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(71) Applicant: **OUTOTEC (FINLAND) OY** [FI/FI]; Rauhalanpuisto 9, FI-02230 Espoo (FI).

(72) Inventors: **RÖNNBERG, Tom**; Rauhamäenkuja 3, 02820 Espoo (FI). **KALENIUS, Jaakko**; Rauhalanpuisto 9, 02230 Espoo (FI). **CEDER, Ari**; Nissnikuntie 9 D 15, 02430 Masala (FI).

(74) Agent: **PAPULA OY**; P.O. Box 981, 00101 Helsinki (FI).

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(54) Title: CONVEYOR CONFIGURED TO CARRY AND TRANSPORT A MATERIAL BED THROUGH A FURNACE AND SINTERING, HARDENING, OR DRYING EQUIPMENT

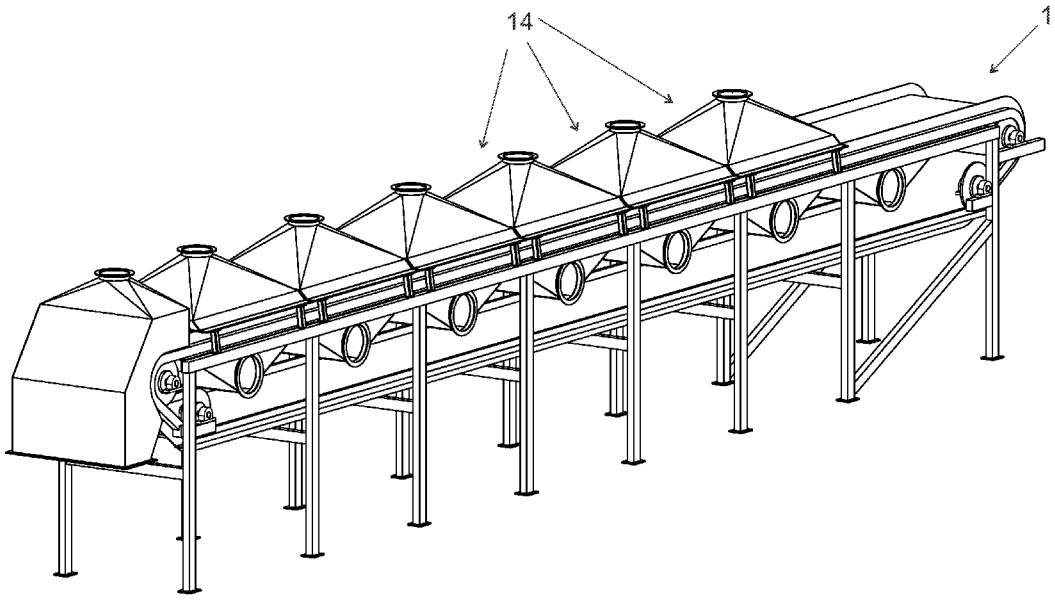

FIG 1

(57) Abstract: Described is a conveyor (1) configured to carry and transport a material bed through a furnace and a sintering, hardening, or drying equipment comprising a furnace, which is divided into number of sequential process zones, wherein different and/or same temperature conditions prevail, and a conveyor (1) configured to convey a material bed through the process zones of the furnace, wherein the conveyor (1) comprising a material carrying surface (2) configured to carry the material bed. The conveyor (1) comprises at least two endless conveyor chains (3) and a plurality of lamella members (15) secured to said at least two endless conveyor chains (3), each endless conveyor chain (3) are engaged with at least two wheels (4), at least one of said at least two wheels (4) is a chain drive sprocket wheel, and the lamella members (15) forming the material carrying surface (2) of the conveyor (1).

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[Continued on next page]

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

CONVEYOR CONFIGURED TO CARRY AND TRANSPORT A MATERIAL BED THROUGH A FURNACE AND SINTERING, HARDENING, OR DRYING EQUIPMENT

Field of the invention

The invention relates to a conveyor configured to carry and transport a material bed through a furnace as defined in the preamble of independent claim 1.

The invention also relates to a sintering, hardening, or drying equipment as defined in the preamble of independent claim 13.

Publication WO 2009/022059 presents a conveyor belt for a strand sintering furnace.

A problem with using conveyor belts in furnaces is the service and possible repair of the conveyor belt. In practice the belt must be cut and removed from the sintering machine for the duration of the service and the repair.

