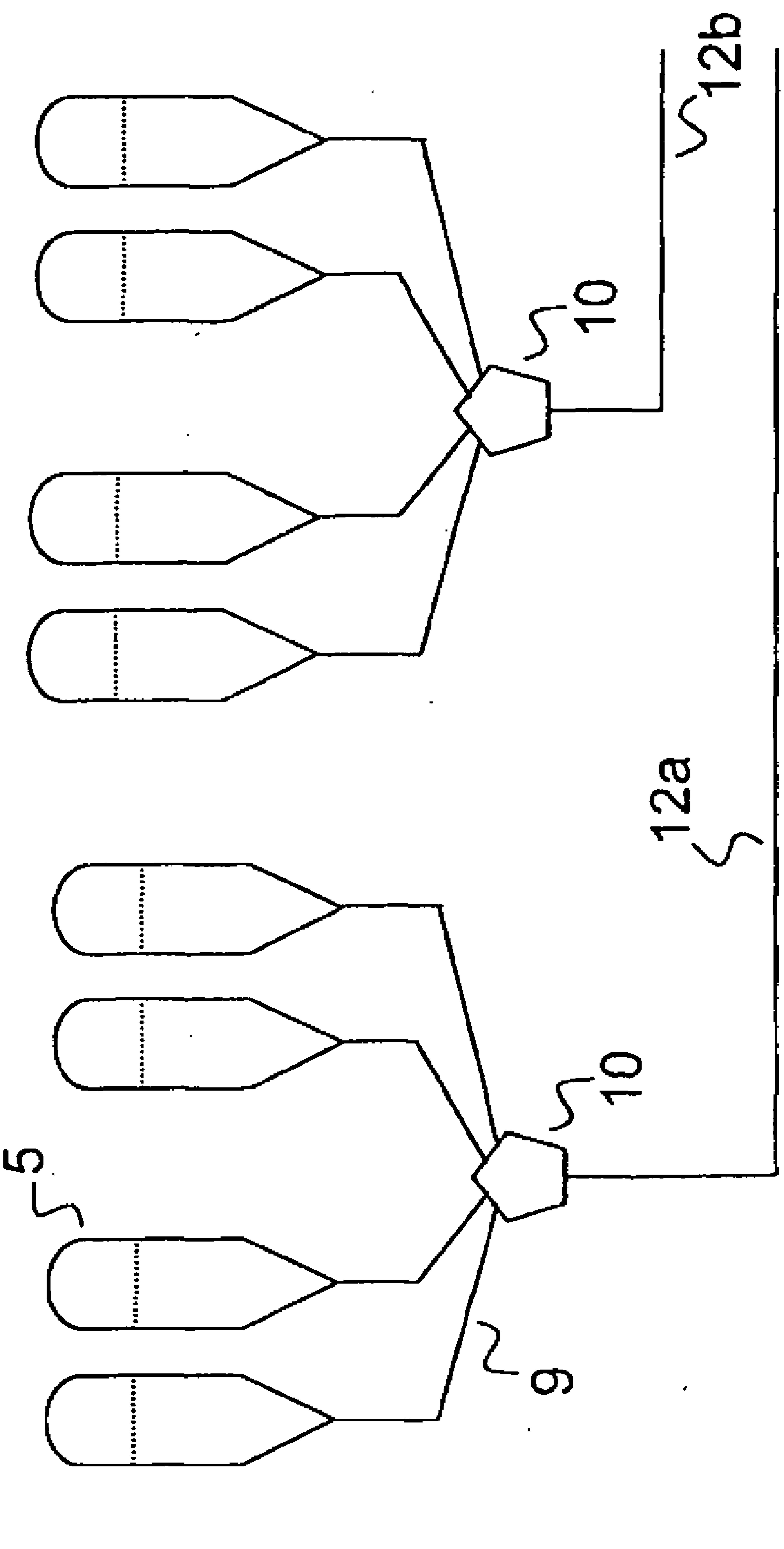
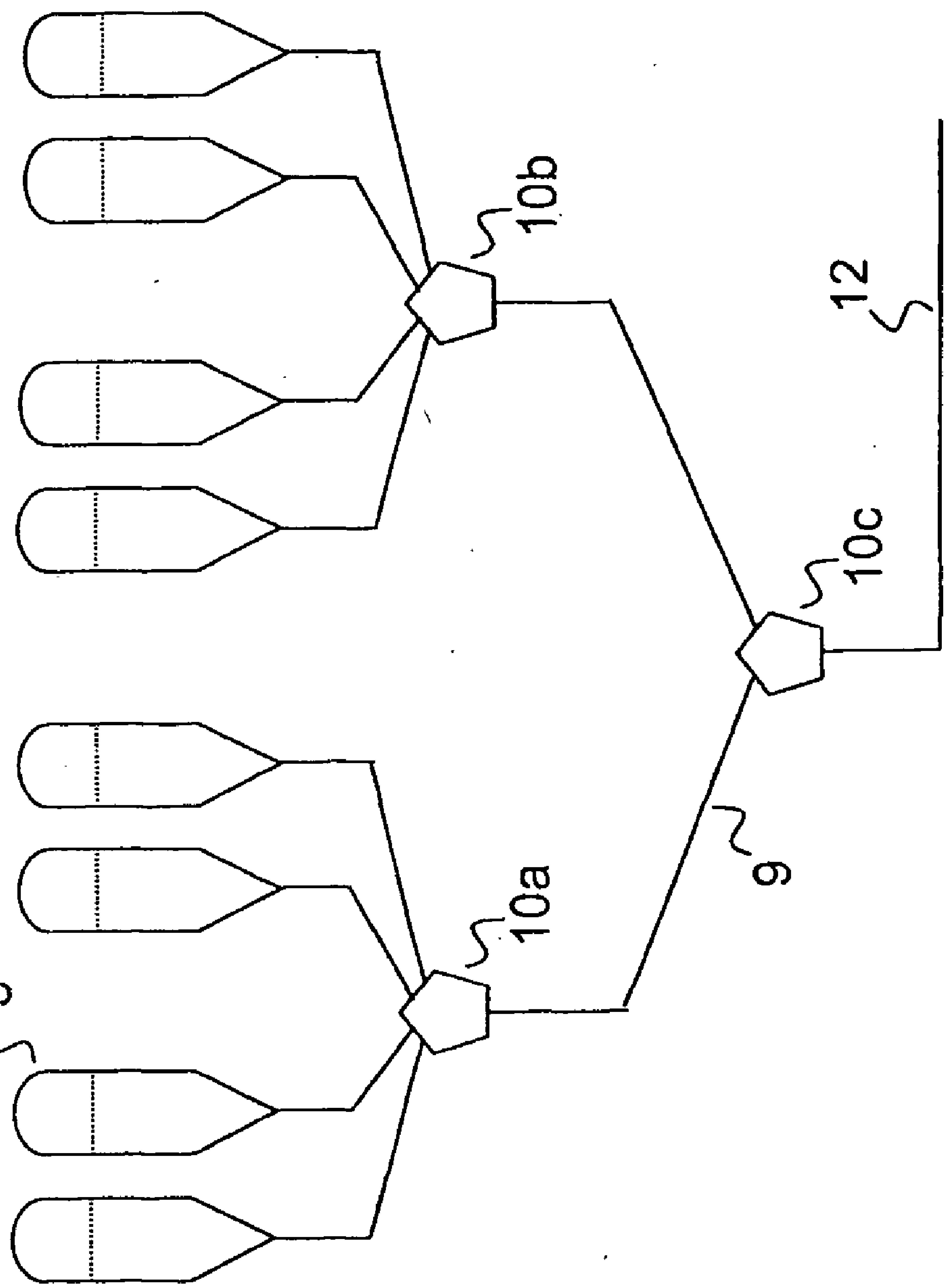


