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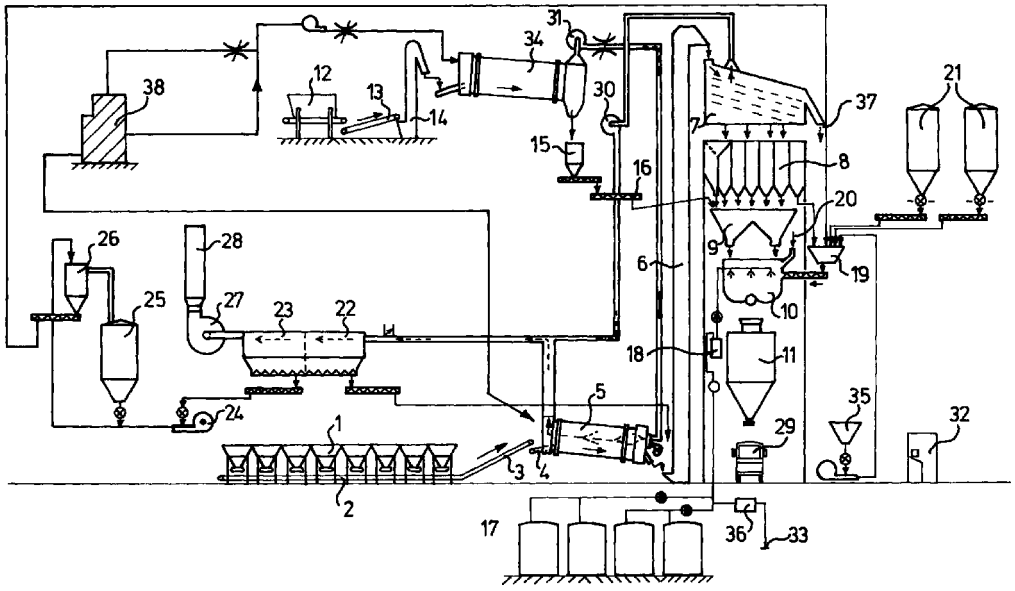
(54) Process for recycling tar and/or bitumen containing material comprising thermal conversion in combination with the production of asphalt

(57) The present invention relates to a process and apparatus for recycling tar and/or bitumen containing material in an asphalt production plant, wherein tar and/or bitumen containing material is thermally converted into hot gases and a hot mineral residue, which are supplied to a mixing plant for the production of new or recycling asphalt. Preferably, the tar and/or bitumen containing material comprises asphaltic aggregate reclaimed from (old) asphalt pavement.

According to the present invention it is possible to recycle tar and/or bitumen containing materials in an efficient and economical manner. The invention also makes it possible to remove harmful substances from the tar and/or bitumen containing material.



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Description

[0001] The present invention relates to a process for recycling tar and/or bitumen containing material in an asphalt production plant, wherein tar and/or bitumen containing material is thermally converted into hot gases and a hot mineral residue, which are supplied to a mixing plant for the production of asphalt. The present invention also relates to an apparatus for carrying out the process.

[0002] In particular asphalt material reclaimed from old pavement material is to an increasing extent used in the production of asphalt, often referred to as "recycling asphalt". The main reason it that old asphalt contains valuable materials such as bitumen, which is a petroleum product and mineral aggregates. An example of a process for recycling of old asphalt is described in WO 85/05439. According to this document reclaimed asphaltic aggregate is mixed with fresh bitumen and fresh mineral aggregate. The reclaimed asphaltic aggregate is dried and heated in a so-called recycle dryer (a parallel drum), which requires a substantial supply of energy.

[0003] EP 216,316 describes a process for recycling asphaltic granulate. The apparatus used comprises a drum dryer for drying minerals, a drum dryer for drying asphaltic granulate and a mixer in which the dried materials are mixed with filler and bitumen. The gases from the dryer for drying asphaltic aggregate are directed to the dryer for drying minerals. The object of the described process is not to oxidise or otherwise deteriorate the recycled bitumen material, but to heat it.

[0004] EP 437,990 describes a process for preparing bituminous asphalt products from recycled asphalt material and fresh minerals and bitumen. According to this process, the recycled asphaltic aggregate is dried and heated in a first drum and then introduced into a second drum where it is mixed with fresh mineral aggregate and fresh bitumen. Also according to this document the object is to heat the recycled material and to avoid its thermal degradation. In DE 3723103 a method is described wherein recycled asphaltic material is heated and mixed with fresh bitumen and mineral aggregate. The object is also to reuse reclaimed asphaltic material without deterioration of the bitumen.

