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(54) **Production process with conversion of waste heat from multiple sources of waste heat**

(57) A production process with the conversion of waste heat from multiple waste heat sources, wherein the waste heat is partly converted into electrical energy by means of a main cooling circuit (1), whereby the waste

heat from a number of waste heat sources is collected, via one or more intermediate auxiliary cooling circuits (11), in a main cooling circuit (1) to generate electrical energy.

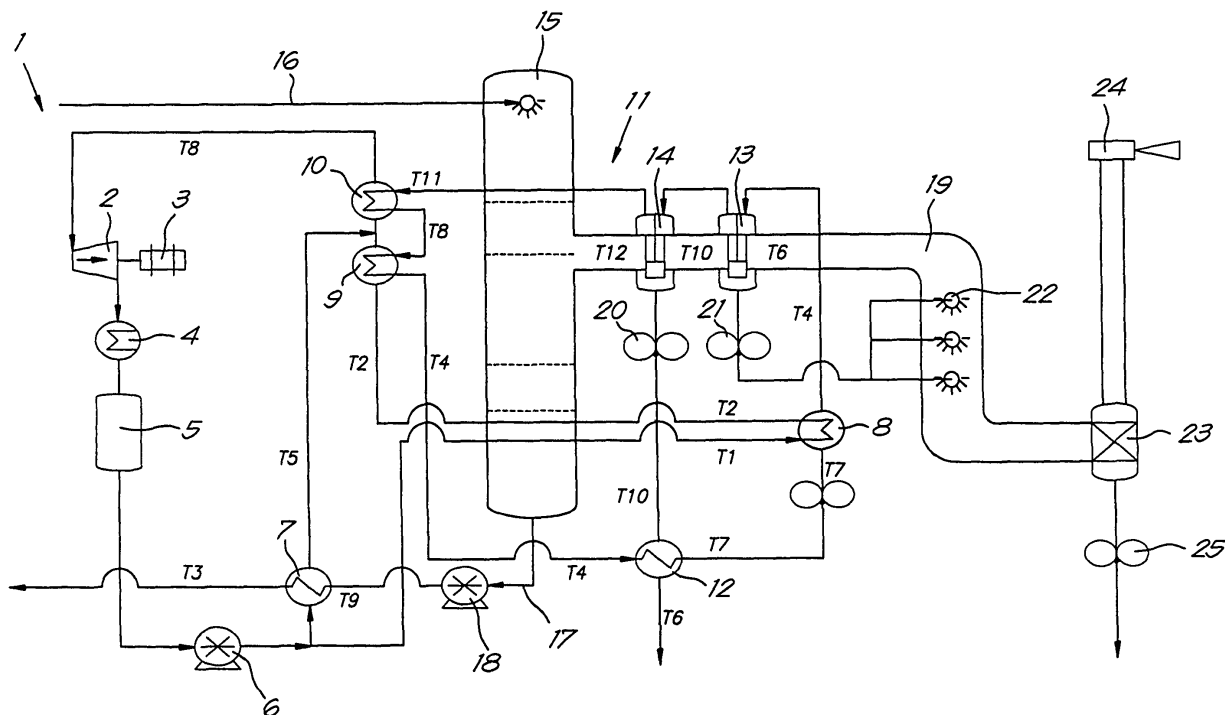


Fig. 1

Description

[0001] The present invention relates to a production process with the conversion of waste heat from multiple waste heat sources.

[0002] As an example we take the stripping and fractionating process of palm oil in which it is known that volatile components can be removed from palm oil by processing the palm oil bulk in a stripper.

[0003] In this stripping and fractionating process the crude palm oil is put in a process tank that is raised to a high temperature and mixed with stripping steam, whereby the volatile components evaporate from the palm oil and are fractionated immediately afterwards in a built-on fractionation pipe. The fractionation process enables the volatile components of stearic acid and palmitic acid to be separated out selectively and separately, while even more volatile components such as lower hydrocarbons are removed.

[0004] Traditionally a great deal of waste heat is released from this process. For example, the heated oil must be cooled again after stripping, and also the separated fractions of stearic acid and palmitic acid must be condensed with the emission of waste heat.

[0005] The condensation of the stripping steam used also releases waste heat. This condensation can be done with an ice condenser that sublimates the steam to ice, and ammonia is used as a coolant, or this condensation can be done by an alkaline vacuum system with a cooling unit that uses cold barometric water as a primary coolant and a mixture of water and ethylene glycol as an intermediate coolant, which in turn is cooled again in a cooling unit by a coolant such as freon or ammonia. In any case, waste heat is released that can be recovered.