FIG. 8



CONTINUOUS FUEL SUPPLY FOR A COAL GASIFICATION REACTOR

[0001] The invention relates to a process for the controlled continuous supply of fine-grain to pulverised fuel materials into a pressurised feed tank in a pressure gasification process in which finely ground or pulverised (<0.5 mm) fuel materials such as coal, petrol coke, biological waste or fuels are converted in suspension with low particle load (<50 kg/m^3; no fluidised bed) by reaction with gasifying agents containing oxygen, under elevated pressure at temperatures above the slag melting point.

[0002] In the course of pressure gasification processes a carbon-containing fuel material is converted by means of an oxygen-containing gas, wherein the oxygen-containing gas is supplied in a substoichiometric ratio so that a carbon monoxide containing product gas is obtained. If the reaction gas contains water vapour, the product gas is of synthesis gas character and contains major portions of hydrogen. To achieve a conversion that is as complete as possible under substoichiometric conditions, the fuel material must be fed to the reactor in finely ground condition. The reaction normally takes place under elevated pressure.

[0003] Since gasification reactions are operated economically only if operated continuously for an extended period of time, the amount of finely ground fuel material supplied per time unit should be as constant as possible to ensure trouble-free operation. The transfer of the fuel material to the required pressure level and the supply of the fuel material under pressure are problems yet to be solved in coal gasification reactions. For this reason, coal gasification plants always include plant equipment which serve to ensure trouble-free supply of fuel to the reactor. Such equipment usually consists in special dosing tanks and lock hopper assemblies operated by gravity flow.

[0004] Using dosing tanks is not always a means to completely eliminate the pressure variations occurring when loading the reactor. This may result in pressure variations during the carbon gasification reaction which will temporarily change the composition of the synthesis gas. Especially the discontinuous filling of the dosing tank from the pressure locks generates pressure variations which are of unfavourable effect on the pressure difference which serves as driving force for the conveyance between dosing tank and burner.

[0005] Introducing the fuel material by gravity flow as done when supplying the coal gasification reactors with fuel material is also a potential source of error. As the finely ground fuel material may clog or plug depending on its quality and degree of drying, conveyance will sometimes proceed batchwise only or with unexpected periodic interruptions. In addition, lock hopper systems based on gravity flow frequently require sophisticated design solutions since tanks between which conveyance is to be achieved must be arranged on top of each other.

[0006] Fuel feed systems according to the state of the art are expenditure-intensive and not always reliable in operation. In the case of large-capacity plants, the spatial separation of grinding and gasification units involves considerable additional expenditure as regards the transport of finely ground fuel materials from the grinding unit to the fuel feed system. This makes it necessary to provide additional equipment (conveying vessels or pneumatic pumps, filters, buffer tanks above the feed systems). In addition, considerable expenditure is incurred by piping, instrumentation and construction work, the latter especially because of the exposed position of the buffer tanks at the highest elevation of the gasification unit. Furthermore, lock hopper systems which operate according to the gravity flow principle have proven to be inadequately reliable in operation. Additional equipment will at any rate increase the risk of failure.

[0007] Apart from this commonly known fact, the principle of lock hopper gravity feed involves specific functional risks. Despite many very diverse approaches, it has proven to be extremely difficult to carry out the process of vessel pressurising carefully enough to keep the internal stress of the bulk material sufficiently low. In many cases, the bulk material is locally compacted to such a degree that the gravity flow to the feed tank is subsequently not induced at all or only to an inadequate extent. The solid material inventory of the feed tank hence diminishes, which frequently causes a limited output or may even cause the failure of the gasification unit.

[0008] The problem aggravates if oversizing owing to a high plant capacity comes up against the construction limits and if the gasification unit is to be designed for a higher pressure (typically 4 MPa) than that of the units which have been in operation for many years (typically 2.5 MPa).

[0009] Lock hopper gravity feed from the lock hopper into the feed tank will produce very high transfer mass flow rates, provided the desired gravity flow is achieved, and thus comparatively short transfer periods. The transfer of solids during lock-hopper feeding will raise the filling level in the feed tank. The filling level will then continuously decrease again by the amounts of fuel supplied to the burners and increase again by the next lock hopper transfer operation. In this way, the feed tank is subjected to temporarily changing conditions which may even affect the steady delivery from the feed tank. It is considerably more advantageous to keep the pressure conditions, the filling level and the pulsed feed into the bulk fill by dropping-in material, for instance, as constant as possible with regard to time.

[0010] The present invention solves these problems by a dosing tank which contains the finely ground fuel material under pressure and, according to the invention, has a nearly constant fuel filling level. Such almost constant filling level in the feed tank is ensured according to the invention by supplying solid material continuously from at least two lock hoppers via at least one jointly used continuous supply line which is suited for dense-flow conveying. As the continuous supply line is not operated by gravity, it is further possible to install the feed tank and the supplying lock hoppers at different geodetic elevations and, in addition, at a greater distance from one another, as may be, for example, in a different building.