[0005] The drawback of processes which recycle old reclaimed asphalt by heating it and then mixing it into new asphalt is that only old asphalt of a high quality can be used. If lower quality asphalt types are used, these result in a deterioration of the quality of the recycling asphalt product A further drawback is that these processes cannot be used for recycling of asphalt containing harmful substances, such as tar containing asphalt.

[0006] Tar containing asphalt has been used up to about 1991 (in the Netherlands). Tar containing asphalt has the disadvantage that it contains polycyclic aromatic hydrocarbons (PAH's), which are harmful substances for which strict legal limitations apply. It is not allowed to recycle tar containing asphalt by hot mixing it with new asphalt, because then the PAH's could evaporate into the environment. Conventionally tar containing asphalt is therefore recycled in a cold manner as "mineral" aggregate in cement and/or bitumen-emulsion bound granular base course material. However, this is only a temporary solution because the harmful substances from the tar are not removed.

[0007] The object of the present invention is to provide a process which allows the recycling of low quality tar and/or bitumen containing material, such as tar containing asphalt or low quality bitumen containing asphalt. Another object is to recycle tar and/or bitumen containing material in combination with the production of asphalt such that it results in saving of energy and starting materials. A further object is to provide a process for total recycling of asphalt in an efficient and economical manner.

[0008] The present invention provides a process for recycling of tar and/or bitumen containing material comprising thermally converting tar and/or bitumen containing material into a mineral residue and hot gases; and supplying the hot gases and mineral residue to an asphalt production plant.

[0009] This process has the following advantages:

* The thermal conversion of tar and/or bitumen containing material proceeds substantially autothermal, which means that the thermal conversion process requires little external energy supply and therefore results in saving of energy in the production of asphalt.
* The present process results in the removal of harmful substances from the tar and/or bitumen containing material.
* The mineral residue contained in the tar and/or bitumen containing material is recycled for use in high grade applications, i.e. in the production of new or recycling asphalt and therefore results in saving of starting materials.
* If the hot gases still contain contaminants or dust particles, these are removed by the filtration system of the asphalt production plant. No separate filtration system for the thermal conversion system is necessary.
* The tar and/or bitumen containing material is completely recycled without further residues.

[0010] In the present application, "recycling" is meant to include re-using of reclaimed materials. When "recycling of asphalt" is mentioned this term therefore includes thermal conversion of reclaimed asphalt and then using the residues and energy content for the production of asphalt, as well as mixing reclaimed asphalt together with new mineral aggregate and new bitumen to obtain a new asphalt product ("recycling asphalt").

[0011] With the term "asphalt" is meant asphalt

which at least in part contains fresh bitumen and which may also contain bitumen from reclaimed asphalt. This term thus also includes the so-called recycling asphalt, which consists of both fresh bitumen and recycled bitumen.

[0012] The tar and/or bitumen containing material which is thermally converted preferably comprises asphaltic aggregate. With the term "asphaltic aggregate" is meant tar-free or tar-containing asphalt reclaimed from (old) asphalt pavement. This means that the asphaltic aggregate can contain reclaimed tar containing asphalt pavement, but also aged (oxidized) bitumen containing asphalt pavement and/or contaminated, for instance with hydrocarbons, bitumen containing asphalt pavement.

[0013] Other materials that can be present in the tar and/or bitumen containing material are other tar and bitumen containing materials, such as roof cuttings. Further, any other organic material which is combustible can be added, provided that the residues alter conversion do not disturb the asphalt production process. Preferably, the tar and/or bitumen containing material comprises more than 30 % by weight, more preferably more than 50 % by weight, most preferably more than 80 % by weight of asphaltic aggregate.

[0014] With thermal conversion is meant any process which converts the tar and/or bitumen containing material under the influence of heat to substances which are less or not harmful to the environment. This process therefore does not involve just heating the recycled material but converts it into different substances. The thermal conversion is for instance an incineration process.

[0015] The thermal conversion process is preferably a process which allows to control the temperature of the gas stream discharged from the process. The thermal conversion apparatus is preferably a fluidised bed reactor, more preferably a toroidal fluidised bed reactor. Such toroidal fluidised bed reactors are available under the tradename TORBED from Torftech, UK and are described in patent application EP 68853, which is incorporated by reference. The use of such a thermal conversion process makes it possible to recycle tar containing asphalt, without the risk of PAH's remaining in the discharge streams of the process. The process control of the thermal conversion apparatus depends on the starting materials used. Specific conditions such as temperature can readily be determined by a skilled person.