[0006] A disadvantage of this process is that a quantity of energy is wasted in the form of waste heat, which increases the energy cost of the entire industrial process.

[0007] Another disadvantage is that the environment can be taken out of equilibrium by the release of the waste heat, with the attached costs for the environment.

[0008] The purpose of the present invention is to make optimum use of this waste heat by partly converting it into electrical energy, and by utilising it to heat liquids during the production process.

[0009] To this end the invention relates to a production process with the conversion of waste heat from multiple waste heat sources in which the waste heat is partly converted into electrical energy by a main cooling circuit, whereby the waste heat from multiple waste heat sources is collected in the main cooling circuit, directly and/or via one or more intermediate auxiliary cooling circuits, in order to generate electrical energy.

[0010] An advantage of the present invention is that fewer external energy sources are needed for the production process, such as fossil fuels, which reduces the production costs, due to the conversion of part of the waste heat.

[0011] Another advantage of the present invention is

that electrical energy is also generated in the production process, which may or may not be used then in the production process itself.

[0012] An additional advantage of the present invention is that less waste heat is released into the environment, such that the environment is spared more.

[0013] The main cooling circuit is a circuit of coolant that absorbs waste heat by directly cooling a production product, in this case the end product of stripped palm oil and the fractionation products from it, and also by cooling an auxiliary cooling circuit that absorbs waste heat from production sub-processes.

[0014] The auxiliary cooling circuit contains a mixture of water and ethylene glycol, by which waste heat is absorbed through a heat exchanger, originating from the fractionation condensers that are used for separating the fractionated products, such as stearic acid and palmitic acid.

[0015] An advantage coupled to the use of separate intermediate auxiliary circuits is that every auxiliary circuit can have its own coolant, different to the coolant of the main circuit for electricity generation, as well as other auxiliary cooling circuits such that every auxiliary cooling circuit can be optimised according to its function.

[0016] The waste heat absorbed in the main cooling circuit is now utilised to drive a turbine that is coupled to a generator to generate electrical energy. The spent coolant is further cooled with a condenser and is further recycled to be heated again by the waste heat sources.

[0017] Preferably the auxiliary cooling circuit uses part of the absorbed waste heat to preheat liquids supplied to the production process, or in this case to preheat a part of the main cooling circuit.

[0018] The main cooling circuit cools a part of the auxiliary cooling circuit to cool a fractionation condenser in the fractionation process.

[0019] In order to better demonstrate the characteristics of the invention, a preferred embodiment is described below, as an example without any limiting nature, of a production process, in this case a palm oil stripping and fractionation process with the conversion of waste heat according to the invention, with reference to the accompanying drawings, in which:

Figure 1 schematically shows the production process of a palm oil stripping and fractionation process with the conversion of waste heat according to the invention.

[0020] Figure 1 schematically shows a closed ammonia main cooling circuit 1 that contains a turbine 2 connected to an electrical power source 3, a condenser 4 and a receiving vessel 5, a pressure pump 6, and four heat exchangers 7, 8, 9 and 10.

[0021] Figure 1 also schematically shows a closed auxiliary cooling circuit 11 with a mixture of water and ethylene glycol that contains four heat exchangers 8, 9, 10 and 12, and two condensers 13 and 14.

[0022] Figure 1 further schematically shows a stripper process tank 15 with an input of palm oil 16 and an output of palm oil 17, an output pump 18, and a heat exchanger 7. The process tank 15 is connected to a fractionation pipe 19, to two condensers 13 and 14, two output pumps 20 and 21, and a set of sprayers 22. The fractionation pipe 19 opens out into a separator 23, connected to a vacuum installation 24 and an output pump 25.

[0023] The operation of the production process in figure 1 can be explained as follows.

[0024] In the stripper process tank 15, unrefined palm oil is raised to a high temperature whereby more volatile components than palm oil are removed via a fractionation pipe 19, and stearic acid is separated at a temperature of 190°C in a condenser 14, and palmitic acid is separated in a subsequent condenser 13 at a temperature of 80°C.

[0025] The separated stearic acid is taken to a heat exchanger 12 via a pump 20, where the stearic acid is cooled to a temperature of 80°C and then taken to the storage.

[0026] The separated palmitic acid is injected downstream into the fractionation pipe, via a pump 21, with sprayers 22 that absorb the more volatile fractions insofar as they are not condensed in the condenser 13, and take them to a separator 23 for separation of the usable fractions that are then taken to the storage via pump 25. The unusable lighter fractions are removed via a vacuum system 24.