[0011] Known are dosing devices for fuel materials that feed the fuel material to the reactor via a dosing tank with upstream lock hopper system. U.S. Pat. No. 5,143,521 A describes a system for the feeding of fuel material into a feed tank which stores pressurised fuel material and is supplied continuously with finely ground fuel material by a system of lock hoppers. The lock hoppers are connected by a line and pressurised alternately. The pressure of the expansion gas of the one lock hopper may be used via a system of expansion turbines, Venturi tubes and compressors to pressurise the other lock hopper. In this way, it is possible to adjust the pressure of finely ground coal at atmospheric conditions to a level suited for coal gasification. Nitrogen is used as pressurising gas.

[0012] DE 102005047583 A1 describes a process and a facility for dosing and feeding pulverised fuel materials under pressure to a coal gasification reactor. To ensure a constant the feed of fuel material to the coal gasification reactor over a given period of time, the fuel is stored intermediately in a dosing tank, in the lower part of which a dense fluid bed is generated above the tank bottom by feeding in gas, through which the pulverised fuel material is supplied continuously via burners to a pressurised gasification reactor. Actual feeding to the burners is here implemented by the so-called high-speed conveyance, wherein the supply of auxiliary gas to the feed line downstream of the burner is used to generate a pressure difference by which the fuel material is then transported to the burners. The dosing tank is supplied with fuel material from two locks which transport the fuel material by means of gravity and a star feeder into the dosing tank. This is, however, susceptible to failures and requires structures of high altitudes. A use of grinding devices is not mentioned.

[0013] The present invention describes an integrated process for comminuting a carbonaceous fuel material, pressurising the fuel by means of a suitable gas, distributing and transporting the fuel to a feed tank and feeding it to the reactor. Transport, distribution of the fuel and feeding to the reactor are implemented by dense-flow conveying in a so-called continuous supply line. In this way, the complete fuel supply chain of the reactor can be carried out without gravity flow. The gasification reactor outlet temperatures are preferably above the slag melting point in a range between 1200 and 2000° C. and the pressure is preferably between 0.3 and 8 MPa.

[0014] Dense-flow conveying in this context signifies a pneumatic conveying which does not transport the fuel material particles as individual particles but in a dense flow in the form of dense packings or plugs which fill in the entire cross-sectional area of the pipe. The dense-flow conveying flow rates are generally between 4 and 5 m/s, wherein a high transport volume is achieved despite the high solid load of the gas flow. Dense-flow conveying is characterised by gentle transport of the material and is especially little susceptible to failures by adhering or moist conveying material. The present pneumatic dense-flow conveying process is carried out preferably with solid densities of at least 100 kg/m^3 and at a differential pressure of at least 0.5 bar.

[0015] Special claim is laid to a process for supplying finely ground fuel materials to a cooled reactor (**15**) for gasification by means of oxygen-bearing gasifying agents under pressure, wherein

[0016] the gasifier outlet temperatures are above the slag melting point in the range between 1200 and 2000° C. and the pressure is between 0.3 and 8 MPa,

[0017] and the finely ground fuel material is pressurised via a lock system to a pressure level above the gasifier pressure, transferred to at least one feed tank and from there dosed in dense flow via at least one fuel line to one or more gasification burners of one or several gasifiers, and

[0018] the transfer from at least two lock hoppers to at least one feed tank is carried out by using a pneumatic continuous supply line jointly, simultaneously or successively at solid material densities of at least 100 kg/m^3 and a differential pressure of at least 0.5 bar.

[0019] In an embodiment of the process, the transfer from the lock hoppers to the feed tank or tanks is controlled by at least one connection device and at least one unifying element and the transfer from the unifying element to the feed tank is implemented by means of individual connection devices or by means of additional unifying elements with transferring connection devices.

[0020] The transferring connection devices are designed in an exemplary fashion as continuous supply lines suited for dense-flow conveying. By installing unifying elements downstream of the lock hoppers, the fuel material is conveyed from the lock hoppers to the feed tanks via a number of continuous supply lines which is, smaller than the number of lock hoppers. It is also possible to direct the solid material from the outlets of the lock hoppers not directly into the unifying elements but via connection elements so that it is passed via lines into the unifying elements first and then into the continuous supply line. Here, the number of unifying elements is smaller than the number of lock hoppers and it may be identical with the number of continuous supply lines. The unifying elements are provided as closely to the outlet nozzles as possible and arranged as symmetrically to them as possible to ensure a smooth solid flow.

[0021] In a preferred embodiment of the process, the fuel material is processed into a finely ground form by mean of a mill or a suitable grinding device. For this purpose, the fuel material can be made available in any form. It is possible to deliver fuel material that has already been finely ground. In such case, claim is only laid to the pressurisation of the fuel material and the transport into the reactor. Usually, however, the grinding process is an integral part of the process according to the invention, especially if the grinding device is arranged in local proximity to the reactor. In a preferred embodiment of the invention, the coal milling and drying (CMD) unit is an integral part of the coal gasification plant.

[0022] To carry out the transfer function, the lock hoppers are pressurised with a gas. Recycled process gas may be used, for example. It is also possible to use an inert gas. Pressurising is performed advantageously with inert gases (e.g. nitrogen, carbon dioxide) or by means of process gases or recycle gases. To configure the transfer process in an advantageous way, pressurising of the lock hoppers by supplied gas is preceded by a mutual partial pressurisation of the lock hoppers. To keep the process conditions as constant as possible, the lock hoppers are pressurised and depressurised alternately.

[0023] In an additional embodiment of the process, the grinding circuit is blanketed with inert gas and for blanketing the grinding circuit with inert gas, the expansion gases from the lock hoppers are used. The latter are depressurised at regular intervals for carrying out the transfer process, wherein the discharged gas can be recycled to the grinding devices. This will make the process reliable in operation and keep the plant operating cost at a reasonable level. The gas of the grinding circuit is additionally dedusted. For this purpose a dust separator is used which may also be used to dedust the expansion gases from the lock hoppers. The pressurisation or expansion gas may be dedusted by means of a dust separator in basically any place of the process.

