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(54) METHOD AND SYSTEM FOR PRODUCING PELLETS FROM BIOMASS IN A PELLET PRESS FOR USE AS FUEL IN FIREPLACES

(75) Inventor: **Gernot von Haas**, Heidelberg (DE)

(73) Assignee: **DIEFFENBACHER GMBH MASCHINEN-UND ANLAGENBAU**, Eppingen (DE)

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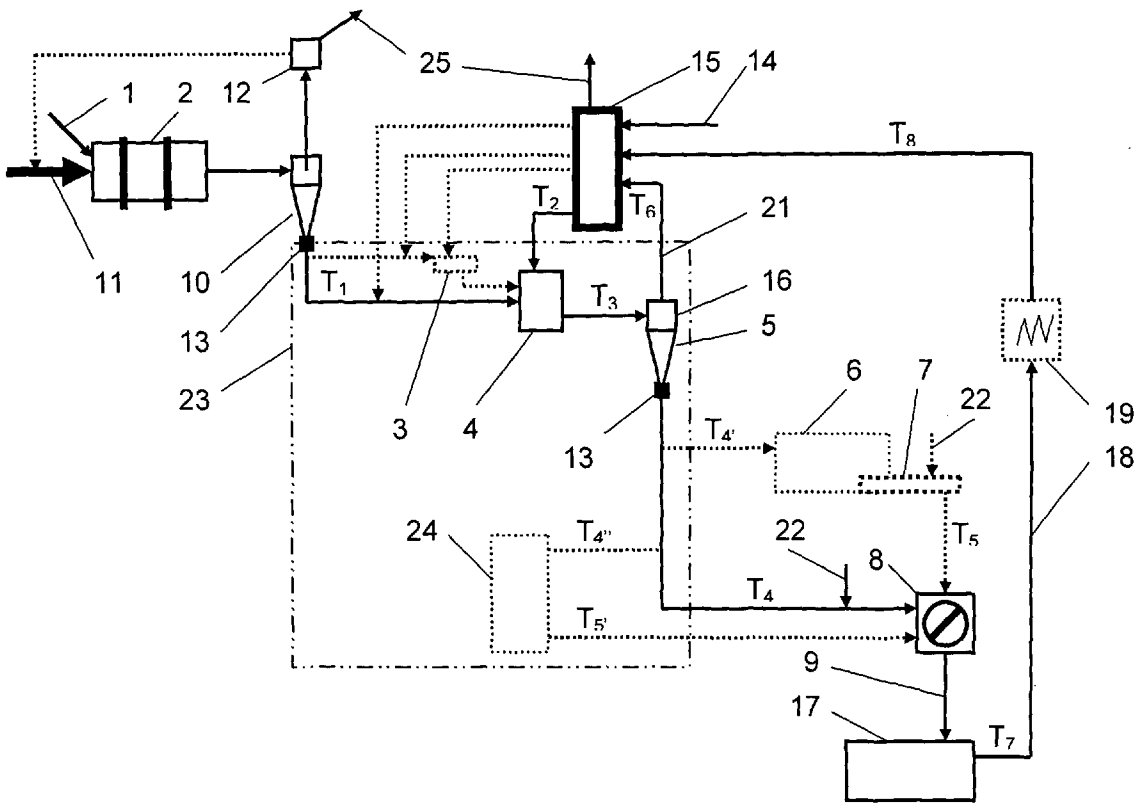
(57) **ABSTRACT**

A system and a method for producing pellets from biomass in a pellet press for use as fuel in fireplaces. To produce pellets in an energy-saving and more energetically cost-effective manner as compared to prior art. In the method according to one embodiment, the biomass, which comprises cellulosic and/or lignocellulosic fibers, chips or shreds and is heated and dried in the course of the production process in a dryer, separated from the dryer air, and the biomass is supplied to a pellet press, wherein the temperature of the biomass is heated or substantially maintained by hot air in a treatment region between the dryer and the pellet press, and the treatment region comprises at least parts of the transport path and/or at least one additional device for carrying out at least one additional method stop, and wherein the temperature of the hot air exceeds at least 65° Celsius.