Objective of the invention

The object of the invention is to provide a conveyor and a sintering, hardening, or drying equipment to solve the above-identified problem.

Short description of the invention

The conveyor of the invention is characterized by the definitions of independent claim 1.

Preferred embodiments of the conveyor are defined in the dependent claims 2 to 11.

The invention relates also to a sintering, hardening, or drying equipment as defined in claim 12

The sintering, hardening, or drying equipment of the invention is correspondingly characterized by the definitions of independent claim 13.

Preferred embodiments of the sintering, hardening, or drying equipment are defined in the dependent claims 14 to 23.

List of figures

In the following the invention will described in more detail by referring to the figures, of which

Figure 1 shows parts of a furnace,

Figure 2 shows sections and a part of a sliding member of a first embodiment of a conveyor for a furnace,

Figure 3 shows a lamella member that is perforated,

Figure 4 shows sections and a part of a sliding member of a second embodiment of a conveyor for a furnace

Figure 5 shows sections and a part of a sliding member of a third embodiment of a conveyor

for a furnace,

Figure 6 shows sections of a fourth embodiment of a conveyor for a furnace,

Figure 7 shows a lamella member that is perforated and that is provided with side walls,

Figure 8 is cross section of a lamella member that is provided with side walls and with a refractory lining and where the material bed also functions as thermal insulation, and

Figure 9 is a cross section of another lamella member that is provided with side walls and with a refractory lining.

Detailed description of the invention

First the conveyor 1 configured to carry and transport a material bed through a furnace and some embodiments and variants of the conveyor will be described in greater detail.

The conveyor 1 comprises a material carrying surface 2 configured to carry the material bed.

The conveyor 1 comprises at least two endless conveyor chains 3 and a plurality of lamella members 15 secured to said at least two endless conveyor chains 3.

Each endless conveyor chain 3 is engaged with at least two wheels 4.

At least one of said at least two wheels 4 is a chain drive sprocket wheel. A driving means such as an electric, pneumatic, or hydraulic motor may be provided to drive to the chain drive sprocket wheel.

Said plurality of lamella members 15 forming the material carrying surface 2 of the conveyor 1.

Compared to the elements forming a conveyor belt, the lamella members 15 can have a much simpler construction, partly due to the fact that the elements of a conveyor belt must have connection means for connecting the elements of the conveyor belt together to form the conveyor belt. This also makes service and maintenance of the conveyor 1 easier than service and maintenance of a conveyor belt. To keep the conveyor belt laterally in position is also easier than to keep a conveyor belt laterally in position, because it is more easy to keep a chain in position on a wheels 4 than to keep a conveyor belt in position on rollers. Another advantage is that the two endless conveyor chains 4 can be provided so that they are outside the furnace or at an outer edge of the furnace resulting in that a small thermal load will be subjected on the said at least two endless conveyor chains 4.

Said at least two endless conveyor chains 3 are preferably, but not necessarily, made of metal.

Said at least two endless conveyor chains 3 are preferably, but not necessarily, identical and arranged to run in parallel at a distance from each other.

Each lamella member 15 of said the plurality of lamella members 15 extend preferably, but not necessarily, between at least two endless conveyor chains 3 of said least two endless conveyor chains 3.

Each lamella member 15 can have two parallel lateral sides 5, a front side 6 and a trailing side 7 that is parallel with the front side 6.

A chain guide 8 may be provided and configured to steer the endless conveyor chain 3 laterally.

The lamella members 15 have preferably, but not necessarily, side walls 9. Such side walls 9 raises the capacity of the conveyor 1 as more material can be loaded onto the material carrying surface 2 of the conveyor 1, because the side walls 9 prevents the material from falling off the conveyor from the sides of the conveyor. The complete width of the conveyor can be utilized for carrying material. The side walls 9 can be lateral side walls, project perpendicularly or at least partly in an angle and/or curved with respect to a lamella member 15.

The lamella members 15 are preferably, but not necessarily, releasable secured to said at least two endless conveyor chains 3. This allows faster changing of individual lamella members 15, for example when a lamella member 15 travels on the underside of the conveyor.