[0024] The finely ground fuel material is then preferably fed to a feed tank. In this way it is possible to store the fuel material in accordance with the availability and to temporarily buffer the raw material flow. It is thus possible to adjust bottlenecks which are compensated by refilling at a later date.

[0025] To run the process according to the invention, all solid, carbonaceous fuel materials that can be divided into small particles by milling or grinding may be used. These may especially be all kinds of carbon, wherein hard coal, brown coal and basically coals of all carbonization kinds are suitable. Suitable as fuel materials are also biological fuel materials such as wood, biomasses and other fuel materials such as plastic waste and petrol coke or mixtures of these. To run the process according to the invention, it should merely be possible to crush the fuel materials into a finely ground form which is suitable for dense-flow conveying.

[0026] Subsequent to the comminuting process and the storage in the feed tank, the solid material is passed to the lock hopper system in which the solid material is pressurised with supplied gas to carry out the gasification reaction. In a preferred embodiment of the invention the feed tank is atmospheric. Conveyance of the solid material into the lock hoppers is advantageously performed by gravity.

[0027] To run the process according to the invention, the lock hopper system consists of at least two lock hoppers. In this way, it is possible to connect the discharging operations in series and to ensure a nearly continuous material flow. In an advantageous embodiment the lock hoppers are pressurised individually.

[0028] In an embodiment of the process according to the invention two lock hoppers are used to ensure a continuous material flow. The investment cost for the plant is thus low. In a further embodiment of the invention, it is also possible to use three or more lock hoppers. This is especially recommended in the case of high plant throughputs.

[0029] It is possible to use a plurality of lock hoppers and a plurality of unifying elements. In principle, the facility according to the invention may consist of lock hoppers and unifying elements of any number. The number of lock hoppers is determined by the throughput of the plant. The number of unifying elements is determined by the number of lock hoppers and the number of continuous supply lines. Different arrangements of theoretically any number are possible. The interconnection of the lock hoppers and the unifying elements may basically also be carried out as desired. For this, any number of connection devices may be used. Preferred connection devices are pipelines. Possible as well are hoses or flanges, for example. The mode of spatial interconnection may also be selected as desired.

[0030] Subsequent to pressurising the tanks, the contained fuel material is discharged in dosed quantities and the pressure in the tanks is then expanded. In an advantageous embodiment of the invention the expansion gas is used to partially pressurise the next lock hopper in the cycle. In order to improve the efficiency, this may be implemented by introducing the expansion gas directly into the tank to be pressurised.

[0031] To reduce the dust load of the expansion gas, the expansion gas is advantageously introduced into the dust separator which is also used to dedust the gas from the storage tank or from the grinding process. In principle, it is also possible to clean the gas from solid material dusts by means of several independent dust separators. To keep the investment cost low, it is advantageous to use only one dust separator.

[0032] The material flow from the lock hoppers is routed to the feed tank via at least one unifying element and the continuous supply line. To utilise the advantage of the invention, the lock hoppers are emptied one after the other in such a way that a nearly continuous fuel material flow to the feed tank is achieved. In this way, the subsequent feed tank for the gasification reactor can be supplied with a continuous material flow of a pressure that is suitable for the gasification reaction, wherein the filling level of the feed tank remains nearly constant. The filling level of fuel material in the feed tank can be adjusted according to the advantageous embodiment of the process such that it does not vary by more than ±30% over a given period of time. If the process according to the invention is run by specialists, it is easily possible to keep the filling level variations of the feed tank in a range of not more than ±10% over an extended period of time.

[0033] The filling level of the feed tank may also be kept constant by controlling the continuous supply of finely ground fuel material from the lock hoppers by adjusting the pressure difference between lock hopper and feed tank. The inlet or outlet of gas into the free space of the lock hoppers influences the pressure difference between lock hopper and feed tank and is used as control parameter for the solid material transport.

[0034] To run the process, the finely ground fuel materials are preferably of a particle size which is smaller than 0.5 mm. This is achieved in a grinding and comminuting process. The discharge of solid material from the lock hopper may be facilitated by the addition of gas into the lock hopper in the immediate vicinity of the discharge nozzle. The density in the continuous supply line is adjusted advantageously by adding gas into the continuous supply line or into the unifying element or into both. The addition of gas at this point may also be used to purge the continuous supply line or the unifying element. The connection elements between lock hopper and unifying element may also be supplied with gas.

[0035] The conveying gas volume supplied at the discharge of the lock hopper is recovered in the feed tank in an advantageous embodiment of the invention and returned into the lock hopper by means of an injector. The returned conveying gas and the propellant gas of the injector are jointly used as replacement gas for the emptying lock hopper and thus also for maintaining the pressure of the lock hopper during the conveying process.

[0036] To suit certain requirements, it may be of advantage that two or more lock hoppers discharge solid material simultaneously or temporarily simultaneously into a conveying line. Gas balancing between the feed hoppers may advantageously be achieved by a gas connection line between the lock hoppers.

[0037] The process according to the invention may also include processes which are subsequent processes of the coal gasification process according to the invention. Also included in the process according to the invention are process steps which are required for a routine operation of the reactor. These may, for instance, be cleaning steps. These may as well be supporting process steps such as the supply of gas for loosening plugs. Possible as well are process steps for measuring parameters such as filling levels, flow rates, pressures or temperature. The invention especially also describes a facility to run this process. The facility according to the invention may include all plant units that are required for operating a coal gasification plant according to the process of the present invention.

[0038] Claim is also laid to a facility used to supply solid fuel materials to a reactor for the gasification of solid fuel materials, comprising

[0039] a grinding device,

[0040] a dust separator,

[0041] a storage tank,

[0042] at least two lock hoppers,

[0043] at least one connection device for dense-flow conveying,

[0044] a feed tank,

[0045] a gasification reactor, wherein

[0046] the grinding device is connected to a storage vessel by means of connection devices, wherein a dust separator is installed between the grinding device and the storage tank, and

[0047] the storage vessel is connected to the lock hoppers via connection devices which are suited for gravity flow or dense-flow conveying, and

[0048] the lock hoppers are connected to a feed tank by means of jointly used connection devices which are suited as continuous supply line for dense-flow conveying, and this feed tank is connected to the gasification reactor via further fuel material lines.