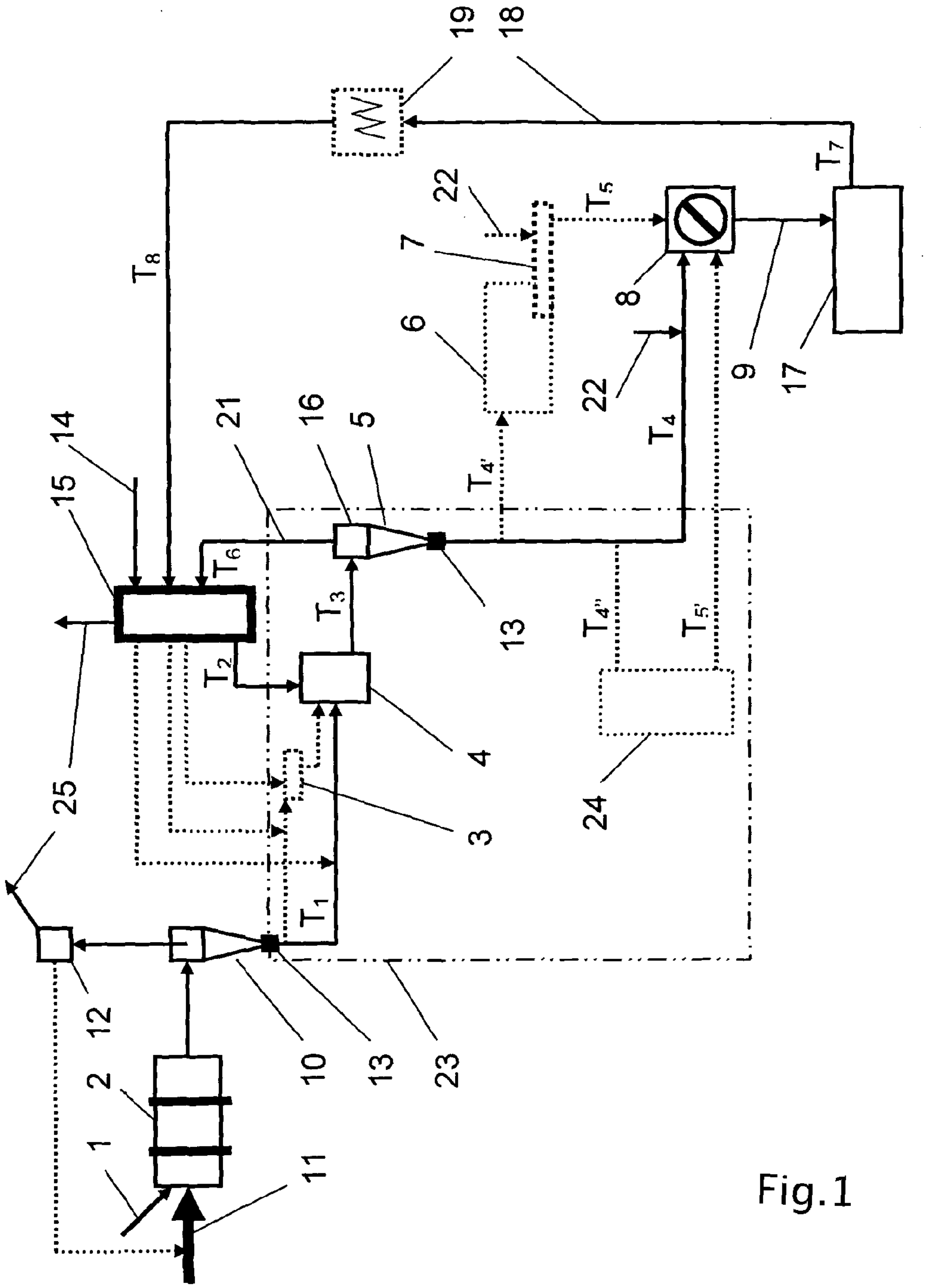

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Fig.1

METHOD AND SYSTEM FOR PRODUCING PELLETS FROM BIOMASS IN A PELLET PRESS FOR USE AS FUEL IN FIREPLACES

[0001] The invention relates to a method for producing pellets in a pelletizing press for use as a fuel in fireplaces according to the preamble of Claim **1**.