The lamella members 15 are preferably, but not necessarily, secured to said at least two endless conveyor chains 3 by means of a pivoting arrangement 10 allowing each lamella member 15 to pivot with respect to said at least two endless conveyor chains 3. A lamella member 15 can for example be configured to hang on the underside from the chain, when the lamella member 15 travels on an underside of the conveyor 1, and/or a lamella member 15 can be configured to rest on the upper side on the chain, when the lamella member 15 travels on an upper side of the conveyor 1, as is illustrated in figure 4. An advantage of this is that it allows better inspection of the condition of the lamella members 15.

Alternatively, the lamella members 15 can be constructed and designed so that only a part of each lamella member 15 is allowed to pivot with respect to said at least two endless conveyor chains 3.

Adjacent lamella members 15 may overlap as shown for example in figure 2. An advantage of this is that material of the material bed does not fall between two adjacent lamella members 15.

A transversal wall 11 can be formed in the conveyor 1 at the points of the conveyor 1 where two adjacent lamella members 15 overlap.

Adjacent lamella members 15 are preferably, but not necessarily, unattached to each other. An advantage of this is that it is easier to replace single lamella members 15, which are not attached to other lamella members 15.

The lamella members 15 are preferably, but not necessarily, made of metal or of other heat-resistant material. An advantage of this is that lamella members 15 of metal can withstand heat and fatigue. The lamella members can for example be made of cast iron, non-alloy steel, alloy steel such as stainless steel, acid-proof steel, or fire-proof steel. The lamella members 15 can also be made of or comprise ceramic material and heat-resistant polymer. The lamella members 15 can also be made of a combination of at last two of metal, ceramic material and heat-resistant polymer. Which material that is selected is dependent of the process conditions.

The lamella members 15 are preferably, but not necessarily, perforated 12. An advantage of this is that it allows gas to flow through the lamella members 15 and the material.

The lamella members 15 are preferably, but not necessarily, identical in shape and dimensions. An advantage of this is that easier to replace single lamella members 15 if they are interchangeable. This leads also to the fact that a smaller amount of different spare parts needed.

The conveyor 1 can have sliding members 13 for supporting the lamella members 15.

The lamella members 15 can, as illustrated in figures 8 and 9, be provided with a lining 16 so that the lining 16 of the lamella members forms the material carrying surface 2 of the conveyor. The lining 16 can comprise at least one of autogenous material, insulating material, fatigue-resistant material, wear-resistant material, heat-resistant material, or fire-resistant material. The lining 16 can alternatively be a coating comprising at least one of autogenous material, insulating material, or fire-resistant material. The lining 16 or the coating can cover at least partly the lamella member 15 and at least partly the possible side walls 9, provided that the lamella member 15 is provided with such side walls 9. The material bed that is conveyed will also form a protective layer protecting the lamella member 15. The material bed that is conveyed can also form a thermal insulation for the lamella member 15.

The invention relates also to a sintering, hardening, or drying equipment comprising a furnace, which is divided into number of sequential process zones, wherein different and/or temperature conditions prevail, and a conveyor 1 according to any embodiment described and configured to convey a material bed through the process zones of the furnace.

Next the sintering, hardening, or drying equipment and some embodiments and variants of the equipment will be described in greater detail.

The sintering, hardening, or drying equipment comprises a furnace, which is divided into number of sequential process zones 14, wherein different and/or temperature conditions prevail.

The sintering, hardening, or drying equipment comprises a conveyor 1 configured to convey a material bed through the process zones of the furnace.

The conveyor 1 comprises a material carrying surface 2 configured to carry the material bed.

The conveyor 1 comprises at least two endless conveyor chains 3 and a plurality of lamella members 15 secured to said at least two endless conveyor chains 3.

Each endless conveyor chain 3 is engaged with at least two wheels 4.

At least one of said at least two wheels 4 is a chain drive sprocket wheel. A driving means such as an electric, pneumatic, or hydraulic motor may be provided to drive to the chain drive sprocket wheel.

Said plurality of lamella members 15 forming the material carrying surface 2 of the conveyor 1.

Compared to the elements forming a conveyor belt, the lamella members 15 can have a

much simpler construction, partly due to the fact that the elements of a conveyor belt must have connection means for connecting the elements of the conveyor belt together to form the conveyor belt. This also makes service and maintenance of the conveyor 1 easier than service and maintenance of a conveyor belt. To keep the conveyor laterally in position is also easier than to keep a conveyor belt laterally in position, because it is more easy to keep a chain in position on a wheels 4 than to keep a conveyor belt in position on rollers. Another advantage is that the two endless conveyor chains 4 can be provided so that they are outside the furnace or at an outer edge of the furnace resulting in that a small thermal load will be subjected on the said at least two endless conveyor chains 4.