[0049] The dense-flow conveying from the lock hopper system to the feed tank allows to install the feed tank at the same or different geodetic height as the lock hopper system. In the case of the gravity lock hopper systems known to date it is indispensable to install the lock hoppers above the feed tank. By this measure it is possible to reduce the constructional height of the overall plant to a considerable degree. It is also possible to locate the lock hopper system and the feed tank and the reactor in separate buildings. The invention also involves the advantage that lower constructional heights may be selected for the respective units. The various plant components may be arranged as desired so that the spatial layout of the plant can be done in a flexible way.

[0050] The transfer of the fuel material from the lock hoppers to the feed tank or tanks is implemented via at least one connection device and at least one unifying element, and the transfer from the unifying element to the feed tank via individual continuous supply lines for dense-flow conveying. The transfer from the lock hopper to the feed tank may be implemented via further unifying elements with transferring connection devices.

[0051] Depending on the embodiment of the process, 2 or more lock hoppers are used to pressurise the fuel material. This is especially recommended for plants with high fuel material throughputs or if the lock hopper system is to be pressurised to higher pressures. The inlet sides of the lock hoppers are connected to a feed tank which conveys the fuel material into the lock hoppers by the aid of both dense-flow conveying and gravity conveying. For this purpose, a star feeder or a material manifold may be installed in a suitable place between the storage tank and the lock hoppers. It is also possible to install intermediate vessels, bulb-shaped vessels or gas feeding devices between the storage tank and the lock hoppers.

[0052] The fuel material supply system of the coal gasification plant may also include a grinding device or a mill which may be of any type desired. The mill in turn may also include additional comminuting devices such as shredders for wood or crushers for coal. The mill or crusher may also be supplied with gas or blanketed with inert gas. In a preferred embodiment of the facility according to the invention the lock hoppers are spatially integrated into the grinding unit and are filled by gravity flow from at least one storage vessel for finely ground fuel.

[0053] To run the process according to the invention, the lock hopper system consists of two or more lock hoppers which may be pressurised from outside. The lock hopper system is connected to an upstream storage tank which supplies the lock hopper system by gravity conveyance with finely ground fuel material. The conveying or transport of the solid material is influenced advantageously by introducing gas so that gas introduction devices which influence the conveying or transport of solid material may be installed in any place of the lock hopper system, the dense-flow conveying lines or the feed tank.

[0054] The lock hoppers may be of any design desired. They may be provided in the form of cylinders or as spheres. Preferably they are provided with a downward discharge cone, the angle of which is determined by the properties of the bulk material to counteract arching and to ensure a uniform material flow. For this reason, they are tapered towards the bottom in the ideal case. The fuel material hence exits downwards in gravity direction. The storage tanks as well as the downstream feed tanks are also of this preferred design. The lock hoppers are fitted with inlet valves via which the lock hoppers may be pressurised. The lock hoppers are equipped with nozzles, shutoff and control valves according to the state of the art which serve to control the flow of solid material, to depressurise and pressurise or carry out pressure compensation.

[0055] In an advantageous embodiment of the invention the expanded gases may be recycled to the grinding device and/or the fuel storage tank. To separate the gas from dust before it is discharged from the system or recycled for being used in the plant, the lines are preferably routed via dust separators. The latter separate the dust and pass it to a proper disposal or recycle it to the storage tank, for example. It is theoretically possible to install devices by which the gas flow can be separated from solid material or dust in any place of the lock hopper system, the dense-flow conveying line, the fuel lines or the expansion lines. It is therefore of advantage to provide for a gas-sided connection of the lock hoppers with the feed tank.

[0056] The lines may be provided with gas introduction devices in any place desired. These may be so-called “boosters”, for example. Especially the discharge devices for solid material, however, which are prone to caking, plugging or arching, may include additional gas introduction devices by which the solid material can be loosened. The lock hoppers as well may be provided with gas introduction devices in any place desired.

[0057] In such case, the material discharge of the lock hoppers is fitted with a connection element via which the material flow from the lock hoppers is passed to the unifying element. These elements shall be designed for high pressures as the fuel is at a pressure level above that of the gasification reactor during the whole conveying process from the lock hopper to the feed tank. To ensure controlled material flow, the lock hoppers are mounted advantageously such that they are arranged symmetrically to the unifying element so that the connection elements between the lock hoppers and the unifying element are preferably of the same length.

[0058] The unifying elements may be of any type desired. Preferably these are devices which assume the function of mixing elements. These may be, for example, pipe manifolds or Y-manifolds but also so-called “pipe headers”. Examples of suitable unifying elements are given in EP 340 419 B1; here the elements described are reversed in their function and used as unifying elements. The connection devices as well may be of any type desired. Preferably used are pipes. Possible as well are hoses or flanges.

[0059] The connection devices or the unifying element may also be supplied advantageously with gas for material distribution. If a plurality of unifying elements is provided, they may be supplied with gas individually. For this purpose, the unifying element is preferably provided with a gas introduction device. The feed tank as well is provided with gas injection devices or gas introduction devices in an embodiment of the invention.

[0060] The pipeline for supplying solid material to the feed tank normally ends above the solid material filling level and, depending on the properties of the bulk material, it may also enter the feed tank below the solid material level in an embodiment of the invention. As the solid material level is subject to only slight variations if the process is run advantageously, this may be at a lower or central height position of the feed tank. In this way it is possible to achieve a low bulk density in the feed tank if the solid material shows good gas-retaining properties, which reduces the additional amount of gas required for conveyance to the burners.

[0061] The facility according to the invention may be provided with plant equipment required for the operation of a solid fuel supply system in any place desired. This may be pumps but may also be heating or cooling devices. Also included are valves or shutoff devices. These may theoretically be installed in any place. The integration of injectors is also possible. Here, so-called "boosters" (gas injectors) may be used, for example, but also possible are gas jet pumps. Finally the facility according to the invention also includes thermometers or flow sensors for gases and solid materials, pressure sensors, level meters or other measuring devices.