[0002] Furthermore, the invention relates to a facility for producing pellets from biomass in a pelletizing press for use as a fuel in fireplaces according to the preamble of Claim **17**.

[0003] The production of pellets, also referred to as granules, from fine material or compacted and/or molten material has already been known for some time. Briquette presses have compacted material between two rollers, either one or both having been constructed as matrices, and molded it into briquettes for combustion. In the plastic industry or the industry which processes animal food, pelletizing by means of extruders and perforated discs, optionally using downstream cutting devices, is also sufficiently known. The production of pellets for use as a fuel in fireplaces from preferably chopped biomass, such as wood, its wood chips, sawdust, or the like, is also already sufficiently known and is propagated in the field of renewable energy sources as a pioneering technology for climate protection, in particular in Europe. The production process is subject to certain norms, thus, the produced pellets must have a certain abrasion resistance (for pneumatic transport) and cannot release toxic or environmentally harmful active ingredients in the course of combustion. Low-quality pellets often contain foreign materials (lubricants, colorants, . . .).

[0004] During the facility planning for the production of pellets for use in fireplaces, in particular in large-scale industrial facilities, the cost factor due to the energy to be applied is a problem in particular. The production of the pellets is advantageously to consume very little energy, since it typically does not originate from renewable energy sources (oil/gas combustion, power plants). It is also problematic to construct a large-scale facility from multiple purchased individual plant parts, in particular from niche producers, since each individual plant part (heavy material separator, drying device, grinding device, cyclone, or pelletizing press) can rarely be integrated cost-effectively and optimally in an overall facility. In previous facilities, the chips were dried very intensively, so that the chips could be heated using steam before the pelletizing. The reason for this is that the chips lose much of the temperature obtained through the drying process during the transport from the dryer up to the pelletizing, or in further devices for the treatment of the chips, but also in particular during the storage in a silo. For a rapid production process, steam is therefore used for preheating the chips before the pelletizing press, since the condensing steam not only causes dampening of the chips, but rather also a rapid temperature increase of the chips. However, known levels of moisture of the chips before the pelletizing are not to be exceeded, 12 wt.-% moisture is typical, so that the chips must be dried to 8 to 10 wt.-% in the case of a 2 to 4% increase of the chip moisture by the steam treatment. The excessive drying of the chips and the production of the steam requires a very large amount of energy.

[0005] The object of the invention comprises providing a method and a facility, in which biomass, preferably wood mass in the form of chips, can be compressed into pellets in a way which saves energy in relation to the prior art and which is energetically cost-effective.

[0006] The achievement of the object for a method comprises the method heating and drying biomass in the course of the production in a dryer, the dried and heated biomass being separated from the dryer air, and the biomass being supplied to a pelletizing press,

[0007] the temperature of the biomass in a treatment area between the dryer and the pelletizing press being heated or substantially maintained using hot air and the treatment area comprising at least parts of the transport path and/or at least one further device for performing at least one additional method step, and the temperature of the hot air exceeding at least 65° C.

[0008] The achievement of the object for a facility is that in the facility for drying and heating the biomass, a dryer having an airlock for separating the dryer air is arranged before the pelletizing press in the production direction,

[0009] at least one treatment area being arranged in the facility between the airlock and the pelletizing press and at least one transport means for transporting the biomass between the dryer and the pelletizing press and/or at least one device for performing at least one further method step is arranged in this treatment area, and at least one heating device for heating and/or providing hot air of essentially greater than 65° C. is arranged associated with the treatment area, the heating device being operationally linked at least once with the transport means and/or with a device for performing further method steps for the supply of the hot air.