[0027] The palm oil stripping and fractionation process produces waste heat that is absorbed by a closed water/ethylene glycol auxiliary cooling circuit 11. Thus the heat originating from the cooling of the fractionated stearic acid is absorbed in the heat exchanger 12, and the heat originating from the cooling of the fractionation condensers 18 and 19 is also absorbed, after which this heat is transferred to the main cooling circuit 1 with a coolant in the heat exchangers 8, 9 and 10.

[0028] In addition to the waste heat, absorbed in a closed water/ethylene glycol auxiliary cooling circuit 11, the stripping and fractionation process produces waste heat from the cooling of the stripped palm oil itself that is transferred via the heat exchanger 7 directly to the main cooling circuit 1.

[0029] In this way the main cooling circuit 1 collects the waste heat absorbed from a number of sources in the production process, after which this heat is utilised to drive a turbine 2 coupled to an electric generator 3 for the production of electrical energy.

[0030] The spent coolant is further cooled in a condenser 4 and further guided via a collection vessel 5 and a pressure pump 6 in the closed main cooling circuit 1 to reabsorb waste heat.

[0031] The main cooling circuit 1 extracts waste heat from the auxiliary cooling circuit 11 with a heat exchanger 8, such that the water/ethylene glycol mixture is brought to the right lower temperature of T3 (60°C) in order to cool the fractionation condensers 13 and 14.

[0032] The auxiliary cooling circuit 11 releases waste heat to the main cooling circuit 1 in the heat exchanger 9, whereby the coolant is evaporated before being combined with the other coolant supply that comes from heat exchanger 7, and is then further heated by the heat exchanger 10. The coolant at T8 (123°C) is now ready to drive the turbine 2.

[0033] The temperatures indicated in figure 1 are designated with symbols. In this case these symbols represent the following temperatures, but the symbols are not limited to these temperatures:

T1 = 30°C
T2 = 44.5°C
T3 = 50°C
T4 = 60°C
T5 = 75°C
T6 = 80°C
T7 = 89°C
T8 = 132°C
T9 = 140°C
T10 = 190°C
T11 = 205°C
T12 = 270°C

[0034] Aside from utilising the waste heat to generate electrical energy, waste heat is also utilised directly to heat or cool liquids in the production process.

[0035] Thus the main cooling circuit is heated by the auxiliary cooling circuit in heat exchanger 8, whereby the coolant of the auxiliary cooling circuit is brought to the right temperature T4 (60°C) for condensing palmitic acid in condenser 13.

[0036] The auxiliary cooling circuit is thus heated in heat exchanger 12 by the waste heat that is released from cooling the fractionated stearic acid, separated in condenser 18, after which the cooled stearic acid is taken to the storage at the desired temperature of T6 (80°C).

[0037] The present invention is not in any way limited to the embodiment described as an example and shown in the figures. Such a process for converting waste heat from multiple sources in a production process to generate electrical energy and to directly heat liquids during the production process can be realised according to different variants, without acting outside the scope of the invention.

Claims

1. A production process with the conversion of waste heat from multiple waste heat sources, **characterised in that** the waste heat is partly converted into electrical energy by means of a main cooling circuit (1), whereby the waste heat from a number of waste heat sources is collected, via one or more intermediate auxiliary cooling circuits (11), in a main cooling circuit (1) to generate electrical energy.

2. A production process according to claim 1, **characterised in that** the main cooling circuit (1) absorbs waste heat by directly cooling an end product, and also by cooling an auxiliary cooling circuit (11) that absorbs waste heat from production sub-processes. 5
3. A production process according to claim 2, **characterised in that** the production sub-processes consist of the thermal fractionation of volatile components from palm oil in a fractionation pipe (19) with condensers (13,14), and the cooling of purified fractionation products by means of a heat exchanger (12). 10
4. A production process according to claims 1 to 3, **characterised in that** the auxiliary cooling circuit (11) contains a mixture of water and ethylene glycol. 15
5. A production process according to claim 2, **characterised in that** the auxiliary cooling circuit (11) absorbs waste heat from fractionation condensers (13, 14) that separate fractionated products. 20
6. A production process according to claim 5, **characterised in that** the fractionated products are stearic acid and palmitic acid. 25
7. A production process according to claims 1 to 6, **characterised in that** the main cooling circuit (1) directly cools the formed end product, refined palm oil, via a heat exchanger (7). 30
8. A production process according to claims 1 to 7, **characterised in that** the main cooling circuit (1) drives a turbine (2), coupled to an electrical power source (3) to generate electrical energy. 35
9. A production process according to claims 1 to 3, in which the auxiliary cooling circuit (11) uses waste heat from the production process to preheat liquids that are supplied to the production process. 40
10. A production process according to claim 9, **characterised in that** the auxiliary cooling circuit (11) preheats the main cooling circuit (1) via heat exchangers (8,9). 45
11. A production process according to claims 1 to 3 **characterised in that** the main cooling circuit (1) pre-cools the auxiliary cooling circuit (11) via heat exchangers (8,9). 50
12. A production process according to claim 11, **characterised in that** the main cooling circuit (1) pre-cools the auxiliary cooling circuit (11) in order to cool one or more fractionation condensers (13,14) of the fractionation process via a heat exchanger (8). 55
13. A production process according to claims 1 to 3, **characterised in that** the auxiliary cooling circuit is heated in a heat exchanger (12) by waste heat that is released from the cooling of the fractionated stearic acid separated in a condenser (14).