Said at least two endless conveyor chains 3 are preferably, but not necessarily, made of metal.

Said at least two endless conveyor chains 3 are preferably, but not necessarily, identical and arranged to run in parallel at a distance from each other.

Each lamella member 15 of said the plurality of lamella members 15 extend preferably, but not necessarily, between at least two endless conveyor chains 3 of said least two endless conveyor chains 3.

Each lamella can have two parallel lateral sides 5, a front side 6 and a trailing side 7 that is parallel with the front side 6.

A chain guide 8 may be provided and configured to steer the endless conveyor chain 3 laterally.

The lamella members 15 have preferably, but not necessarily, side walls 9. Such side walls 9 raises the capacity of the conveyor 1 as more material can be loaded onto the material carrying surface 2 of the conveyor 1, because the side walls 9 prevents the material from falling off the conveyor 1 from the sides of the conveyor 1. The complete width of the conveyor 1 can be utilized for carrying material. The side walls 9 can be lateral side walls, project perpendicularly or at least partly in an angle and/or curved with respect to a lamella member 15.

The lamella members 15 are preferably, but not necessarily, releasable secured to said at least two endless conveyor chains 3. This allows faster changing of individual lamella members 15, for example when a lamella member 15 travels on the underside of the conveyor 1.

The lamella members 15 are preferably, but not necessarily, secured to said at least two endless conveyor chains 3 by means of a pivoting arrangement 10 allowing each lamella member 15 to pivot with respect to said at least two endless conveyor chains 3. A lamella member 15 can for example be configured to hang on the underside from the chain, when the lamella member 15 travels on an underside of the conveyor 1, and/or a lamella member 15 can be configured to rest on the upper side on the chain, when the lamella member 15 travels on an upper side of the conveyor 1. An advantage of this is that it allows better inspection of the condition of the lamella members 15.

Alternatively, the lamella members 15 can be constructed and designed so that only a part

of each lamella member 15 is allowed to pivot with respect to said at least two endless conveyor chains 3.

Adjacent lamella members 15 may overlap as shown for example in figure 2. An advantage of this is that material of the material bed does not fall between two adjacent lamella members 15.

A transversal wall 11 can be formed in the conveyor 1 at the points of the conveyor 1 where two adjacent lamella members 15 overlap.

Adjacent lamella members 15 are preferably, but not necessarily, unattached to each other. An advantage of this is that it is easier to replace single lamella members 15, which are not attached to other lamella members 15.

The lamella members 15 are preferably, but not necessarily, made of metal, or of other heat-resistant material. An advantage of this is that lamella members 15 of metal can withstand heat and fatigue. The lamella members 15 can also be made of or comprise ceramic material and heat-resistant polymer.

The lamella members 15 are preferably, but not necessarily, perforated 12. An advantage of this is that it allows gas to flow through the lamella members 15 and the material.

The lamella members 15 are preferably, but not necessarily, identical in shape and dimensions. An advantage of this is that easier to replace single lamella members 15 if they are interchangeable. This leads also to the fact that a smaller amount of different spare parts needed.

The conveyor 1 can have sliding members 13 for supporting the lamella members 15.

The lamella members 15 can, as illustrated in figures 8 and 9, be provided with a lining 16 so that the lining 16 of the lamella members forms the material carrying surface 2 of the conveyor. The lining 16 can comprise at least one of autogenous material, insulating material, or fire-resistant material. The lining 16 can alternatively be a coating comprising at least one of autogenous material, insulating material, fatigue-resistant material, wear-resistant material, heat-resistant material, or fire-resistant material. The lining 16 or the coating can cover at least partly the lamella member 15 and at least partly the possible side walls 9, provided that the lamella member 15 is provided with such side walls 9. The material bed that is conveyed will also form a protective layer protecting the lamella member 15. The material bed that is conveyed can also form a thermal insulation for the lamella member 15.

It is apparent to a person skilled in the art that as technology advanced, the basic idea of the invention can be implemented in various ways. The invention and its embodiments are therefore not restricted to the above examples, but they may vary within the scope of the claims.

