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(54) METHOD AND SYSTEM FOR UTILIZING BIOMASS AND BLOCK-TYPE THERMAL POWER PLANT

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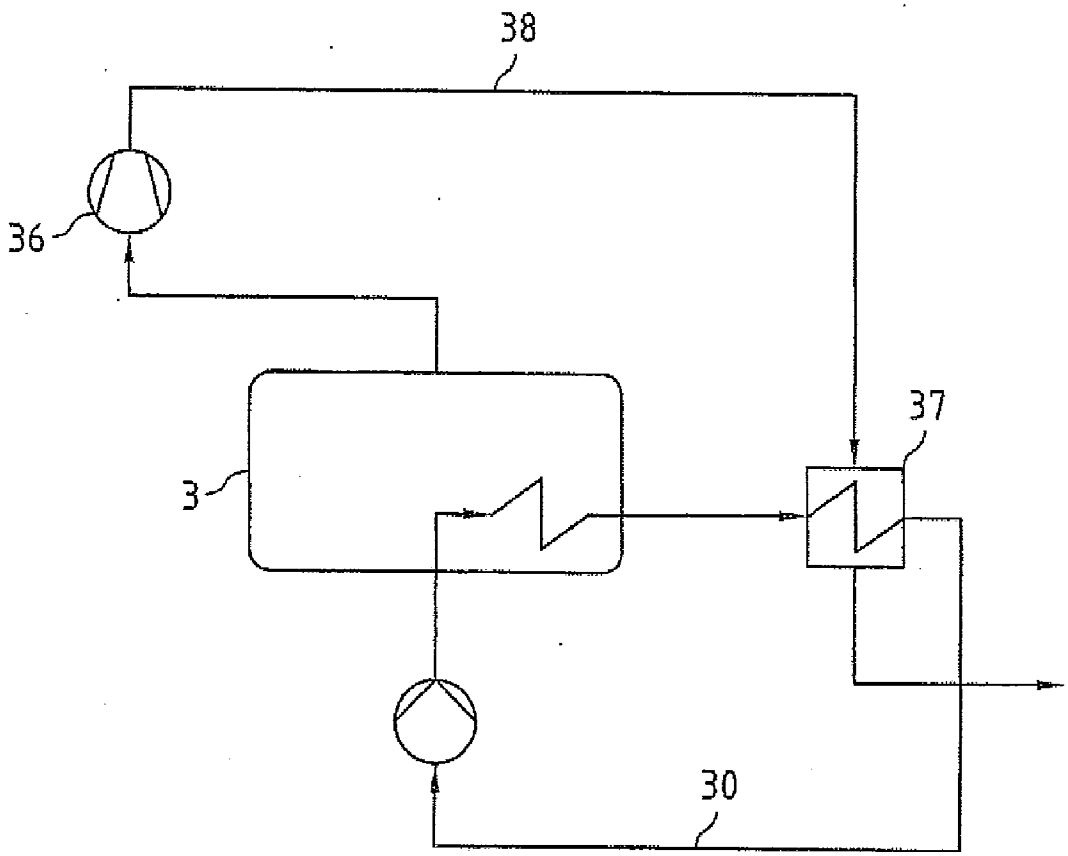
(57) ABSTRACT

The invention relates to a method for reclaiming biogenic mass, in particular sludge, wherein the product to be reclaimed is first dried and then thermally decomposed in a pyrolysis reactor for the purpose of creating pyrolysis gas. The method according to the invention is characterized in that the product is thermally dried in at least two drier stages arranged after one another, wherein the waste heat of the drier stage downstream of the product in the transport direction is used as process heat for the respectively upstream drier stages. The invention further relates to a system for reclaiming biogenic mass, in particular sludge.