[0062] The design type of dense-flow conveying from the lock hoppers and from the feed tank allows to construct the whole plant construction at low height. As the conveyance is independent of gravity, the plant equipment may be installed in any place desired. By this system, the space requirement can be reduced to a considerable degree. The system of several lock hoppers and the upstream storage tank as well as the constant-level feed tank allows to achieve trouble-free and very constant conveying of fuel to the feed tank over a given period of time, even for an extended period of time. This contributes to the reliability of the plant and ensures a constantly high product quality.

[0063] The facility according to the invention is illustrated in more detail by means of two drawings, the embodiment not being limited to these drawings.

[0064] FIG. **1** shows the process flow of a coal gasification plant-which is equipped with a facility for the supply of fuel material according to the invention. Fuel material **1** is supplied and introduced into a mill or suitable grinding device **2**. The finely ground fuel material is then passed via a dust separator **3** and fuel line **3**_a_ into a storage tank **4**, where the fuel is stored intermediately. Subsequently the fuel is supplied to lock hoppers **5**. The represented example shows two of them **5**_a_, **5**_b_. Lock hoppers **5** serve to pressurise the fuel batch by batch by supplying gas. For this purpose, lock hoppers **5** are provided with gas introduction devices **6**_a_, **6**_b_ above the filling and gas introduction devices **6**'_a_, **6**'_b_ into the filling. Between lock hoppers **5** there is a compensation line **7** which may be opened in the case of need. An expansion line **8** for depressurisation leaves lock hoppers **5**, via which the expanded gas may be used completely or only partially for blanketing grinding device **2**. The expanded gas, however, may also be used for blanketing storage tank **4** with inert gas. To adjust recycle gas **8**_c_ of grinding device **2** recycled by means of blower **8**_b_ to adequate temperatures, the line may be provided with a heat exchanger **8**_d_ or another suitable device for supplying heat. Downstream of lock hoppers **5**_a_, **5**_b_ the finely ground fuel material is discharged via suitable connection devices **9**_a_, **9**_b_ and passed to unifying element **10**. Unifying element **10** may be supplied with gas via gas line **11**. The finely ground material is then routed via continuous supply line **12** to a feed tank **13**.

[0065] In the exemplary variant shown in FIG. **1**, two lock hoppers **5**_a_, **5**_b_ make use of a continuous supply line **12** via unifying element **10**. This is achieved advantageously in such a way that lock hoppers **5**_a_, **5**_b_ feed the solid material alternately into dense-flow conveying continuous supply line **12** via unifying element **10**. To minimise the interim time for switching from one lock hopper to the other **5**_a_, **5**_b_ and to ensure an almost uninterrupted conveying of solid material, it is advantageous to couple both lock hoppers **5**_a_, **5**_b_ in timely overlapping manner to unifying element **10**. Helpful in this respect is pressure compensation via compensation line **7** between that lock hopper that is almost empty already and the other lock hopper that is still full **5**_a_, **5**_b_. It goes without saying that it is also possible and advantageous to implement the described procedure with more than two lock hoppers **5**. If there are more than two lock hoppers **5**, it is also possible to use the expansion gas of that lock hopper **5** that has just been emptied and shall now be depressurised for being loaded with solid material from atmospheric storage tank **4**, for partial pressurisation of a lock hopper **5** which is still under atmospheric condition. Connection device **9**_a_, **9**_b_ is provided with two valves (not shown), one close to the hopper discharge, one close to unifying element **10**. After a lock hopper **5** has been emptied to a minimum level and shut off from unifying element **10** by the valve in proximity to unifying element **10**, it is recommended to purge or blow free by gas injection **9**'_a_, **9**'_b_ at connection device **9**_a_, **9**_b_, before the second valve is closed.

[0066] In the ideal case, a constant filling level **13**_a_ prevails in feed tank **13**. The pressure of feed tank **13** can be kept constant by excess gas **21** or feed gas **22** by a gas compensation process. From feed tank **13**, the solid material is routed via fuel lines **14**_a_, **14**_b_ to coal gasification reactor **15** with one or more burners **16**_a_, **16**_b_. In this case, the entire facility for the supply of solid fuel is located in a separate plant unit, the building of grinding unit **17**_a_. Coal gasification reactor **15** and feed tank **13** are located in another building, the building of gas production unit **17**_b_.

[0067] The advantages of the invention already mentioned which especially involve a considerable reduction of the number of equipment items, the construction height and hence the investment cost as well as an increase in plant reliability, are obtained for a moderate increase in the demand for pressurising gas. This is due to the fact that that part of the gas used for dense-flow conveying of the solid material in continuous supply line **12** which has been used to reduce the solid material density to a value below the one prevailing in feed tank **13**, cannot be used as feed gas for coal gasification reactor **15** since it is excess gas, see FIG. **2**. If no additional devices are available, this part is to be removed unused as excess gas **21**. At the same time, many times the amount of gas is required in lock hopper **5**, which is the active transferring hopper, as a replacement for the discharged amount of solid material. It therefore suggests itself to reduce the demand for gas by recycling excess gas **21** from feed tank **13** as recycle gas **20** to the lock hopper and using it for a partial substitution of the gas consumed for replacement. This may be implemented by a blower or another device for pressure increase. Owing to the low pressure difference to be overcome between feed tank **13** and lock hopper **5** at simultaneously high system pressure, an injector **18** suggests itself, especially a gas jet pump. In addition, the pump is also capable of conveying dust-bearing gas, dust separation is not required. As propellant gas serves the pressurising gas used for the purpose of replacement, which is available at significantly higher pressure. The pressure side of injector **18** is switched over to the currently active lock hopper **5**. Under typical operating conditions the portion of recycle gas amounts to about 25% of the amount of replacement gas. At the same time the supply pressure of propellant gas **23** is about 10 bar higher than the pressure of the lock hopper, whereas the pressure of recycle gas **20** is only about 1-2 bar above the pressure of the lock hopper. These numerical relationships make it obvious to the specialist that injector system **18** is fully operative under the specified conditions.

[0068] Gas recycling is integrated into the pressure control system of feed tank **13** in the following way: Based on the consideration that, at constant operating conditions, excess gas **21** is to be removed from feed tank **13**, the pressure increase in feed tank **13** is avoided by having injector **18** suck off the released amount of gas and feed it to lock hopper **5**. If the pressure in feed tank **13** continues to rise, the excessive pressure amount is removed as excess gas **21**. This gas as well can be used beneficially if required, e.g. for substituting purge gases which are fed to the gasification reactor in various places. Should a pressure increase of feed tank **13** be required especially during the start-up procedure, which cannot be achieved by excess gas **21**, with closed valves in the lines for recycle gas **20** and excess gas **21**, the shortage is compensated by fresh feed gas **22**.