Claims

1. A conveyor (1) configured to carry and transport a material bed through a furnace,

wherein the conveyor (1) comprising a material carrying surface (2) configured to carry the material bed,

characterized

by the conveyor (1) comprising at least two endless conveyor chains (3) and a plurality of lamella members (15) secured to said at least two endless conveyor chains (3),

by each endless conveyor chain (3) being engaged with at least two wheels (4),

by at least one of said at least two wheels (4) is a chain drive sprocket wheel, and

by said plurality of lamella members (15) forming the material carrying surface (2) of the conveyor (1).

2. The conveyor (1) according to claim 1, **characterized** by the lamella members (15) having side walls (9).

3. The conveyor (1) according to claim 1 or 2, **characterized** by the lamella members (15) being releasable secured to said at least two endless conveyor chains (3).

4. The conveyor (1) according to any of the claims 1 to 3, **characterized** by the lamella members (15) being secured to said at least two endless conveyor chains (3) by means of a pivoting arrangement (10) allowing each lamella member (15) to pivot with respect to said at least two endless conveyor chains (3).

5. The conveyor (1) according to any of the claims 1 to 4, **characterized** by adjacent lamella members (15) overlapping.

6. The conveyor (1) according to any of the claims 1 to 5, **characterized** by adjacent lamella members (15) being unattached to each other.

7. The conveyor (1) according to any of the claims 1 to 6, **characterized** by the lamella members (15) being made of heat-resistant material such as of at least one of metal, ceramic, or heat-resistant polymer or of a combination as of at least two of metal, ceramic, or heat-resistant polymer.

8. The conveyor (1) according to any of the claims 1 to 7, **characterized** by the lamella members (15) being perforated (12).

9. The conveyor (1) according to any of the claims 1 to 8, **characterized** by the lamella members (15) being identical in shape and dimensions.

10. The conveyor (1) according to any of the claims 1 to 9, **characterized** by sliding members (13) for supporting the lamella members (15).

11. The conveyor (1) according to any of the claims 1 to 20, **characterized**
by the lamella members (15) being provided with a lining (16), and
by the lining (16) of the lamella members forming the material carrying surface (2) of the conveyor.

12. Sintering, hardening, or drying equipment comprising
a furnace, which is divided into number of sequential process zones, wherein different and/or same temperature conditions prevail, and
a conveyor (1) according to any of the claims 1 to 11 configured to convey a material bed through the process zones of the furnace.

13. Sintering, hardening, or drying equipment comprising
a furnace, which is divided into number of sequential process zones, wherein different and/or same temperature conditions prevail, and
a conveyor (1) configured to convey a material bed through the process zones of the furnace,
wherein the conveyor (1) comprising a material carrying surface (2) configured to carry the material bed,
characterized
by the conveyor (1) comprising at least two endless conveyor chains (3) and a plurality of lamella members (15) secured to said at least two endless conveyor chains (3),
by each endless conveyor chain (3) being engaged with at least two wheels (4),
by at least one of said at least two wheels (4) is a chain drive sprocket wheel, and
by the lamella members (15) forming the material carrying surface (2) of the conveyor (1).

14. The equipment according to claim 13, **characterized** by the lamella member (15) having side walls (9).

15. The equipment according to claim 13 or 14, **characterized** by the lamella members (15) being releasable secured to said at least two endless conveyor chains (3).

16. The equipment according to any of the claims 13 to 15, **characterized** by the lamella

members (15) being secured to said at least two endless conveyor chains (3) by means of a pivoting arrangement (10) allowing each lamella member (15) to pivot with respect to said at least two endless conveyor chains (3).

17. The equipment according to any of the claims 13 to 16, **characterized** by adjacent lamella members (15) overlapping.

18. The equipment according to any of the claims 13 to 17, **characterized** by adjacent lamella members (15) being unattached to each other.

19. The equipment according to any of the claims 13 to 18, **characterized** by the lamella members (15) being made of heat-resistant material such as of at last one of metal, ceramic, or heat-resistant polymer or of a combination as of at least two of metal, ceramic, or heat-resistant polymer.

20. The equipment according to any of the claims 13 to 19, **characterized** by the lamella members (15) being perforated (12).

21. The equipment according to any of the claims 13 to 20, **characterized** by the lamella members (15) being identical in shape and dimensions.

22. The equipment according to any of the claims 13 to 21, **characterized** by sliding members for supporting the lamella members (15).