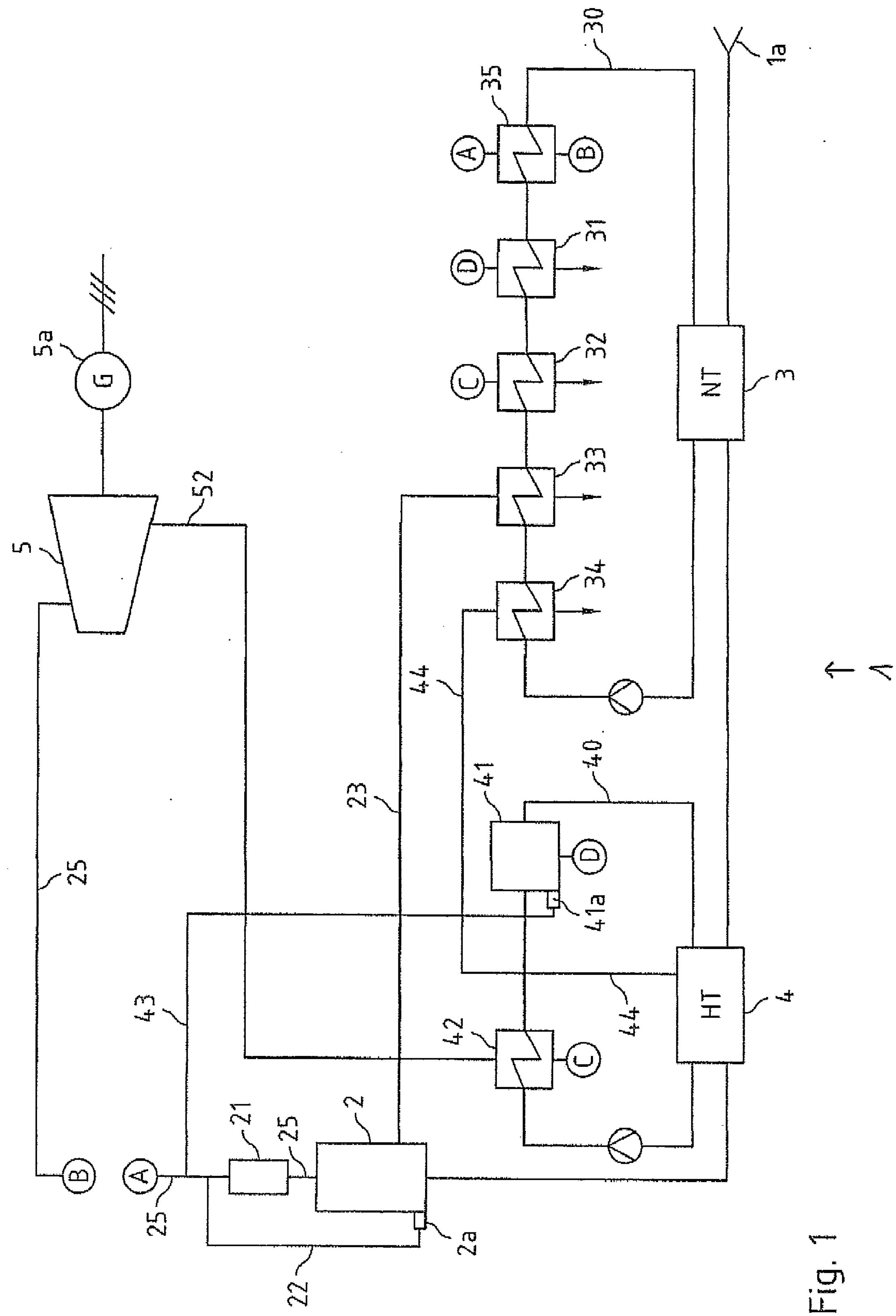

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Fig. 1

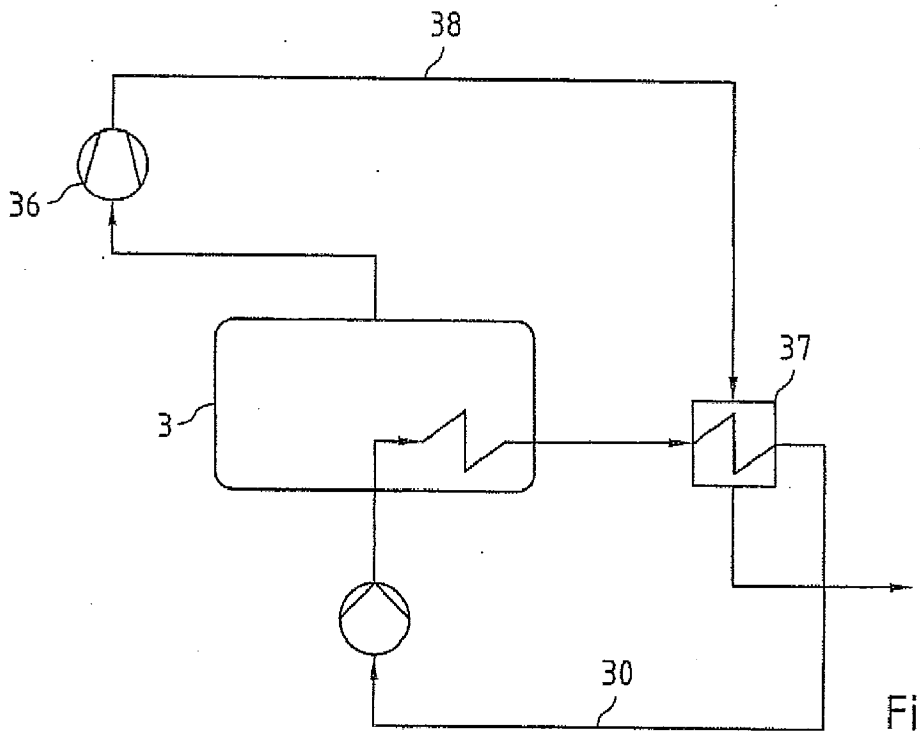

Fig. 2

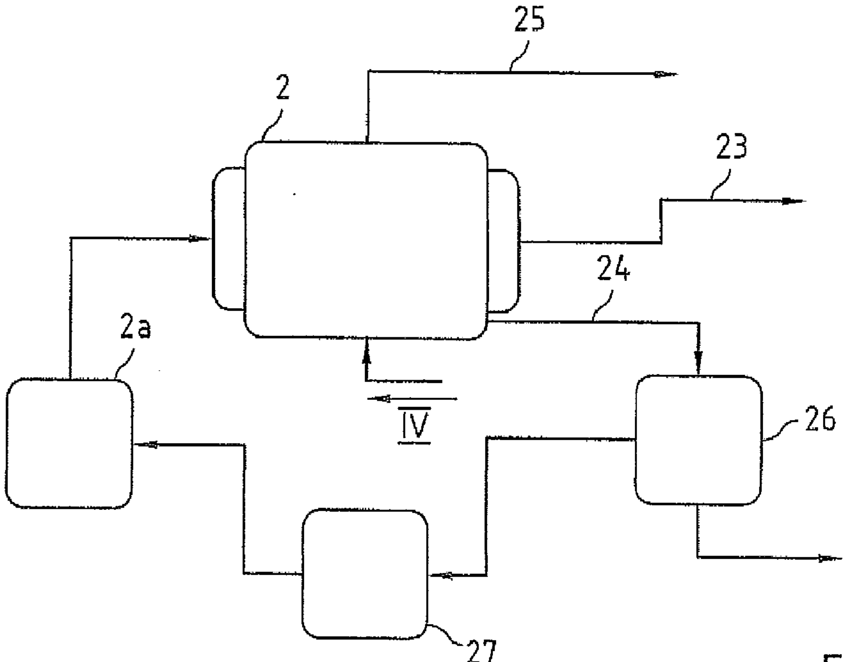

Fig. 3

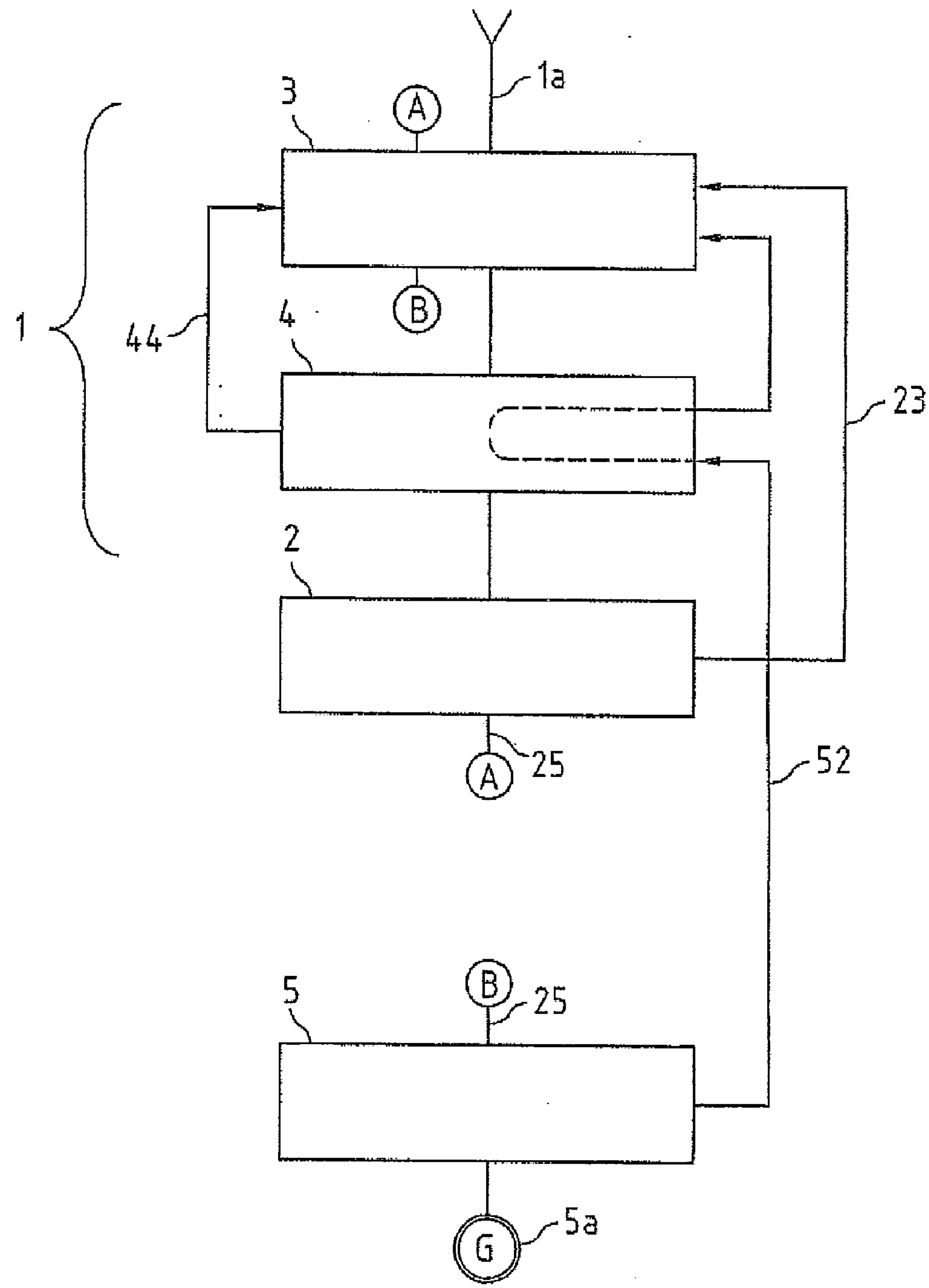

Fig. 4

METHOD AND SYSTEM FOR UTILIZING BIOMASS AND BLOCK-TYPE THERMAL POWER PLANT

[0001] The invention relates to a method for utilising biogenic mass, in particular sewage sludge, in which the material to be utilised is first dried and then thermally decomposed in a pyrolysis reactor for the purpose of generating pyrolysis gas. The invention further relates to a system for utilising biogenic mass.