[0010] The method sequence according to the invention advantageously achieves high savings potentials in the power consumption in large-scale industrial facilities, because the overall production method is performed in an energetically optimized way and energetically costly temperature increases of the biomass to be treated are avoided or unnecessary high-energy method measures are avoided, such as dampening the biomass using steam for the temperature increase, simultaneously increasing the biomass moisture by several percent, and subsequently drying the biomass to produce the required degree of dryness of the biomass for the pelletizing.

[0011] For this purpose, the biomass is advantageously heated by means of hot air after the dryer along its transport path and/or in further devices for performing further method steps. The further devices are referred to hereafter as the treatment area (between dryer and pelletizing press). The corresponding transport paths and/or the devices are advantageously to be sufficiently insulated in relation to the surroundings or the lower temperature.

[0012] A hot steam dryer or a flash dryer is preferably used for the basic drying method. However, a drum dryer is particularly preferred because of the high exit temperature and/or the high throughput quantity. A drum dryer or flash dryer or a hot steam dryer can typically have a temperature of the biomass which is 10° higher than the typical belt dryers.

[0013] A treatment area, in which the dried biomass is prepared for the pelletizing press, is preferably established in an advantageous manner between the dryer and the pelletizing press. Required or advisable preparations can be, for example, conduction through a heavy material separator, a grinding device, a classification device, a water spraying device, a dosing device for the pelletizing press, transport devices, or the like. In all of these devices, the temperature of the biomass is typically significantly reduced, but particularly in start-up operation of the facility, of course. Typical facilities have a steaming device before the pelletizing press for this purpose, which elevates the biomass to a temperature at which it can be pelletized again in an energetically costly manner. However, the steaming normally also increases the moisture content of the biomass, so that in anticipation a dryer must dry the biomass more intensively below this increased moisture content. The present invention particularly advantageously has the property that this special energy expenditure no longer must be completed twice, in particular through a special design of the treatment area between dryer and pelletizing press. It is sufficient, in order to make the pelletizing in the pelletizing press easier, to apply water to the biomass before the pelletizing press, preferably to spray it with water. The water is to be preheated in this context, of course, and is preferably to have a temperature greater than 60° C. The biomass is preferably transported using hot air and/or introduced into or guided through the treatment devices as needed. In addition to the optimum temperature control of the machine elements which come into contact with the biomass, maintaining the temperature or increasing the temperature of the biomass is possible. A plurality of measuring and regulating devices is preferably located in the facility, in order to set the temperature control and the control or regulation of the hot air supply or the temperature of the hot air in an energetically optimal manner. The goal is to transport the biomass at a temperature of substantially greater than 65° C. into the pelletizing press, without changing the essential temperature level of the biomass after the dryer, whose exit temperature is preferably greater than 60° C., downward in the direction of a typical ambient temperature. This measure is to be supported in particular by insulation of the corresponding devices in the treatment area and/or heating devices of the devices themselves.

[0014] In a particularly preferred embodiment, a hot air circulation is provided as the treatment area, which comprises at least one device for achieving a method step (for example, grinding, sorting, classification, heating), a heating device for the hot air, and a cyclone for separating the hot air from the biomass. Known facility requirements, such as control and regulating devices, fresh air supply, hot air purification, or the like will be added by a person skilled in the art in accordance with the facility requirements or specifications, where necessary or advisable, in particular in the course of overall energetic economy.

[0015] In the course of energetic optimization, it can be advisable or even necessary to use a hot air-water steam mixture instead of hot air, which allows a better heat transfer, in particular during heating of the biomass. In this case, of course, application or spraying of water before the pelletizing press can be omitted or it is throttled accordingly.

