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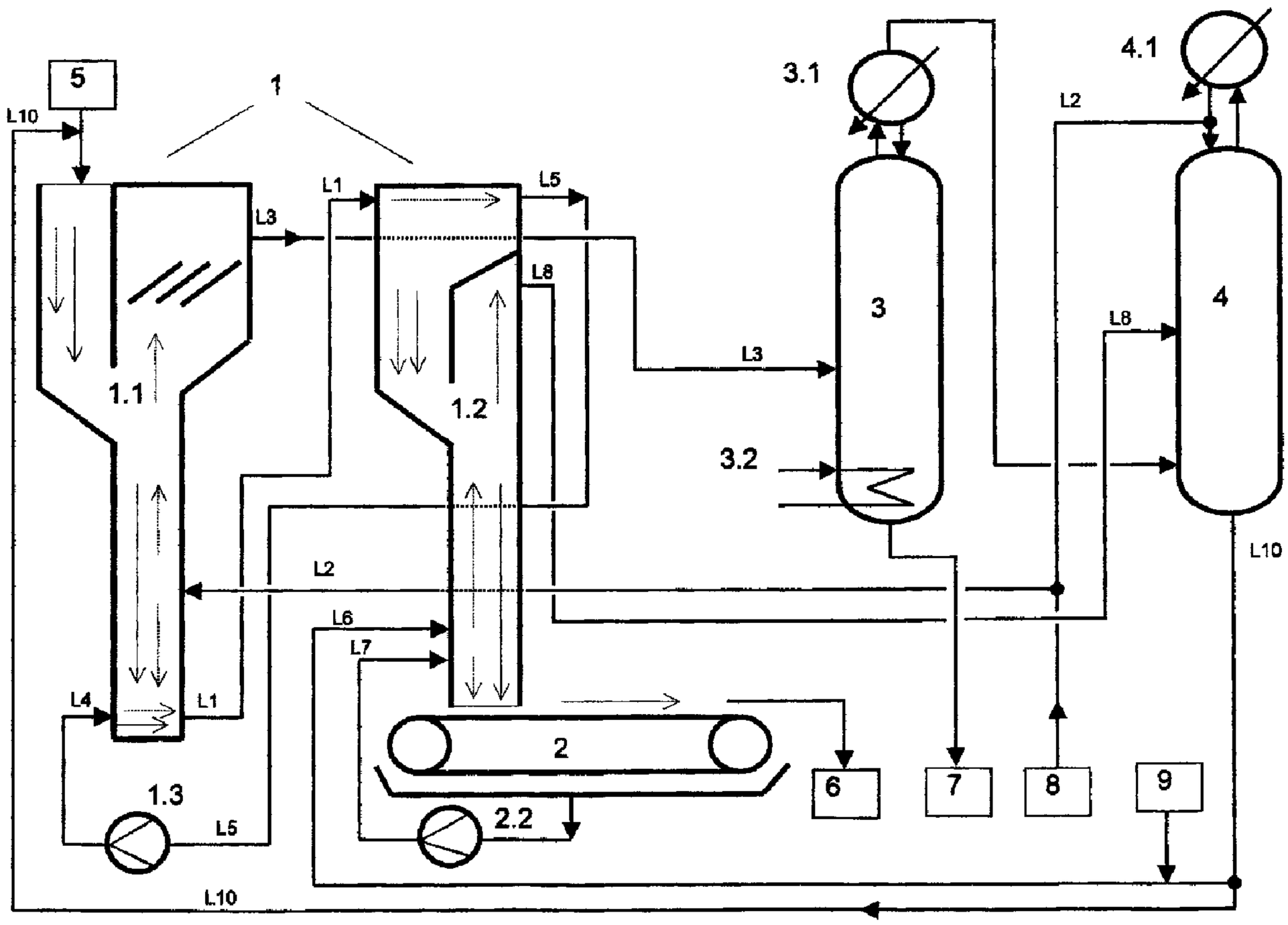
(54) Titre : METHODE ET APPAREIL PERMETTANT L'EXTRACTION PAR SOLVANT DE SABLE BITUMINEUX
(54) Title: METHOD AND APPARATUS FOR SOLVENT EXTRACTION OF OIL-CONTAINING SAND