[0002] For years, the utilisation of biogenic mass, in particular its use as an alternative energy carrier, has been the subject of intensive research. The generic term “biogenic mass” includes “biomass” in accordance with the German Biomass Ordinance, that is to say vegetable residues, waste and by-products of vegetable and animal origin, biowaste, waste wood, etc. and also recycled process waste and domestic and industrial sewage sludges.

[0003] In particular, the utilisation and disposal of sewage sludges, which is possible in different ways, has recently proven to be problematic. In principle, utilisation is possible by depositing the sewage sludges over arable land (agricultural utilisation). Although this is permitted in accordance with the provisions of the German Sewage Sludge Ordinance, in the long term the use as a fertiliser is associated with a contamination and burdening of the soil, wherein the food produced from crops cultivated on this soil is enriched with harmful substances. The deposition of sewage sludges over arable land is also continually associated with a high transport volume, and therefore high costs and CO_2 emissions emerge as a further drawback.

[0004] Although the co-incineration of sewage sludges in central power plants is possible in principle, it is likewise again associated with a high transport volume since the sewage sludge has to be transported to the power plant with a solid fraction of just approximately 25% (the other 75% being moisture). At the power plant, the sludge is to be subjected to a complex drying procedure which is energy intensive such that the thermal energy additionally obtained during the subsequent co-incineration of the dried sewage sludge is consumed more or less completely for this purpose. There are thus no advantages in terms of energy for the energy supplier.

[0005] The incineration of sewage sludge in decentralised power plants also leads only to little success in terms of reduced process costs. Although the transport routes are generally shortened, the energy obtained from the incineration process is still too low compared to the energy to be consumed for the drying process. Furthermore, the incineration process has to be maintained using additional fuels, wherein it is approximately only these which account for an ultimately positive energy balance.

[0006] A further possibility of utilisation of sewage sludge lastly consists of fermentation in biogas systems. However, a central drawback in this instance is that the yields of biogas are too low and therefore the efficiency of the method is also too low.

[0007] Starting from this prior art, the object of the invention is to provide a method and a system for utilising biogenic mass, in particular sewage sludge, which method and system can be operated with high efficiency based on the energy content of the introduced biogenic mass in relation to the energy generated by the utilisation.

[0008] In accordance with the invention the object is achieved with a method for utilising biogenic mass, in particular sewage sludge, according to the preamble of claim **1**, in that the material is thermally dried in at least two dryer stages arranged in succession, wherein the waste heat of the dryer stage arranged downstream in the direction of transport of material is used as process heat for the dryer stage arranged upstream.

[0009] The specific advantage of the method according to the invention is that, owing to the use of the waste heat of the downstream dryer stage as useful heat in the upstream dryer stage, the energy to be provided for the necessary drying of the biogenic mass can thus be minimised overall, and therefore the energy obtained for example during a combustion of the pyrolysis gas obtained during the pyrolysis process is much greater than the energy to be applied for the drying of the biogenic mass, which was not previously possible in comparable methods of the prior art. In this regard the applicant’s calculations have demonstrated that an energy recovery from biogenic mass of approximately up to 80% is possible based on the energy content thereof.

[0010] A further advantage of the method according to the invention is that it can be operated in a fully decentralised manner, for example since the biogenic mass can be dried and pyrolysed in the vicinity of the location of its origin, that is to say in the case of sewage sludge in the vicinity of a sewage treatment plant, wherein the pyrolysis gas can optionally then be used in a fuel cell or in a heat engine connected to a generator, for example a gas turbine, a combustion engine or a Stirling engine to produce electricity. In the case of use in a block-type thermal power station, useful heat can be obtained in addition to electricity, and therefore the method according to the invention is also significant in terms of the desired increased use of power-heat-cogeneration.

[0011] The at least two dryer stages preferably comprise at least one low-temperature dryer as an upstream dryer stage and at least one high-temperature dryer as a downstream dryer stage. In this case, in a cascaded drying process the waste heat of the high-temperature stage is thus made available to the low-temperature stage as process heat, and is utilised in the system, that is to say in the process inherent to the system. It is understood that further dryer stages may be provided in addition to a low-temperature stage and a high-temperature stage, and therefore a dryer cascade formed of a plurality of dryer stages can also be formed, in which each next highest dryer stage arranged downstream in the direction of transport of the material to be dried makes its waste heat available as process heat to the upstream dryer stage or to the upstream dryer stages which is/are at a lower temperature.