[0016] As described above, the tar and/or bitumen containing material is first thermally converted which results in a hot gas stream and a mineral residue which was contained in the asphalt. The mineral residue resulting from the thermal conversion is clean and environmentally safe. The big advantage of using asphaltic aggregate in this process is that the mineral residue obtained after the thermal conversion of the asphaltic aggregate already has a composition suitable for use in asphalt. It can be transferred directly to the aggregate dryer because it does not disturb the composition of the asphalt.

[0017] Furthermore, the inherent heat of the tar or bitumen containing materials is re-used. The tar or bitumen itself is fuel for the thermal conversion process, hence this process requires little energy supply. Further, the thermal conversion process results in a stream of hot gases and hot mineral residue which can be used advantageously in the asphalt production process.

[0018] The asphalt production plant to which the hot gases and hot mineral residue are supplied can be a batch type asphalt mixing plant or a continuous asphalt mixing plant, such as a drum mixer. These asphalt mixing plants can be of conventional design.

[0019] When a batch type asphalt mixing plant is used, the hot mineral residue obtained after thermal conversion is preferably transferred to the aggregate dryer, which is used to dry and heat fresh mineral aggregate. The aggregate dryer can be of conventional design. The hot mineral residue can be transferred to the aggregate dryer with or without intermediate storage. Preferably the hot mineral residue is not stored. This allows use of the energy of the hot mineral residue in the aggregate dryer. Part or all of the hot gases obtained after thermal conversion can also be directed to the aggregate dryer.

[0020] The asphalt production plant can also comprise a device for heating and drying asphaltic aggregate, preferably a parallel drum, sometimes referred to as a recycle dryer. This device serves to heat and dry asphaltic aggregate before mixing it with fresh mineral aggregate and fresh bitumen. The device makes it possible to recycle not-contaminated bitumen containing asphalt of high quality. It is not allowed to supply low quality materials (contaminated) such as tar containing asphalt to a device for heating and drying asphaltic aggregate due to legal restrictions. According to the invention, part or all of the hot gases obtained after thermal conversion can be directed to the device for heating and drying asphaltic aggregate.

[0021] As in conventional batch type asphalt mixing processes, the process according to the present invention preferably also includes the steps of classifying the dried and heated aggregate according to particle size using a suitable sizing screen arrangement and mixing a metered quantity of the classified aggregate with a metered amount of bitumen. To this mixture dried and heated asphaltic aggregate obtained in the parallel drum can be added.

[0022] According to the present invention there is also provided an apparatus for recycling asphalt, comprising an apparatus for thermal conversion of a tar and/or bitumen containing material including asphaltic aggregate into a hot mineral residue and hot gases; and means for transferring the hot mineral residue and hot gases to an asphalt production plant.

[0023] The present invention further provides a

batch type apparatus for the production of asphalt. Besides the apparatus for thermal conversion this apparatus preferably contains an aggregate dryer as described above and means for transferring the hot mineral residue obtained after thermal conversion to the aggregate dryer and/or means for transferring hot gases to the aggregate dryer.

[0024] Preferably, the batch type apparatus also includes a parallel drum for heating and drying asphaltic aggregate as described above and means for directing part or all of the hot gases obtained after thermal conversion to the parallel drum. Further the batch type apparatus can comprise means for directing part or all of the hot gases from the parallel drum to the aggregate dryer.

[0025] Other components which are conventionally present in a batch type asphalt mixing plant will be described in detail below.

[0026] The batch type apparatus according to the invention can further include a cold feed hopper for storing starting mineral aggregate. Preferably the apparatus includes a plurality of cold feed hoppers for storing aggregate of various size to be used in producing the final mix. The same means can be used to transfer mineral residue from the thermal conversion apparatus, optionally after intermediate storage, to the aggregate dryer.

[0027] The aggregate dryer is of conventional design and can be a large elongated drum having a burner directed into one end, with the aggregate being fed therethrough from the other end, and providing rotation of the drum with flights for mixing the aggregate material with the hot gases and causing it to be dried.

[0028] The hot and dried aggregate can be transported to the sizing screen arrangement by means of a transfer belt, elevator or other suitable means.