[0016] Moreover, the water is heated to a temperature of greater than 65° C., preferably greater than 80° C., particularly preferably 90° C. before or during the supply to the biomass. In a preferred embodiment, the applied water can alternatively or additionally be heated on the biomass by means of radiant energy. Microwave emitters are preferably arranged for this purpose, which heat the water or the biomass during the transport between the water spraying and the pelletizing press. The temperature of the hot air is particularly preferably set using a heating device, the heating device using fresh air as the supply air and/or preheated air from at least one hot air return line and/or preheated air from a heat exchanger or directly from the waste heat of a pellet cooler after the pelletizing press. In the treatment area between the dryer, preferably a drum dryer having an airlock device for separating the dryer air from the biomass, and the pelletizing press, multiple method steps may be necessary in order to prepare or condition the biomass for the pelletizing. Safety aspects for the pelletizing press itself from metal, rocks, or the like are also to be considered. For this purpose, for example, a heavy material separator for separating heavy material and/or a grinding device for chopping the biomass and/or a cyclone for separating the hot air from the biomass would be necessary before the pelletizing press. The separation of the hot air from the biomass can be necessary in order to increase the overall energetic economy of the facility. This is particularly advantageous if, in the treatment area, the hot air is guided via the heating device in an essentially closed circuit. This circuit offers substantial advantages in a control and regulating aspect. Of course, the circuit can also be expanded via an optional silo and/or the pelletizing press itself, so that after the pelletizing press, preferably in the pellet dryer, the still warm hot air is preferably guided via a heat exchanger via a hot air return line or a heat reclamation unit back to the heating device. The hot air in the circuit of the treatment area is to be regularly exchanged and/or filtered at least in parts, the corresponding exhaust air being guided in accordance with the environmental regulations, if needed via an exhaust air purification device, for example, a wet electrostatic precipitator (WESP) and/or a regenerative thermal oxidizer (RTO).

[0017] The teaching of the invention fundamentally states that the cooling of the biomass between the drying in the dryer and the pelletizing is to be reduced as much as possible or even prevented. Depending on the facility type or method type, heating of the biomass can even be provided, in particular if the biomass must still be stored in a silo before the pelletizing press, in order to ensure proper distribution or shaking of the biomass into one or more pelletizing presses. Depending on the definition, the storage and the discharge from the silo can also be considered as a method step associated with the treatment area. The biomass is preferably to reach the pelletizing press at a temperature of greater than 65° C., and the hot air in the treatment area is to be set accordingly. Further suggestions on the design or regulation of the temperature of the biomass are dependent on the devices used for performing the method steps in the treatment area and the employed biomass itself, of course. The possibility for insulating the respective devices or the transport paths is also partially a matter of design by the designer of the facility and therefore cannot be described in the specific case for a person skilled in the art. However, the biomass is also preferably at least surrounded with hot air or correspondingly pneumatically transported during the transport.

[0018] To support the specification that the biomass reaches the pelletizing press at 65° C., it can be necessary for the biomass to leave the drum dryer at least at a temperature T_1 of substantially greater than 65° C. Subsequently, the biomass is to be transported in a further method step by means of hot air through at least one heavy material separator and/or guided through a grinding device and chopped. For possibly necessary heating of the biomass, it can be necessary to increase the temperature of the hot air, in particular using hot air of a temperature of 70° to 80° C., and to transport the biomass through at least one heavy material separator and simultaneously heat it and/or guide it through a grinding device, chop it, and heat it therein. Alternatively or in combination with the previous method steps, it would further be advantageous to apply hot air to the biomass, in particular hot air at a temperature greater than 65° C., in at least one silo and/or in a discharge device associated with the silo. To save energy, it can also be necessary for the biomass to be separated from the hot air in a cyclone in a further method step after the grinding device and/or a heavy material separator, insufficiently chopped parts of the biomass being returned to the grinding device and/or the separated hot air being supplied via a hot air return line to the heating device. It is energetically advisable, depending on the starting temperature of the dryer, to heat the hot air for the transport means, the heavy material separator, the grinding device, the silo, and/or the cyclone to at least the temperature of the biomass.

[0019] Further advantageous measures and designs of the subject matter of the invention are disclosed in the subclaims and the following description of the drawing.