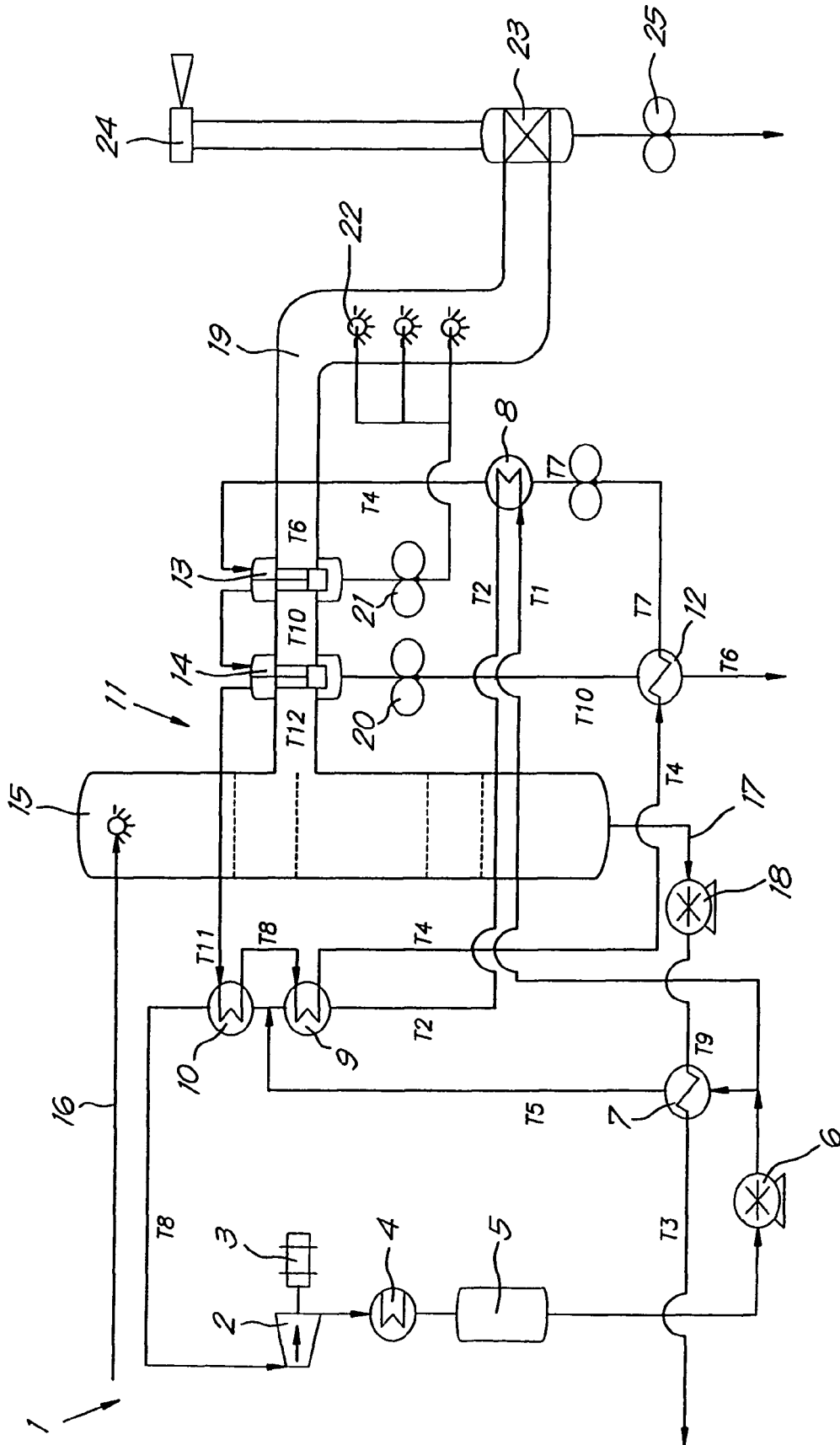


Fig. 1