[0029] The sizing screen arrangement serves to classify the preheated and dried aggregate into various particle sizes and is connected to a system for holding the graded material. The sizing screen arrangement may be provided in any suitable form to separate the aggregate into any suitable number of size ranges as desired.

[0030] The batch type apparatus may also include an asphaltic aggregate storage silo (cold feeder) and means for transporting the asphaltic aggregate, for instance a conveyor belt or other transfer means, to the parallel drum where it is dried and heated. The parallel drum is of conventional design. The heated asphaltic aggregate can be transported directly to the weighing hopper but can also be stored in an intermediate storage silo.

[0031] The batch type apparatus may also include storage silo's for storing hot mineral aggregate to serve as a buffer.

[0032] The batch type apparatus may further include a weighing hopper for weighing the heated aggregate and optionally (heated) asphaltic aggregate. The proportion of mineral aggregate and reclaimed asphalt discharged into the weighing hopper may be controlled according to the grade or mix required in the final batch.

[0033] Bitumen may be added to the mix from a suitable bitumen storage tank or other facility. The bitumen preferably is added to the mix in a suitable mixing chamber. Filler materials, such as fine material or powder may also be added to the mixing chamber or elsewhere. An associated filler tank or silo may be provided for this purpose. Fines may be collected by extraction from exhaust gas of the aggregate dryer and used to provide at least part of the filler. Extraction may be by means of a bag filter or fabric filter for example.

[0034] According to the present invention the mineral residue and hot gases obtained after thermal conversion can also be supplied to a continuous asphalt mixing plant. Continuous mixing plants generally can be divided into two categories. In the first type mineral aggregate is heated and dried in a drum dryer. The heated and dried aggregate is then discharged into a separate mixing device, such as a pugmill. Bitumen is then introduced into the mixer along with the mineral aggregate and is thoroughly mixed, the resulting new asphalt being discharged from the other end of the mixer.

[0035] In this type of mixing plant the mineral residue obtained after thermal conversion can be added to the fresh mineral aggregate in the dryer. The hot gases can be supplied to the dryer.

[0036] In the second type of continuous mixing plant, the so-called drum mixer, the drying and mixing processes are both carried out in a single rotating drum. Mineral aggregate is added at the top of the rotating drum. A burner is mounted in the upper end to heat and dry the mineral aggregate. Bitumen is introduced into the drum downstream of the burner. The heated and dried aggregate and the bitumen are then mixed in the bottom portion of the drum, and the new asphalt is discharged out the lower end of the drum.

[0037] In this type of mixing plant, the mineral residue obtained after thermal conversion can be introduced into the drum together with fresh mineral aggregate. The hot gases can be introduced at any point in the drum, but are preferably introduced near the burner.

[0038] These conventional drum mixers can also be used for recycling old asphalt. In that case asphaltic aggregate is generally introduced into the drum mixer downstream of the burner. According to a specific embodiment of the invention it is possible to produce a material consisting substantially only of recycled material. For instance, about 15 % asphaltic aggregate is converted in the apparatus for thermal conversion and 85% asphaltic aggregate is supplied to the drum mixer. In this manner a product can be obtained consisting of substantially 100% recycled asphalt. If necessary, also small amounts of fresh bitumen can be added to the

material.

[0039] The present invention will now be described by means of the accompanying drawing which shows a batch type apparatus for the production of asphalt according to the present invention.

[0040] In the drawing, fresh aggregate is supplied to a cold feed hopper 1. From the cold feed hopper 1 the aggregate is transferred by conveyor belts 2, 3 and 4 to the aggregate dryer 5. From the aggregate dryer 5 the heated and dried aggregate is transported to a sizing screen arrangement 7 by means of a hot elevator 6. The aggregate dryer 5 is further connected to a dust filter system which consists of a pre-separator 22 and a fabric filter 23. The dust filter system is connected to an exhauster 27 and a stack 28 for discharging the gases from the dryer. The fabric filter 23 is also connected to an exhauster 24, filtered dust storage 25 and filtered dust dosage silo 26 which are used to meter the filtered dust and to transport it to the filler weighing hopper 19. The pre-separator 22 is connected to elevator 6, for transporting the separated material to the sizing screen arrangement 7.

[0041] The apparatus also includes an asphaltic aggregate feeder 12 connected to a conveyor belt 13 and elevator 14 to transport asphaltic aggregate to the parallel drum 34. The parallel drum 34 is connected to an exhauster 31 for transporting the gases of the parallel drum 34 to the aggregate dryer 5. The dried and heated asphaltic aggregate is transported to an intermediate storage silo 15.