[0020] The biomass **1** which is used and produced partially consists of chips or shreds, which arise in sawmills and other fabrication locations as a waste product, and which are delivered on trucks. In the case of large-scale industrial pellet production, it is necessary to make use of a felled stock of trees, which is chopped by means of so-called chopping facilities into chips or shreds. After a first preparation, optionally even mechanical dewatering, these are introduced into a dryer **2**. In the case of large-scale industrial pellet production, drum dryers are preferably provided, which are distinguished by large throughput quantities and uniform exit temperature T_1 of the biomass **1**. A dryer **2** in the drum embodiment preferably has dryer supply air **11** applied thereto, which is preferably guided in a circuit and is separated from the biomass **1** by a dryer cyclone **10** for this purpose after the dryer **2**. The dryer air is typically strongly loaded with dust and even loaded with pollutants because of the drying and is regularly replaced either completely or in parts, in the case of a circuit application of the dryer supply air **11** (dashed line). The moist dryer air, which is enriched with dust, is typically first prepurified in an exhaust air purification facility **12**, before it can be discharged as exhaust air **25** to the environment.

[0021] The biomass **1** exits from the dryer cyclone **10** via an airlock **13**, typically a rotary airlock, at a temperature T_1 in the treatment area **23**, and has a temperature T_4/T_4' after the treatment area **23**. At least one device for performing a method step, which can comprise sorting, classification, grinding, separation of heavy materials, and much more, is located in the treatment area **23**. The transport of the biomass **1** between the dryer **2** and the pelletizing press **8** is also considered to be a method step in this context, as is the storage in a silo **6**, although the latter is not thus shown in the overview drawing. The overview drawing primarily shows a simplified facility having a method step between the dryer **2** and the pelletizing press **8**. The method sequence is read as follows on the basis of the continuous method arrows. After the airlock **13**, the biomass **1** is transported at a temperature T_1 into a grinding device **4**, hot air of a temperature T_2 from the heating device **15** is applied thereto in the grinding device **4**, the biomass **1** subsequently has a temperature T_3, which preferably at least corresponds to the temperature T_1 or is even higher, and is transferred with the hot air into the cyclone **5**. The cyclone **5** separates the hot air at a temperature T_6 from the biomass **1** and transfers the hot air back into the heating device **15** for reheating to the temperature T_2, if necessary. After the cyclone **5**, the biomass **1** is discharged via an airlock **13**, preferably a rotary airlock, from the treatment area **23** and supplied at a temperature T_4, which is greater than 60° C., preferably greater than 65° C., to a pelletizing press **8**. After pelletizing of the biomass **1** to form pellets **9**, these pellets are stored in a pellet cooler **17** or guided through and cooled. The waste heat **18** at a temperature T_7 can be supplied back to the heating device **15** via an optional heat exchanger **19** at a temperature T_8, in order to maintain or even heat the temperature T_1 of the biomass **1** after the dryer **2**. The latter possibility is an expansion of the circuit of the hot air of the treatment area **23**, which can be used alternatively or in combination. The circuit has a corresponding required fresh air supply and the hot air in the circuit is regularly purified in parts or completely, preferably before or in the area of the heating device **15**, in an exhaust air purification device (not shown), and exhausted as exhaust air **25** to the environment.

[0022] In an alternative exemplary embodiment, if a silo **6** is used to store the biomass **1** having an associated discharge device **7**, the temperature T_4 can or even should be increased, so that heat losses of the biomass **1** during the storage and the discharge from the silo **6** can be compensated for, and the temperature T_5 of the biomass before the pelletizing press **8**, in conjunction with an optional water introduction by a spraying device **22**, corresponds to the specifications and is preferably greater than 60° C., more preferably greater than 65° C.

[0023] In a further alternative exemplary embodiment, the biomass can pass through a screen **24**, preferably designed as a flat screen, in the treatment area **23** or as shown in the drawing. It is also advantageous here if the entrained air is heated as the hot air and has at least the temperature of the biomass **1** or even greater. The screen **24** is preferably used for the purpose of screening out sand or fine dust. Similarly as during the use of a silo **6**, the biomass can also have a temperature T_4'' beforehand and a temperature T_5' thereafter, the temperature T_5' preferably being greater than 60° C., particularly preferably greater than 65° C.