[0012] In accordance with a further embodiment of the invention, the heat of the waste gases of the auxiliary burner firing the pyrolysis reactor is used as process heat in the upstream dryer stage and/or the downstream dryer stage. In this case the principle upon which the invention is based is thus extended to the effect that the waste heat of the pyrolysis reactor, which is also still at a much greater temperature level compared to a high-temperature dryer stage, is made available to one or more dryer stages as process heat. Quite generally, in a cascade of process stages of increasing temperature the waste heat of a downstream process stage is thus made available as process heat to the upstream process stages of lower temperature.

[0013] Moving on, the heat of the hot pyrolysis gas produced in the pyrolysis reactor can also be used as process heat in the upstream dryer stage and/or in the downstream dryer stage. The high thermal energy content of the pyrolysis gas can thus be fed as process heat to the dryer stages arranged upstream of the pyrolysis reactor, the efficiency of the entire process thus being further increased.

[0014] In accordance with a further embodiment of the invention the pyrolysis gas produced in the pyrolysis reactor is fed to an energy converter unit for conversion of the energy content of the pyrolysis gas into electricity.

[0015] A fuel cell which converts the chemical energy content of the pyrolysis gas directly into electricity can be considered an energy converter unit, as can a heat engine driving a generator, in particular a gas turbine, a combustion engine or a Stirling engine.

[0016] In the case of a heat engine, in accordance with a further embodiment of the invention for further increasing the process efficiency, the heat of the waste gases of the heat engine can be used as process heat in the upstream dryer stage and/or in the downstream dryer stage.

[0017] In accordance with a further embodiment of the invention, each of the at least two dryer stages is supplied with process heat via its own heat transfer circuit, in particular a thermal oil circuit. In practice, the waste heat can thus be conveyed to the downstream dryer stage, in particular in the form of exhaust vapours, that is to say in the form of a steam-air mixture, by a heat exchanger integrated into the heat transfer circuit of the upstream dryer stage so as to be used in accordance with the invention as process heat for the upstream dryer stage.

[0018] If, in the case of a heat engine operated with the pyrolysis gas, the waste heat of the waste gases thereof is used as process heat for the upstream dryer stage and/or the downstream dryer stage, this may take place in practice in that the waste gases of the heat engine are conveyed through a waste gas heat exchanger integrated into the heat transfer circuit of the respective dryer stage. In particular it is possible to first convey the waste gases through a waste gas heat exchanger integrated into the heat transfer circuit of the downstream dryer stage, whereupon it is then conveyed through a heat exchanger integrated into the heat transfer circuit of the upstream dryer stage.

[0019] The exhaust vapours flowing off from a dryer stage may also supply, at least in part, the necessary process heat for this dryer stage itself, in that at least some of the exhaust vapours are first compressed with the addition of energy, heated and then condensed in a heat exchanger integrated into the heat transfer circuit of the respective dryer stage, wherein the condensation enthalpy is delivered to the heat transfer circuit and the heat transfer medium is heated. In this case the waste heat of the dryer stage is thus raised to a higher temperature level by compression in the manner of a heat pump and is then fed in the form of useful heat via a heat exchanger acting as a condenser back into the heat transfer circuit supplying the dryer stage with process heat.

[0020] In accordance with a further advantageous embodiment of the invention, some of the pyrolysis gas produced in the pyrolysis reactor is used as fuel for the burner of a boiler, in particular a thermal oil boiler, integrated into the heat transfer circuit of the upstream and/or downstream dryer stage. The boiler is preferably arranged in the heat transfer circuit of the downstream dryer stage and the waste gases of the boiler burner are then guided through a heat exchanger integrated into the heat transfer circuit of the upstream dryer stage. In this case the energy content of the branched off pyrolysis gas is used in a particularly efficient manner for both of the at least two dryer stages.

[0021] It may further be provided for some of the pyrolysis gas produced in the pyrolysis reactor to be used as fuel for the auxiliary burner of the pyrolysis reactor itself. As a result, the system can be operated basically independently of further fuels.

[0022] It may further be provided for the pyrolysis coke produced during pyrolysis of the dried material to be fed to a gasifier and for the lean gas produced there by gasification to be fed as fuel to the auxiliary burner for the pyrolysis reactor. This constitutes a further possibility to increase the process efficiency, since in particular the energy of pyrolysis products which generally go unused, in this case the pyrolysis coke, is used directly in the method.

[0023] In terms of device the object mentioned at the outset is achieved with a system for utilising biogenic mass, in particular Of sewage sludge, according to the preamble of claim **17**, in that the dryer device comprises at least two dryer stages arranged in succession in the direction of transport of the material and coupled to one another in such a way that the waste heat of the dryer stage arranged downstream in the direction of transport of the material can be used as useful heat for the dryer stage arranged upstream.

[0024] The comments made above apply accordingly with regard to the advantages of the system according to the invention.