[0069] The pressurising gas used as propellant gas **23** for injector **18** is compensation-controlled by the pressure controller of lock hopper **5**. Depending on the position of the throttling valve in the propellant gas line, the amount of propellant gas ranges between 70 and 100% of the gas amount required for replacement. The set value of the lock hopper pressure is determined via a cascade (not shown) from the level of feed tank **13** (or from its weight). With regard to the level, a fixed set value (e.g. 50%) is given. If this set value is exceeded, the value of pressure difference between lock hopper **5** and feed tank **13** controlled by the controller cascade is reduced so that the subsequently fed solid mass flow decreases, and if the level drops below the set value, the controllers operate vice versa.

[0070] FIGS. **3** to **8** show, by way of example, arrangements with a varying number of lock hoppers **5** and unifying elements **10**. These are connected by pipelines in different ways.

[0071] FIG. **3** shows a facility according to the invention which includes three lock hoppers **5** and one unifying element **10**, wherein each lock hopper **5** is connected to unifying element **10** via a connection device **9**, and unifying element **10** is connected to feed tank **13** via a continuous supply line **12**. Unifying element **10** can be supplied with gas via gas line **11**.

[0072] FIG. **4** shows a facility according to the invention which includes three lock hoppers **5** and two unifying elements **10**, wherein two lock hoppers **5** are connected to the first unifying element **10***a* via connection devices **9***a*, **9***b*, and the first unifying element **10***a* is connected to the second unifying element **10***b* via another connection device, and the third lock hopper **5** is directly connected to the second unifying element **10***b* via a connection device **9***c*, and the second unifying element **10***b* is connected to feed tank **13** via a continuous supply line **12**.

[0073] FIG. **5** shows a facility according to the invention which includes four lock hoppers **5** and three unifying elements **10**, wherein two lock hoppers **5** each are connected to one unifying element **10** each via connection devices **9***a*-**9***d*, these unifying elements **10** being connected to the third unifying element **10***c* via further connection elements **9***e*, **9***f*, and the third unifying element **10***c* being connected to feed tank **13** via a continuous supply line **12**.

[0074] FIG. **6** shows a facility according to the invention which includes six lock hoppers **5** and two unifying elements **10**, wherein three lock hoppers **5** each are connected to one unifying element **10** each via connection devices **9**, these unifying elements **10** being connected to feed tank **13** via separate continuous supply lines **12***a*, **12***b*.

[0075] FIG. **7** shows a facility according to the invention which includes eight lock hoppers **5** and two unifying elements **10**, wherein four lock hoppers **5** each are connected to one unifying element **10** each via connection devices **9***a*, **9***b*, these unifying elements **10** being connected to feed tank **13** via separate continuous supply lines **12**.

[0076] FIG. **8** shows a facility according to the invention which includes eight lock hoppers **5** and three unifying elements **10**, wherein four lock hoppers **5** each are connected to one unifying element **10***a*, **10***b* via connection devices **9**, these unifying elements **10***a*, **10***b* being connected to the third unifying element **10***c* via further connection devices **9**, and the third unifying element **10***b* being connected to feed tank **13** via a continuous supply line **12**.

LIST OF REFERENCES USED

[0077] **1** Fuel material
[0078] **2** Grinding device
[0079] **3** Dust separator
[0080] **3***a* Fuel line
[0081] **4** Storage tank
[0082] **5**,**5***a*,**5***b* Lock hoppers
[0083] **6**,**6***a*,**6***b* Gas introduction devices
[0084] **6**'*a*,**6**'*b* Gas introduction devices
[0085] **7** Compensation line
[0086] **8** Expansion line
[0087] **8***a* Expansion gas line
[0088] **8***b* Blower
[0089] **8***c* Recycle gas
[0090] **8***d* Heat exchanger
[0091] **9***a*-**9***f* Connection devices
[0092] **9**'*a*,**9**'*b* Gas injection
[0093] **10**, **10***a*-**10***c* Unifying elements
[0094] **11** Gas line
[0095] **12**, **12***a*, **12***b* Continuous supply line
[0096] **13** Feed tank
[0097] **13***a* Filling level
[0098] **14***a*,**14***b* Fuel lines
[0099] **15** Coal gasification reactor
[0100] **16***a*,**16***b* Burners
[0101] **17***a* Building of grinding unit
[0102] **17***b* Building of gas production unit
[0103] **18** Injector
[0104] **19** Gas
[0105] **20** Recycle gas
[0106] **21** Excess gas

[0107] 22 Feed gas
[0108] 23 Propellant gas
[0109] Δp Pressure as control parameter
[0110] PC Pressure controllers

1-36. (canceled)

37. A facility for supplying solid fuel materials to a reactor for the gasification of solid fuel materials, comprising
a grinding device;
a dust separator;
a storage tank;
at least two lock hoppers;
a connection device for dense-flow conveying;
a feed tank;
a gasification reactor; and
a device for pressure increase which returns conveying gas from the feed tank to the lock hoppers; wherein
the grinding device is connected to the storage tank by means of connection devices;
the dust separator is installed between the grinding device and the storage tank;
the storage tank is connected to the lock hoppers via the connection devices which are suited for gravity flow or dense-flow conveying, and
the lock hoppers are connected to a feed tank by means of jointly used connection devices which are suited as continuous supply line for dense-flow conveying, and this feed tank is connected to the gasification reactor via further fuel lines.

38. The facility according to claim 37, wherein the transfer of the fuel material from lock hoppers to feed tank or tanks is implemented via at least one connection device and at least one unifying element, and the transfer from the unifying element to the feed tank via individual continuous supply lines for dense-flow conveying or via other unifying elements with transferring connection devices.

39. The facility according to claim 38, wherein the facility includes three lock hoppers and a unifying element, wherein each lock hopper is connected to unifying element via a connection device, and the unifying element is connected to feed tank via a further connection device.