(57) Abrégé/Abstract:
The invention relates to recovery of oil or bitumen from grained material, for instance crushed sediment or tar sand. Examples are the tar sand deposits in Alberta, Canada. The adventages of the invention are produced by the following characteristics: -

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(57) Abrégé(suite)/Abstract(continued):
Extraction of the tar sand in a countercurrent extracting column, in which the sand is moving only by the effect of the gravity or by the effect of streaming liquids. - separation of the grained material by a moving filter, wherein this material is feeding to the filter only by the effect of gravity or streaming liquids, - separation of the product oil from the extract solution by vaporing process - recovery of the solvent by vaporing process. The follow adventages are provided: - Improve the environment protection by reduction of the mass of waste water, - Reduce the energy consumption, - Increase the product output by increasing the oil recovery rate, - Increase the lifetime of the apparatus.

Abstract

Method and apparatus for solvent extraktion of oil-containing sand

The invention relates to recovery of oil or bitumen from grained material, for instance crushed sediment or tar sand. Examples are the tar sand deposits in Alberta, Canada.
The adventages of the invention are produced by the following characteristics:

- Extraction of the tar sand in a countercurrent extracting column, in which the sand is moving only by the effect of the gravity or by the effect of streaming liquids.
- separation of the grained material by a moving filter, wherein this material is feeding to the filter only by the effect of gravity or streaming liquids,
- separation of the product oil from the extract solution by vaporing process
- recovery of the solvent by vaporing process.

The follow adventages are provided:

- Improve the environment protection by reduction of the mass of waste water,
- Reduce the energy consumption,
- Increase the product output by increasing the oil recovery rate,
- Increase the lifetime of the apparatus.

Method and apparatus for solvent extraktion of oil-containing sand

Field of the invention

The invention relates to recovery of oil or bitumen from grained material, for instance crushed sediment or tar sand. The term grained material is choised, because for the application of the process at least a part of the material must have a charakter like sand. The adventages of the invention are reduced if the material containes more of clay. The invention is not practicable for pure clay. The cause of this fact is described at the description of the process design.

In the last time more and more obtained importance such mining processes, wich produced oil by mining of bituminous an oil sands.
The best examples are the tar sand deposits in Alberta, Canada.
The best known process for recovery of oil from this sediment is the hot water process, wich used alcaline water as an extracting medium.
At this process however are be formed large masses of waste water.
Some inventions are proposed, to use solvents instead of water to recover oil and by this way to prohibit the creation of waste water.
A typical process is described in the patent CA 2147943.
At this process the sand is mixed with thinning oil. The feed slurry is in a seperating vessel separated in product oil and oil sand. The oil sand is countercurrently washing with solvent in a screw conveyor. The washed sand is stripped by heated inert gas in a solvent recovery furnace.
Inert gas and solvent vapor are intruduced in a heat exchanger/scrubber and contacted with product oil to form thinning oil.

The major drawback of this process is the mechanical agitation of the solid material in a screw convoyer. This is wearing for the construction material. Furthermore the product oil is containing parts of the solvent and a lot of fine material of the feed sand.

These drawbacks are reduced in solvent processes, wich are developed for decontamination of soil and described in US-Pat 5 507 953 and german DE-OS 19757149. The drawback of first of these processes is, that is used in the process an costly capsuled belt filter and that the solvent recovery part is concepted only for minor masses of oil products, wich are exist in contamineted soils.

In the concept of the second process does not exist the description of the solvent recovery.

Summary of the invention

The prevent invention is designed to overcome the limitation of the prior art processes.
The follow adventages are provided

- Improve the environment protection by reduction of the mass of waste water
- Reduce the energy consumption
- Increase the product output by increasing the oil recovery rate
- Increase the lifetime of the apparatus.

The adventages are produced by the following characteristics:

1. Extraction of the tar sand in a countercurrent extracting column, in which the sand is moving only by the effect of the gravity or by the effect of streaming liquids.
2. Separation of the grained material by a moving filter, with wich this material is feeding to the filter only by the effect of gravity or streaming liquids,
3. Separation of the product oil from the extract solution by vaporing process,
4. Recovery of the solvent by vaporing process.

Detailed description of the present invention

The drawing Fig. 1 is a simplified schematic diagram of the invention.