[0025] The invention will be described hereinafter in greater detail with reference to drawings illustrating an embodiment, in which:

[0026] FIG. **1** is a block diagram of a system for generating electricity from sewage sludge;

[0027] FIG. **2** shows of a block diagram of the low-temperature dryer comprising a thermal oil circuit, according to a preferred embodiment;

[0028] FIG. **3** shows a preferred embodiment of the pyrolysis reactor of the system from FIG. **1**; and

[0029] FIG. **4** is a flow chart illustrating a method for utilising sewage sludge.

[0030] The system illustrated schematically in the form of a block diagram in FIG. **1** for generating electricity from sewage sludge as biogenic mass comprises a dryer device **1**, through which the sewage sludge introduced into the system at a feed point **1***a* is transported and dried. The dryer device is divided into two dryer stages, that is to say a low-temperature dryer **3** and a high-temperature dryer **4**. Further dryer stages may be added (not shown in this case).

[0031] A pyrolysis reactor **2** is arranged behind the high-temperature dryer **4** in the process direction and is fired by an auxiliary burner **2***a*. During the pyrolysis process, the sewage sludge dried in the dryer device **1** is thermally decomposed, wherein pyrolysis gas (normally consisting of nitrogen, carbon dioxide, hydrogen, carbon monoxide and higher carbon atoms) and, as further products, pyrolysis coke and ash which cannot be utilised further are produced.

[0032] The pyrolysis gas escapes from the pyrolysis reactor **2** via a line **25** and arrives in a heat engine, in this case a gas turbine **5**, which in turn is connected to a generator **5***a* for generating electricity. A combustion engine, a Stirling engine or a fuel cell which converts the chemical energy of the pyrolysis gas directly into electricity may also be provided instead of a gas turbine.

[0033] The low-temperature dryer **3** as well as the high-temperature dryer **4**, as individual dryer stages of the dryer device **1**, each comprise a heat transfer circuit, in this case a thermal oil circuit **30**, **40** which supplies the respective dryer stage **3**, **4** with process heat. The thermal oil circuits **30**, **40** can be coupled to one another (not shown in FIG. **1**), which is advantageous in particular when starting up the system so as to achieve rapid drying of the sewage sludge until a steady operating state is reached.

[0034] A thermal oil boiler **41** for heating the thermal oil and a heat exchanger **42** are arranged in succession in the thermal oil circuit **40** of the high-temperature dryer **4**. For its part, the thermal oil boiler **41** comprises an auxiliary burner **41***a*, of which the fuel feed line **43** is connected to the pyrolysis gas line **25**. The auxiliary burner **41***a* is accordingly operated directly with the pyrolysis gas produced in the pyrolysis reactor **2** as fuel. In the heat exchanger **42**, the thermal oil circulating in the thermal oil circuit **40** is additionally heated by the hot waste gases flowing off via a waste gas line **52** from the gas turbine **5**.

[0035] In the present case a total of five heat exchangers **31** to **35** are arranged in succession in the thermal oil circuit **30** of the low-temperature dryer **3**. The waste gases of the burner **41***a* of the thermal oil boiler **41** arranged in the thermal oil circuit **40** flow through the heat exchanger **31**. The residual heat of the waste gases flowing out from the heat exchanger **31** escapes as lost heat. In turn, the waste gases of the gas turbine **5** flow through the heat exchanger **32** once they have already passed through the heat exchanger **42** arranged in the thermal oil circuit **40**. For the sake of clarity, the connection of the heat exchanger **42**, **32** is merely indicated in FIG. **1** by the symbols C-C. The residual heat of the waste gases of the gas turbine escapes, again as lost heat, after passing through the heat exchanger **32**, wherein the thermal oil circulating in the thermal oil circuit **30** is further heated.

[0036] The thermal oil of the thermal oil circuit **30** is further heated by the waste gases of the auxiliary burner **2***a* of the pyrolysis reactor **2**. For this purpose these waste gases flow through the waste gas line **23** and into the heat exchanger **33** integrated into the line.

[0037] Furthermore, the line **44** through which the exhaust vapours exiting from the high-temperature dryer **4** flow is connected to the heat exchanger **34** of the thermal oil circuit **30**, in such a way that the exhaust vapours flow through the heat exchanger **34** and deliver some of their thermal energy to the thermal oil.

[0038] Finally, the heat exchanger **35** is arranged in the thermal oil circuit **30** of the low-temperature dryer **3**. The hot pyrolysis gases exiting from the pyrolysis reactor **2** flow through said heat exchanger, wherein some of their heat is delivered to the thermal oil.

[0039] FIG. **2** shows a block diagram of a particularly preferred embodiment of the low-temperature dryer **3**. A further heat exchanger **37** is integrated into the thermal oil circuit **30** of the low-temperature dryer **3**. For the sake of clarity, the heat exchangers **31** to **35** described above are not shown in FIG. **2**. The exhaust vapours flowing out from the low-temperature dryer **3** are compressed in a compressor **36** in accordance with the arrangement of FIG. **2**, wherein they are raised to a higher temperature level and then flow as a compressed exhaust vapour flow through the line **38** into the heat exchanger **37**, which acts as a condensation heat exchanger. The exhaust vapours are accordingly liquefied as they pass through the heat exchanger **37**, wherein the condensation heat is delivered to the thermal oil circulating in the thermal oil circuit **30**. Owing to this structure corresponding roughly to the operating principle of a heat pump, further process heat for the drying process in the low-temperature dryer **3** can be provided in a very efficient manner by the use of additional energy in the compressor.