40. The facility according to claim 38, wherein the facility includes three lock hoppers and two unifying elements, wherein two lock hoppers are connected to the first unifying element via connection devices, and the first unifying element is connected to the second unifying element via another connection device, and the third lock hopper is directly connected to the second unifying element via a connection device, and the second unifying element is connected to feed tank via a further connection device.

41. The facility according to claim 38, wherein the facility includes four lock hoppers and three unifying elements, wherein two lock hoppers each are connected to one unifying element each via connection devices, these unifying elements being connected to the third unifying element via further connection elements, and the third unifying element being connected to feed tank via a further connection device.

42. The facility according to claim 38, wherein the facility includes six lock hoppers and two unifying elements, wherein three lock hoppers each are connected to one unifying element each via connection devices, these unifying elements being connected to feed tank via separate connection devices.

43. The facility according to claim 38, wherein the facility includes eight lock hoppers and two unifying elements, wherein four lock hoppers each are connected to one unifying element each via connection devices, these unifying elements being connected to feed tank via separate connection devices.

44. The facility according to claim 38, wherein the facility includes eight lock hoppers and three unifying elements, wherein four lock hoppers each are connected to one unifying element each via connection devices, these unifying elements being connected to the third unifying element via further connection devices, and the third unifying element being connected to feed tank via a further connection device.

45. The facility according to claim 37, wherein the lock hoppers are spatially integrated into grinding unit and are loaded from at least one storage tank for finely ground dried fuel material.

46. The facility according to claim 37, wherein the lock hopper system consists of two or more lock hoppers which may be pressurised from outside.

47. The facility according to claim 37, wherein the lock hopper system is connected to a downstream storage tank which supplies the lock hopper system by gravity conveyance with finely ground fuel material.

48. The facility according to 37, wherein the gas side of lock hoppers and feed tank is connected by at least one connection line.

49. The facility according to claim 37, wherein one or more gas introduction devices may be installed in any place of the lock hopper system, the dense-flow conveying lines, the gas-sided connection lines or the feed tank, by which it is possible to influence the conveyance or transport of solid material.

50. The facility according to claim 49, wherein at least one of the devices for the introduction of gas is an injector.

51. The facility according to claim 37, wherein devices may be installed in any place of the lock hopper system, the expansion lines, the recycle lines or the excess gas lines by which the gas flow can be separated from solid material or dust.

52. A process for supplying finely ground fuel materials to a cooled reactor for gasification with oxygen-containing gasifying agents under pressure, wherein:
the gasifier outlet temperatures are above the slag melting point in the range between 1200 and 2000° C. and the pressure is between 0.3 and 8 MPa; and
the finely ground fuel material is pressurised via a lock hopper system to a pressure level above the gasifier pressure, transferred to at least one feed tank and from there dosed in dense flow via at least one fuel line to one or more gasification burners of one or several gasifiers; wherein
the conveying gas volume supplied at the discharge of lock hopper is recovered in feed tank and returned to lock hopper by means of a device for pressure increase; and
the transfer from at least two lock hoppers to at least one feed tank is carried out by using a pneumatic continuous supply line jointly, simultaneously or successively at solid material densities of at least 100 kg/m^3 and a differential pressure of at least 0.5 bar.

53. The process for supplying finely ground fuel materials according to claim 52, wherein the expansion gases from lock hoppers are at least partially used for blanketing the grinding circuit with inert gas.

54. The process for supplying finely ground fuel materials according to claim 52, wherein the dust separator of the grinding unit is also used for dedusting expansion gases from lock hoppers.

55. The process for supplying finely ground fuel materials according to claim **52**, wherein pressurising by supplied gas is preceded by a mutual partial pressurisation of lock hoppers.

56. The process for supplying finely ground fuel materials according to claim **52**, wherein the fuel material is conveyed from lock hoppers to feed tanks via a number of continuous supply lines which is smaller than the number of lock hoppers.

57. The process for supplying finely ground fuel materials according to claim **52**, wherein the solid material from the outlet of each lock hopper is passed to unifying elements via a connection device and then into the continuous supply line, the number of unifying elements being smaller than the number of lock hoppers and at least identical with the number of continuous supply lines.

58. The process for supplying finely ground fuel materials according to claim **52**, wherein the unifying elements are provided as closely to and preferably symmetrically to the outlet nozzles of lock hoppers.

59. The process for supplying finely ground fuel materials according to claim **52**, wherein temporarily at least two lock hoppers discharge solid material simultaneously into continuous supply line.

60. The process for supplying finely ground fuel materials according to claim **52**, wherein the feed tank is spatially integrated into the building of the grinding unit.

61. The process for supplying finely ground fuel materials according to claim **52**, wherein the geodetic installation height of lock hoppers is smaller than the installation height of feed tank.

62. The process for supplying finely ground fuel materials according to claim **52**, wherein the continuous supply line enters feed tank below the solid material level.

63. The process for supplying finely ground fuel materials according to claim **52**, wherein the particle size of the solid fine-grain fuel materials is smaller than 0.5 mm.

64. The process for supplying finely ground fuel materials according to claim **52**, wherein continuous supply from lock hoppers is controlled by adjusting the pressure difference between lock hopper and feed tank such that the filling level of feed tank is kept constant.

65. The process for supplying finely ground fuel materials according to claim **52**, wherein the gas inlet or outlet into the free space of the lock hoppers influences the pressure difference between lock hopper and feed tank and is used as control parameter for the transport of solid material.

66. The process for supplying finely ground fuel materials according to claim **52**, wherein the discharge of solid material is facilitated by the addition of gas into the lock hopper in immediate vicinity to the discharge nozzle.

67. The process for supplying finely ground fuel materials according to claim **52**, wherein the density in continuous supply line is adjusted by adding gas into continuous supply line and/or unifying element.

68. The process for supplying finely ground fuel materials according to claim **52**, wherein the continuous supply line can be purged by adding gas into continuous supply line itself and/or into unifying element.

69. The process for supplying finely ground fuel materials according to claim **52**, wherein the connection elements between lock hopper and unifying element are supplied with gas.

70. The process for supplying finely ground fuel materials according to claim **52**, wherein the conveying gas volume supplied at the discharge of lock hopper is recovered in feed tank and returned to lock hopper by means of an injector.

71. The process for supplying finely ground fuel materials according to claim **69**, wherein the propellant gas which serves to control the pressure of lock hopper is used to operate injector.

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