23. The equipment according to any of the claims 13 to 22, **characterized**
by the lamella members (15) being provided with a lining (16), and
by the lining (16) of the lamella members forming the material carrying surface (2) of the conveyor.

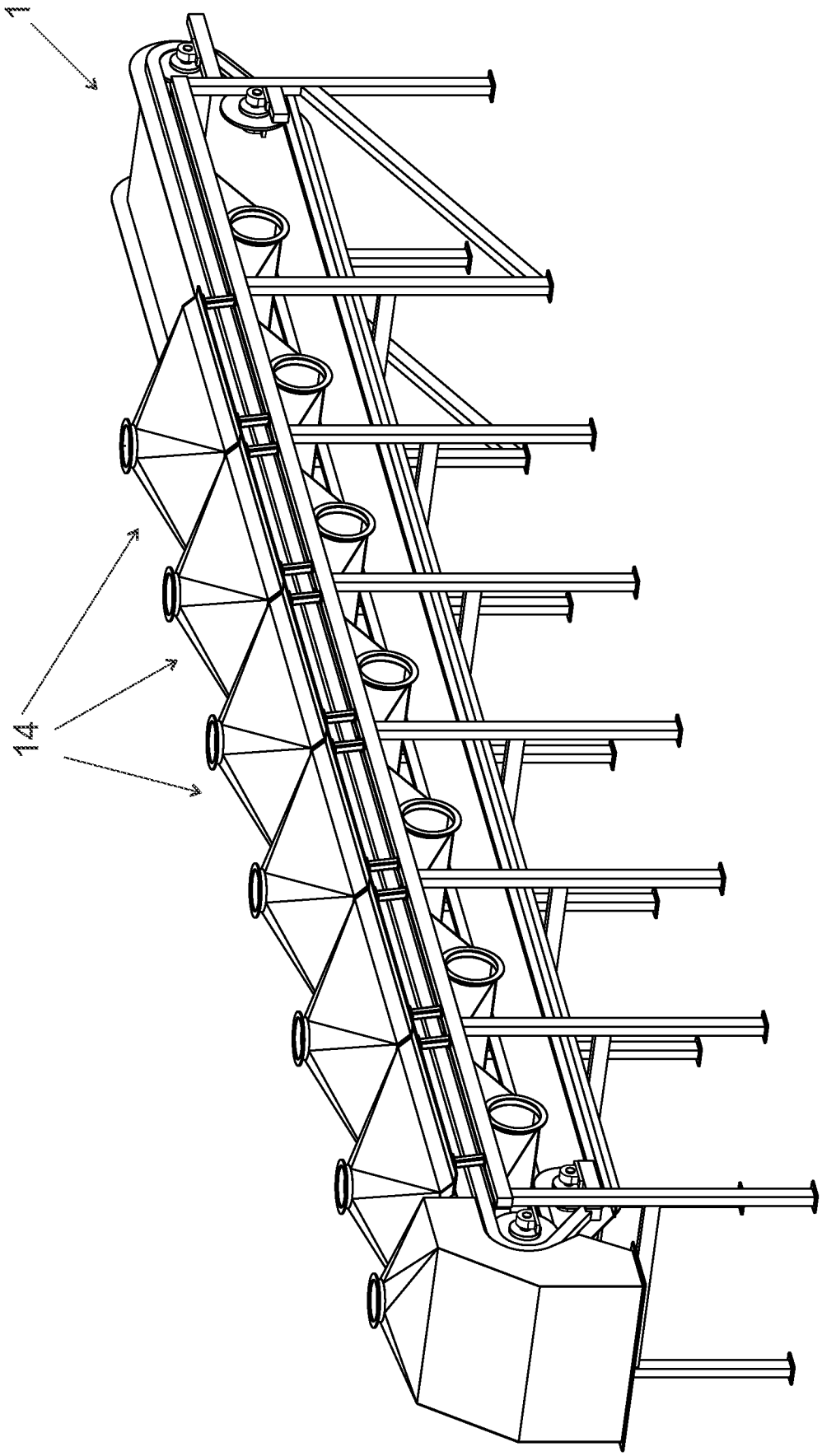