[0024] In an optional embodiment of the treatment area **23**, which is shown by double-dot-dash lines, the hot air can already be supplied, immediately after the biomass **1** is transferred out of the airlock **13** of the dryer cyclone **10**, to the biomass as transport air or as ambient air having a temperature T_2 of the biomass **1** on the path to the grinding device **4**. The alternatives shown by dashed lines comprise further possible additional possible applications of the hot air, also in combination with multiple method steps. One of these steps is the additional arrangement of a heavy material separator **3** between the dryer **2** and the billing device **4**. The biomass is correspondingly first supplied to a heavy material separator in order to separate out rocks or large clumps of the biomass **1**, preferably those having harmful properties for the following devices. However, a heavy material separator in particular requires a large quantity of air for swirling the biomass and correspondingly cools down the biomass if the hot air is not preheated. The teaching of the invention has a particularly advantageous effect here and supplies the biomass **1** to the heavy material separator already having ambient air to which hot air is applied and/or causes the air swirling in the heavy material separator **3** by means of supplied hot air from the heating device **15**. Fresh air as the supply air **14** and/or regenerated heat/air having a temperature T_8 from the pellet cooler **17** and/or, via a hot-air return line **21**, hot air from the cyclone **5** for heating and setting the hot air to the temperature T_2 is supplied to the heating device **15**. The hot air used in the treatment area should and can be regularly replaced with fresh air or can be partially or regularly filtered by means of a round filter **16**.

LIST OF REFERENCE NUMERALS: DP 1384

[0025] **1** biomass
[0026] **2** dryer
[0027] **3** heavy material separator
[0028] **4** grinding device
[0029] **5** cyclone
[0030] **6** silo
[0031] **7** discharge device
[0032] **8** pelletizing press
[0033] **9** pellets
[0034] **10** dryer cyclone
[0035] **11** dryer supply air
[0036] **12** exhaust air purification device
[0037] **13** airlock
[0038] **14** supply air
[0039] **15** heating device
[0040] **16** round filter
[0041] **17** pellet cooler
[0042] **18** waste heat
[0043] **19** heat exchanger
[0044] **20** fresh air
[0045] **21** hot air return line
[0046] **22** water spraying device
[0047] **23** treatment area
[0048] **24** screen
[0049] **25** exhaust air
[0050] T_1 temperature of biomass after dryer (before preparation area)
[0051] T_2 temperature of hot air for biomass
[0052] T_3 temperature of hot air/biomass
[0053] T_4 temperature of biomass after preparation area
[0054] T_5 temperature of biomass after storage in silo
[0055] T_6 temperature of hot air after cyclone **16**
[0056] T_7 temperature of air waste heat (air) from pellet cooler
[0057] T_8 temperature of air after heat exchanger **19**

1. A method for producing pellets from biomass in a pelletizing press for use as a fuel in fireplaces, the biomass comprising fibers, chips, or shreds, which contain cellulose and/or lignocellulose, the biomass being heated and dried in the course of the production in a dryer, the dried and heated biomass being separated from the dryer air, and the biomass being supplied to a pelletizing press,

wherein the temperature of the biomass is heated or essentially maintained using hot air in a treatment area between the dryer and the pelletizing press, and the treatment area comprises at least parts of the transport path and/or at least one further device for performing at least one additional method step, and the temperature of the hot air exceeds at least 65° C.

2. The method according to claim **1**, wherein the temperature of the hot air is set using a heating device, the heating device using fresh air as the supply air and/or preheated air from at least one hot-air return line and/or preheated air from a heat exchanger of the waste heat of a pellet cooler after the pelletizing press.

3. The method according to claim **1**, wherein, in the treatment area, the at least one device for performing at least one further method step comprises a heavy material separator for separating heavy material and/or a grinding device for chopping the biomass and/or a cyclone for separating the hot air from the biomass.