Extraction part

The extraction part containes two countercurrent columns:
In the extracting column (1.1) the grained material is threating with solvent, in the washing column(1.2) the solvent is recovered from the material by water.
The crushed grained material is feeded in the extracting column and is moving down. The speed is related to the material removing by the pipeline L1 at the foot of the column.
Contrary to the material is moving solvent, feeding in by line L2. The solvent recovers the bitumen and oil out of the grained material and forms the extract solution. The extract solution is moving out of the column by pipeline L3.
Solvent is an liquid or an mix of liquids, wich can solve the bitumen and oil, wich can mixed with water and wich can recovered by destillation from all liquids in the process. In preference is the solvent acetone.
The directions of moving in the column: continues line for grained material, dashed line for liquid.

In the top of the extraction column befor line L3 are drawing three separating sheets. They are a symbol for the separating function of this part of the device. Together with the flow-rates of sediment and liquid the dimension of this part determines, how much fine solid material is contained in the product oil.
Target is an small speed of the extract solution. In this case the product oil contained only a small part of fine solid material.
In the bottom of the device via line L4 is liquid injected in, wich carrys away the solid material in the line L1. In this pipeline the material is transported to the washing column (1.2).
In the top of the washing column solid material is separated by sedimentation from the liquid. Liquid is streaming back to the extacting column (1.1) via pump (1.3) and pipeline L4.
Solid material is moving down. Contrary to this material is moving water from the pipelines L6 und L7.
This water removes the solvent out of the solid material, the mix of solvent and water is moving out of the device via line L8.
The bottom of the washing column is open. It is closing by the surface of the continous filter (2) and the clot of solid material, when the filter is not moving. In this case the solid material cannot moving out and the mass of liquid flowing out is limited by the porosity of the clot.
Is the filter aktiv, the solid material is moving out of the washing column. The flow-rate of material is related to the speed of the filter and the dimension of the gap inter filter and column.
The function of the hydraulic closure via clot is depending of a part of grained material in the solid material.
Therefore the process is not practicable for pure clay.
The limitation can be determineted by simple experiment of sedimentation and flowability in laboratory.
Bevore starting up the plant some of sand must be filled in the washing column.

Washed solid material moving out of the plant as filter cake (6) from the filter.
The water flowing out of the filter is moving back in the washing column via pump (2.2) and pipeline L7.

Rehash of the liquid products

Extract solution, moving out of column (1.1) via line L3 is flowing in column (3).
The lower part of the column is heated by a convenient heating material, for instance water vapor. As a result of this the solvent is recovered from the solution.
Bitumen and oil are moving out as a product stream (7).

The vapor of water and solvent is flowing throught the dephlegmator (3.1) and is moving to column (4).
The dephlegmator reduces to carry away of bitumen and helps to keep clean the column.
The vapors from line L9 are stripped in column (4) by the liquid tranported via line L8 from the washing column (1.2).
Out of the top of the column (4) is moving vapor of the solvent, out of the bottom of the column is moving hot water.
The hot water is via line L10 moving to the extraction column (1.1)and is mixed with the feed solid material.
Depending from the difference of the moistness of the streams (5)and(6) and from the moistness of the product (7) water can be lost.
For the liquid balance in the plant water can be added as stream (9).
Vapor of solvent is condensed in the condensator (4.1) and the solvent is moving via line L2 into column (1.1).
Loss of solvent can be add by stream(8).

Claims:

1. A process an apparatus for recovering bitumen and oil products from tar sand, the process comprising the steps of:

   (a) introducing the crushed sediment and a solvent in an extraction countercurrent column to obtain a extrakt solution consisted of bitumen and oil components, solvent, water and sparse parts of the fine of the solid feed and an solid material part consisted of purified solid feed material and solvent,
   (b) introducing the solid material from the step (a) in a countercurrent washing column to obtain a solution consisted of water and solvent and an solid material part consisted of purified solid feed material and water,
   (c) introducing the solid material from the step (b) in a continous filter to obtain an solid material consisted of purified solid feed material and moistness according the pore volume,
   (d) introducing the extract solution from step (a) in an evaporator or in a destillation column to obtain an extrakt consisted of bitumen and oil components, small parts of water and sparse parts of the fine of the solid feed and an vapor consisted of solvent and water,
   (e) introducing the vapor from step (d) and the solution from step (b) in a destillation column to obtain solvent and hot water,
   (f) moving back the solvent from step (e) to the extraktion column,
   (g) moving back the hot water to the extraktion column.