[0040] FIG. **3** shows a block diagram of a particularly preferred embodiment of the pyrolysis reactor **2** of the system of FIG. **1**. The components already known from the block diagram of FIG. **1** bear corresponding reference numerals. The specific feature of the arrangement illustrated in FIG. **3** is that the pyrolysis coke produced during the pyrolysis process is recovered from the reactor via a line **24** and is fed to a gasifier stage **26**, where the pyrolysis coke is gasified in ways known per se from the prior art. The lean gas produced is cleaned in a cleaning stage **27** and is then fed to the auxiliary burner **2***a* of the pyrolysis reactor **2** as additional fuel. The efficiency of the entire method is thus further increased since further pyrolysis products, in this instance the pyrolysis coke, are utilised as an energy source in the process.

[0041] The method taking place in the system of FIG. **1** to generate electricity from sewage sludge will now be explained in greater detail in conjunction with FIG. **1** and the schematic flow chart of FIG. **4**.

[0042] In a first step the sewage sludge to be dried having a dry substance content of normally approximately 25% (the remaining 75% is formed by water) is fed into the system and transported into the low-temperature dryer **3** and pre-dried. Here, it is dried until it has a dry substance content after leaving the low-temperature dryer **3** of approximately 40%. The low-temperature dryer **3** is supplied with the necessary process heat by the thermal oil circuit **30**. The pre-dried material is then conveyed into the high-temperature dryer **4** and is dried until reaching the final degree of dryness. The exhaust vapours produced in the high-temperature dryer **4** are conveyed via the line **44** into the heat exchanger **34** provided in the thermal oil circuit **30** of the low-temperature dryer **3**, where they deliver some of their heat to the thermal oil circulating in the thermal oil circuit **30**. As a result, the waste heat of the dryer stage arranged downstream in the direction of transport of the material, that is to say the waste heat of the high-temperature dryer **4**, is thus used as process heat for the dryer stage arranged upstream, i.e. the low-temperature dryer **3**.

[0043] The material dried to a dry substance content of approximately 85% is then fed into the pyrolysis reactor **2**, where the material is preferably thermally decomposed in a two-stage pyrolysis process in the absence of oxygen, as is known per se from the prior art. The heat necessary for this is generated by the auxiliary burner **2***a*. The burner waste gas produced is fed via the line **23** to the heat exchanger **33** provided in the thermal oil circuit **30** of the low-temperature dryer **3**, and therefore the heat of the burner waste gases is also used as process heat in a dryer stage, in this case in the low-temperature dryer **3**.

[0044] The pyrolysis gas produced in the pyrolysis reactor **2** leaves the pyrolysis reactor **2** via the line **25** and first passes through a dust separator **21**, where any dusts still contained in the pyrolysis gas flow are separated. As can be seen in FIG. **1**, the pyrolysis gas then flows through the heat exchanger **35** so that the heat of the pyrolysis gas produced in the pyrolysis reactor **2** is again fed as process heat to this dryer stage.

[0045] Before passing though the heat exchanger **35**, some of the pyrolysis gas flow is branched off from the line **25** into the lines **22**, **43**. The pyrolysis gas fed into the line **22** is used as fuel to fire the auxiliary burner **2***a* of the pyrolysis reactor

2, whilst the fraction fed into the line **43** is fed as fuel to the auxiliary burner **41***a* of the thermal oil boiler **41** arranged in the thermal oil circuit **40** of the high-temperature dryer **4**. The chemical energy contained in the pyrolysis gas produced in the pyrolysis reactor **2** is thus used in a particularly efficient manner to maintain the entire process.

[0046] The pyrolysis gas flowing through the line **25** is then fed into the gas turbine **5**, where it is combusted, wherein the gas turbine **5** drives a generator **5***a*. The waste gases of the gas turbine are fed through the line **52** to the heat exchanger **42** arranged in the thermal oil circuit **40** of the high-temperature dryer **4** and are then fed to the heat exchanger **32** arranged in the thermal oil circuit **30** of the low-temperature dryer **3** so that the heat contained in the waste gas of the gas turbine is again made available to the two dryer stages **3**, **4** as process heat.

[0047] The principle of providing, in the form of process heat and in a multi-stage process of increasing process temperature, the waste heat of a process step of specific temperature to one or more upstream process steps of lower temperature in order to increase the overall efficiency of the entire process is thus implemented with the method described above.