4. The method according to claim **1**, wherein at least one device for performing at least one further method step and the heating device guide the hot air in the treatment area in an essentially closed loop.

5. The method according to claim **4**, wherein the hot air in the circuit of the treatment area is regularly replaced and/or filtered at least in parts.

6. The method according to claim **1**, wherein the temperature of the hot air is set in such a manner that the biomass reaches the pelletizing press at a temperature of greater than 65° C.

7. The method according to claim **1**, wherein the dryer is a drum dryer, and the biomass leaves the drum dryer at a temperature of substantially greater than 65° C.

8. The method according to claim **1**, wherein the biomass, in a further method step, is transported by means of hot air through at least one heavy material separator and/or guided through a grinding device and chopped.

9. The method according to claim **1**, wherein the biomass, in a further method step, is transported and heated by means of hot air, in particular hot air of a temperature of 70° to 80° C., through at least one heavy material separator and/or guided through a grinding device, chopped, and heated.

10. The method according to claim **8**, wherein the biomass, in a further method step, has hot air applied thereto, in particular hot air at a temperature greater than 65° C., in at least one silo and/or in a discharge device associated with the silo.

11. The method according to claim **8**, wherein the biomass, in a further method step after the grinding device and/or a heavy material separator, is separated from the hot air in a cyclone, insufficiently chopped parts of the biomass being returned to the grinding device and/or the separated hot air being supplied via a hot-air return line to the heating device.

12. The method according to claim **1**, wherein the biomass is at least partially approximately held at the same temperature level or heated, by means of hot air and/or sufficient insulation in relation to the ambient temperature, during the transport and/or the storage between the individual processing steps.

13. The method according to claim **11**, wherein the hot air for the transport means, the heavy material separator, the grinding device, a silo, and/or the cyclone is heated at least to the temperature of the biomass.

14. The method according to claim **1**, wherein water is supplied to the biomass, in particular sprayed on, essentially shortly before the pelletizing press.

15. The method according to claim **14**, wherein the water is heated to a temperature of greater than 65° C., preferably greater than 80° C., particularly preferably 90° C. before or during the supply to the biomass.

16. The method according to claim **14**, wherein the water is heated with the biomass after the application to the biomass by means of radiant energy.

17. A facility for producing pallets from biomass in a pelletizing press for use as a fuel in fireplaces, the biomass comprising fibers, chips, or shreds, which contain cellulose and/or lignocellulose, a dryer having an airlock for separating the drier air being arranged before the pelletizing press in the production direction for drying and heating the biomass, wherein, in the facility, at least one treatment area is arranged between the airlock and the pelletizing press and at least one transport means for transporting the biomass between the dryer and the pelletizing press and/or at least one device for performing at least one further method step is arranged in this treatment area, at least one heating device for heating and/or providing hot air of substantially greater than 65° C. is arranged associated with the treatment area, the heating device being operationally linked at least once with the transport means and/or with a device for performing further method steps to supply the hot air.

18. The facility according to claim **17**, wherein, in the facility, insulation elements in relation to the ambient temperature are arranged at least in parts on the transport devices and/or on at least one silo and/or on at least one of the devices for the method steps.

19. The facility according to claim **17**, wherein a heavy material separator for separating heavy material and/or a grinding device for chopping the biomass and/or a silo and/or a screen and/or a cyclone for separating the hot-air from the biomass are arranged in the treatment area as the devices for performing at least one further method step.

20. The facility according to claim **17**, wherein a silo having an associated discharge device is arranged for storing the biomass.

21. The facility according to claim **17**, wherein a hot-air return line is arranged to establish a closed circuit of the hot air in the treatment area.

22. The facility according to claim **17**, wherein a pellet cooler, which is arranged with the heating device and/or a heat exchanger for reuse of waste heat, is arranged to store and cool the produced pallets.

23. The facility according to claim **17**, used to perform the method according to claim **1**.

* * * * *