2. The process of claim 1, wherein the solid feed material in the steps (a) and(b) is not moved or agitated by mechanical devices, but transported only by gravity and flowing liquids.

3. The process of claim 1, wherein the solvent is a liquid or a mix of liquids mixable with water.

4. The process of claim 1, wherein the solvent is acetone or a mix of liquids with not less than 50 percent of ketone or alcohole.

5. The process of claim 1, wherein in the process water and solvent are separeted by destillation and the hot water from the bottom of the destillation column is added to the solid feed.

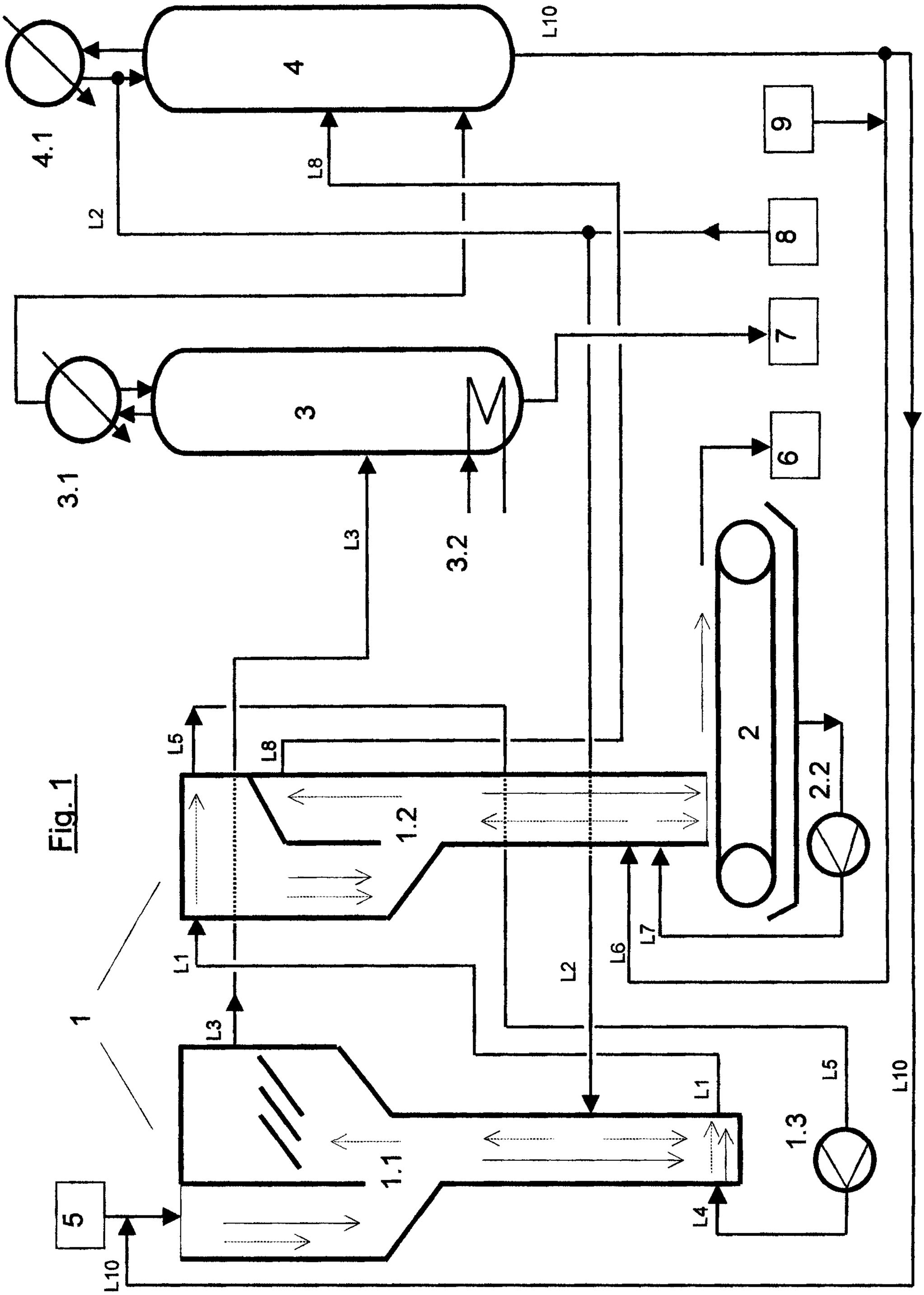
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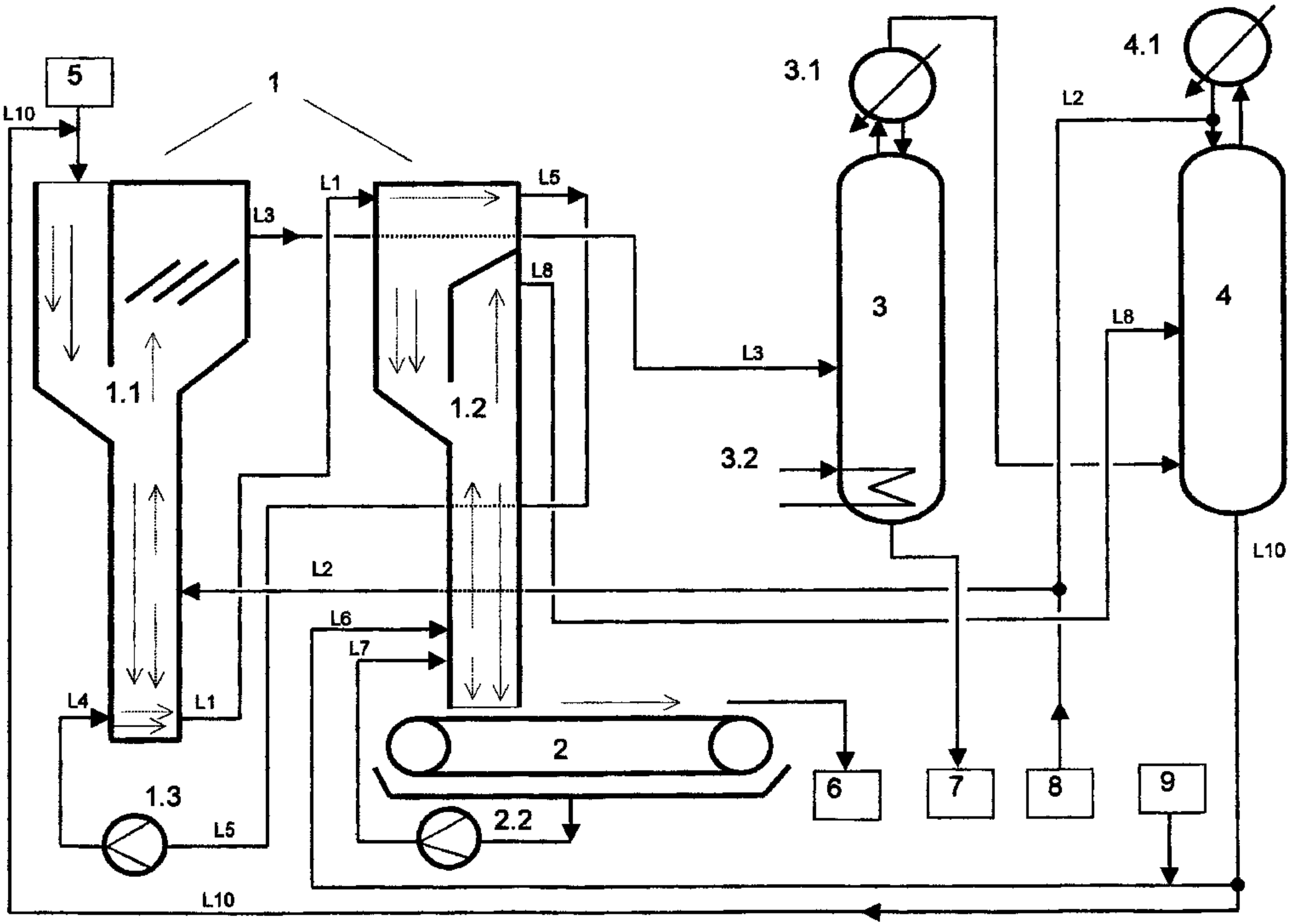
Fig. 1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