[0042] From the storage silo 15 the asphaltic aggregate is transferred by means of screw conveyor 16 to the weighing hopper 9. The weighing hopper 9 is also connected to holding bin for heated mineral aggregate 8. The holding bin 8 receives the heated mineral aggregate from the sizing screen arrangement 7, which contains a screen overflow 37 and a screen exhaust 30 (connected to pre-separator 22).

[0043] In mixer 10 asphaltic aggregate and mineral aggregate from weighing hopper 9 are mixed with additives provided by opening 20, fillers and additives from filler weighing hopper 19 and bitumen. The bitumen is stored in storage tank 17 and transferred via bitumen dosage device 18 to the mixer 10. If desired modified bitumen can be added at 33 and via modified bitumen dosage device 36. The filler material is stored in filler storage silo 21. Additives are supplied to weighing hopper 19 by means of dosage unit 35. From mixer 10 the asphalt is conveyed to the asphalt storage silo 11 from where it can be transported to customers (29). The apparatus further contains a control room 32 having the plant controls.

[0044] Thermal conversion of tar and/or bitumen containing materials, in particular asphaltic aggregate, takes place in thermal conversion apparatus 38. The tar and/or bitumen containing material is transferred to the thermal conversion apparatus 38 from a storage silo (not shown). From thermal conversion apparatus 38 mineral residue obtained after conversion of the tar and/or bitumen containing materials is transferred to the aggregate dryer 5. The gases obtained in the thermal conversion apparatus 38 are directed to the parallel drum 34 and/or to the aggregate dryer 5.

[0045] It should be noted that the drawing only shows an embodiment of the invention and that the invention is not limited thereto. Adaptations to this design are within the reach of a person skilled in the art.

Claims

1. A process for recycling of tar and/or bitumen containing material comprising thermally converting tar and/or bitumen containing material into a mineral residue and hot gases; and supplying the hot gases and mineral residue to an asphalt production plant.

2. A process according to claim 1, wherein the tar and/or bitumen containing material comprises asphaltic aggregate.

3. A process according to claim 2, wherein the tar and/or bitumen containing material comprises more than 30 % by weight, preferably more than 50 % by weight asphaltic aggregate.

4. A process according to any of claims 1 to 3, wherein the thermal conversion is carried out such that a controlled stream of hot gases is obtained.

5. A process according to any of the preceding claims, wherein the thermal conversion is carried out in a fluidised bed reactor.

6. A process according to any of the preceding claims, wherein the asphalt production plant is a batch type asphalt mixing plant.

7. A process according to claim 6, wherein the batch type asphalt mixing plant comprises an aggregate dryer for heating and drying mineral aggregate, characterized in that the mineral residue obtained after thermal conversion is transferred to the aggregate dryer.

8. A process according to claim 7, wherein part or all of the hot gases obtained after thermal conversion are directed to the aggregate dryer.

9. A process according to any of claims 6 to 8, wherein the batch type asphalt mixing plant comprises a device, preferably a parallel drum, for heating and drying asphaltic aggregate, characterized in that part or all of the hot gases obtained after thermal conversion are directed to said device.

10. A process according to any of claims 1 to 5,

wherein the asphalt production plant is a continuous asphalt mixing plant.

11. A process according to claim 10, wherein asphaltic aggregate is supplied to the continuous asphalt mixing plant, such that a product consisting substantially of 100% recycled asphalt is obtained.

12. An apparatus for recycling asphalt, comprising

an apparatus for thermal conversion of a tar and/or bitumen containing material into a hot mineral residue and hot gases; and
means for transferring the hot mineral residue and hot gases to an asphalt production plant.