1-22. (canceled)

23. A method for using a biogenic mass, in which the biogenic material is first dried and then thermally decomposed in a pyrolysis reactor, comprising the steps of:

passing a biogenic mass through a first dryers stage,

passing the biogenic mass through a second dryer stage,

thermally decomposing the biogenic mass in a pyrolysis reactor, to produce a pyrolysis gas,

wherein a waste heat of the second dryer stage being arranged downstream in a direction of transport of the biogenic mass is used as process heat for the first dryer stage being arranged upstream each of the first dryer stage and the second dyer stage being supplied with process heat via a first heat transfer circuit associated with the first dryer stage and a second heat transfer circuit associated with the second dryer stage, the heat of the pyrolysis gas produced in the pyrolysis reactor being used as process heat in at least one of the first dryer stage and the second dryer stage, a first portion of the pyrolysis gas produced in the pyrolysis reactor being fed to an energy converter unit for conversion of the energy content of the pyrolysis gas into electricity, and a second portion of the pyrolysis gas produced in the pyrolysis reactor being used as fuel for a burner of a boiler integrated into at least one of the first heat transfer circuit and the second heat transfer circuit.

24. The method according to claim **23**, wherein the first dryer stage comprises at least one low-temperature dryer and wherein the second dryer stage comprises at least one high-temperature dryer.

25. The method according to claim **23**, wherein the heat of waste gases of an auxiliary burner firing the pyrolysis reactor is used as process heat in at least one of the first dryer stage and the second dryer stage.

26. The method according to claim **23**, wherein the energy converter unit is a fuel cell.

27. The method according to claim **23**, wherein the energy converter unit is a heat engine connected to a generator comprising at least one of a gas turbine, a combustion engine and a Stirling engine.

28. The method according to claim **27**, wherein the heat of the waste gases of the heat engine are used as process heat in the first dryer stage and the second dryer stage.

29. The method according to claim **23**, wherein the first heat transfer circuit and the second heat transfer circuit are a thermal oil circuit.

30. The method according to claim **23**, wherein the waste heat of the second dryer stage is conveyed through a heat exchanger integrated into the heat transfer circuit of the first dryer stage.

31. The method according to claim **23**, wherein at least some of the exhaust vapours exiting from the first dryer stage or second dryer stage are first compressed and then condensed in a heat exchanger integrated into the first heat transfer circuit or second heat transfer circuit, wherein the condensation enthalpy is delivered to the first heat transfer circuit or second heat transfer circuit.

32. The method according to claim **23**, wherein the boiler integrated into the second heat transfer circuit is a thermal oil boiler.

33. The method according to claim **23**, wherein the boiler is arranged in the second heat transfer circuit and the waste gases of the boiler burner are guided through a heat exchanger integrated into the first heat transfer circuit.

34. The method according to claim **27**, wherein the waste gases of the heat engine are first guided through a waste gas heat exchanger integrated into the second heat transfer circuit of the second dryer stage, whereupon they are then guided through a heat exchanger integrated into the first heat transfer circuit of the first dryer stage.

35. The method according to claim **23**, wherein some of the pyrolysis gas produced in the pyrolysis reactor is used as fuel for an auxiliary burner of the pyrolysis reactor.

36. The method according to claim **23**, wherein a pyrolysis coke produced during pyrolysis of a dried biogenic material is fed to a gasifier and a lean gas produced there by gasification is fed as fuel to an auxiliary burner for the pyrolysis reactor.

37. A system for utilizing a biogenic mass, comprising a dryer device and a pyrolysis reactor arranged after the dryer device in the direction of transport of the material for the production of pyrolysis gas from the dried material, wherein the dryer device comprises at least two dryer stages which are arranged in succession in the direction of transport of the material and which are coupled to one another in such a way that the waste heat of the dryer stage arranged downstream in the direction of transport of the material can be used as useful heat for the dryer stage arranged upstream, the at least two dryer stages each comprising their own heat transfer circuit for supplying process heat, the upstream dryer stage comprising a heat exchanger connected to a pyrolysis gas line of the pyrolysis reactor so that the heat of the pyrolysis gas produced in the pyrolysis reactor can be used as process heat in the upstream dryer stage, the pyrolysis gas line being connected after the heat exchanger in a process direction to an energy converter unit for converting the energy content of the pyrolysis gas into electricity, and a line branching off from the pyrolysis gas line before the heat exchanger in the process direction, via which pyrolysis gas line some of the pyrolysis gas produced in the pyrolysis reactor can be fed as fuel for a burner of a boiler integrated into the heat transfer circuit of the downstream dryer stage.

38. The system according to claim **37**, wherein the at least two dryer stages each comprise at least one low-temperature dryer as the upstream dryer stage and at least one high-temperature dryer as the downstream dryer stage.

39. The system according to claim **37**, wherein the at least two dryer stages each comprise a thermal oil circuit as a heat transfer circuit for supplying process heat.

40. The system according to claim **37**, wherein the heat transfer circuits of the at least two dryer stages can be coupled with one another.

41. The system according to claim **37**, wherein the energy converter unit arranged after the pyrolysis reactor in the process direction is a fuel cell which can be operated with the pyrolysis gas, or a heat engine which can be operated with the pyrolysis gas and is connected to a generator.

42. The system according to claim **37**, wherein the system is integrated into a block-type thermal power plant.

43. The method according to claim **23**, wherein the biogenic mass is a sewage sludge.

44. The system according to claim **37**, wherein the biogenic mass is a sewage sludge.

* * * * *