13. A batch type apparatus for the production of asphalt, comprising

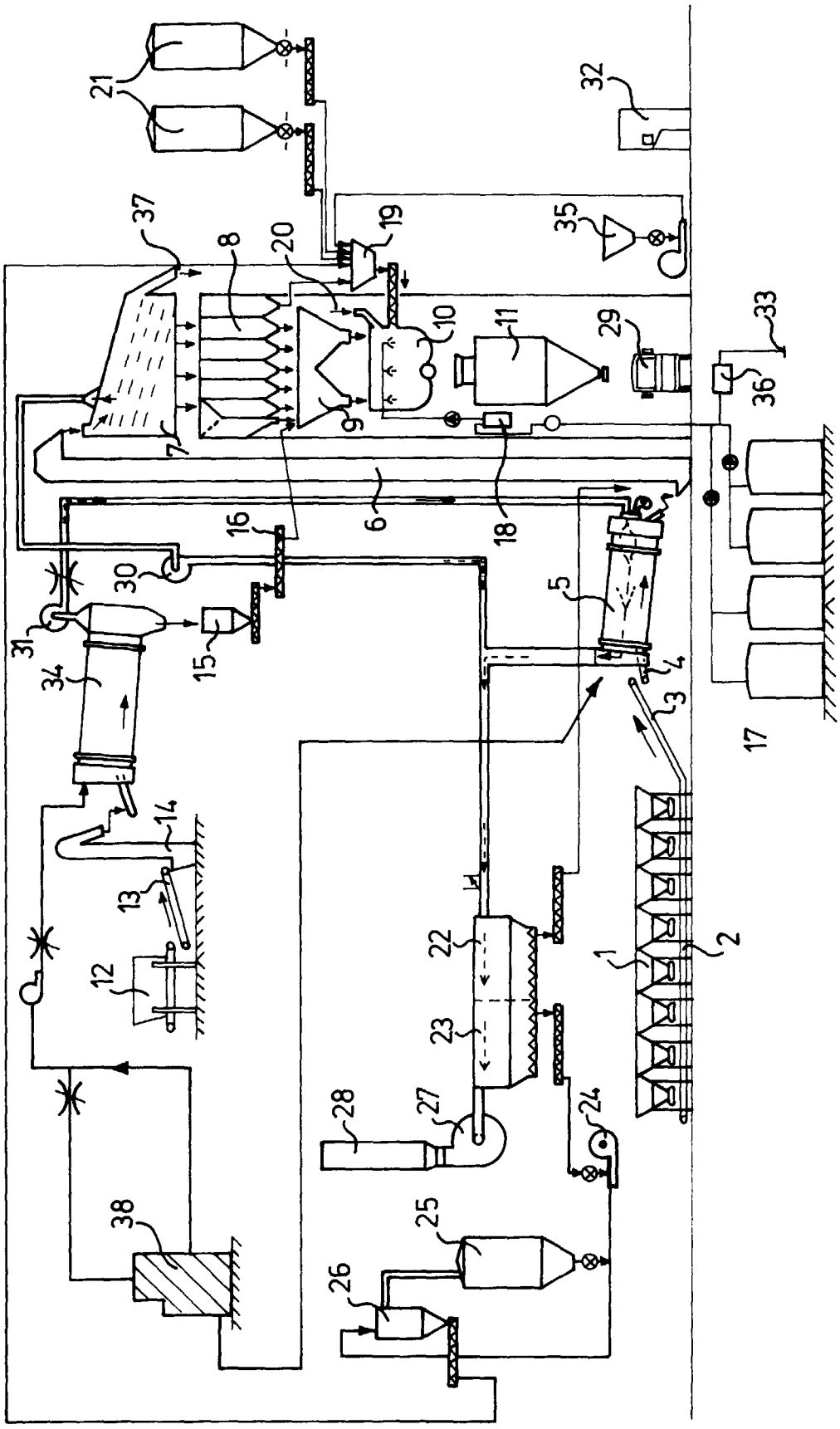
an aggregate dryer for heating and drying mineral aggregate;
a sizing screen arrangement for classifying the dried and heated aggregate according to particle size;
means for transferring the dried and heated mineral aggregate to the sizing screen arrangement;
a weighing hopper and mixer for mixing the classified aggregate with bitumen; characterized in that it further comprises
an apparatus for thermal conversion of a tar and/or bitumen containing material into a hot mineral residue and hot gases; and
means for transferring the hot mineral residue obtained after thermal conversion to the aggregate dryer and/or
means for directing hot gases to the aggregate dryer.

14. An apparatus according to claim 13, further comprising:

a device, preferably a parallel drum, for heating and drying asphaltic aggregate;
means for transferring the dried and heated asphaltic aggregate to the weighing hopper and mixer;
means for directing part or all of the hot gases obtained after thermal conversion to the device for heating and drying asphaltic aggregate.

15. An apparatus according to claim 14, further comprising

means for directing part or all of the hot gases from the device for heating and drying asphaltic aggregate to the aggregate dryer.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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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