FIG 1

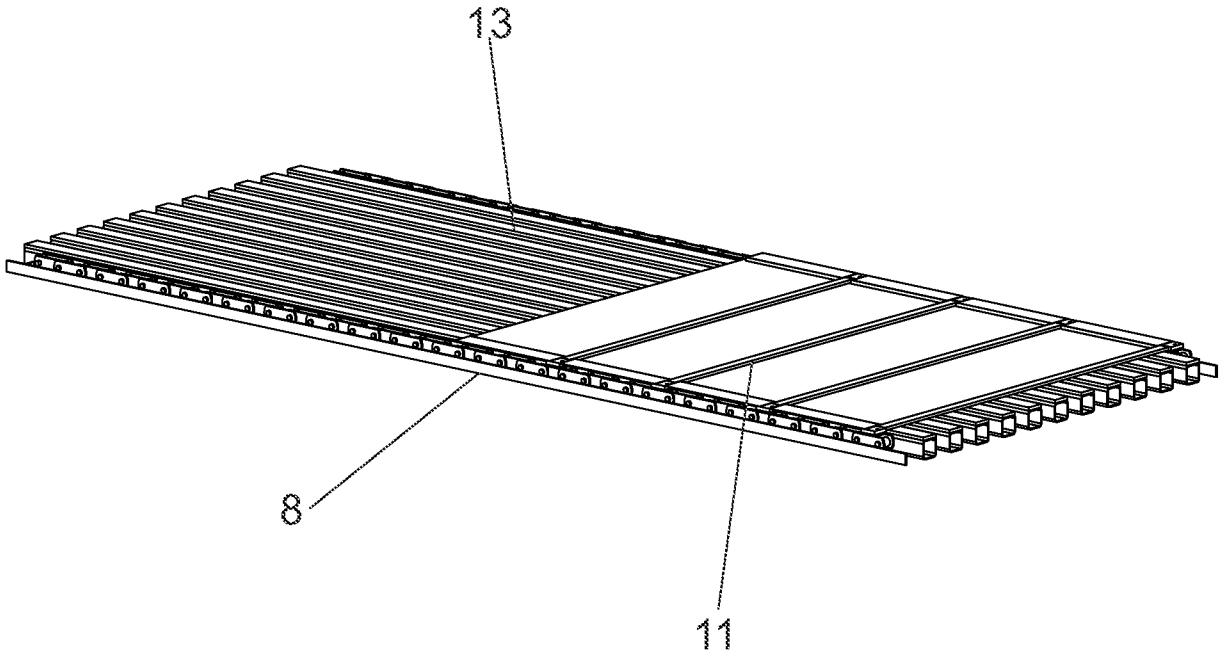


FIG 2

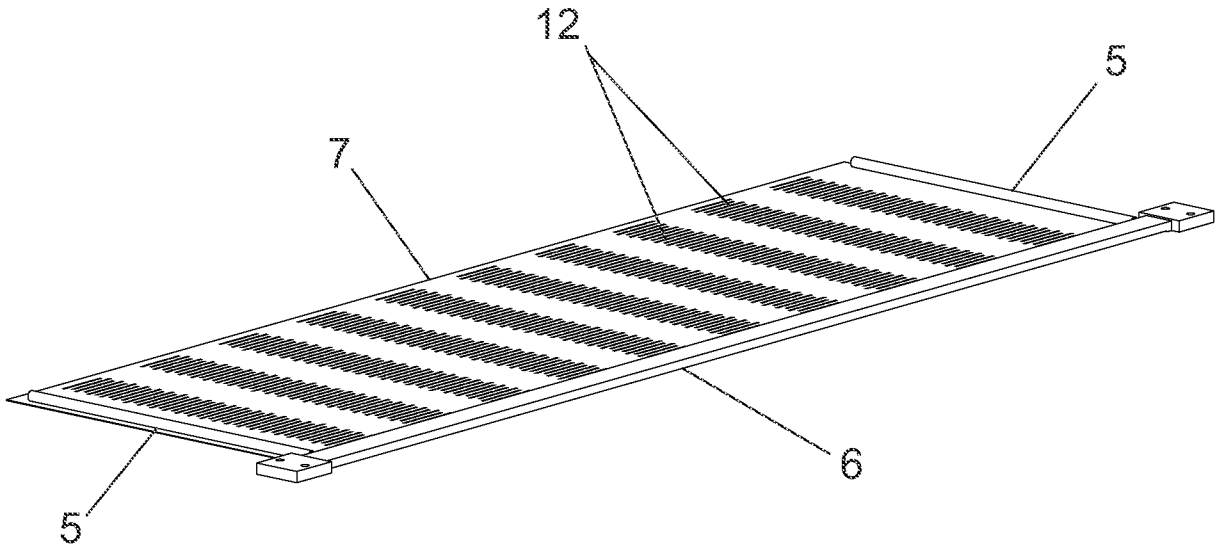


FIG 3

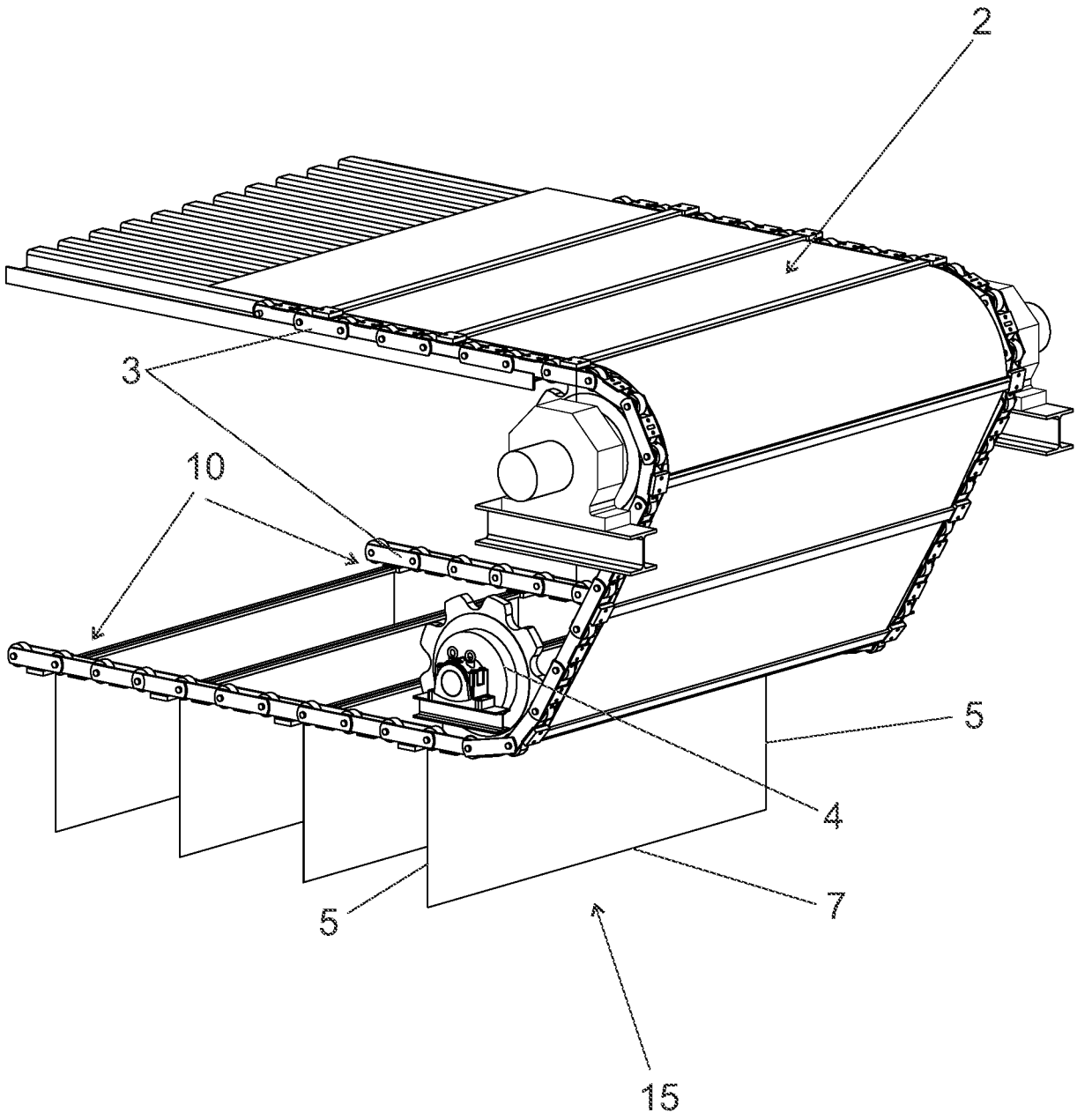
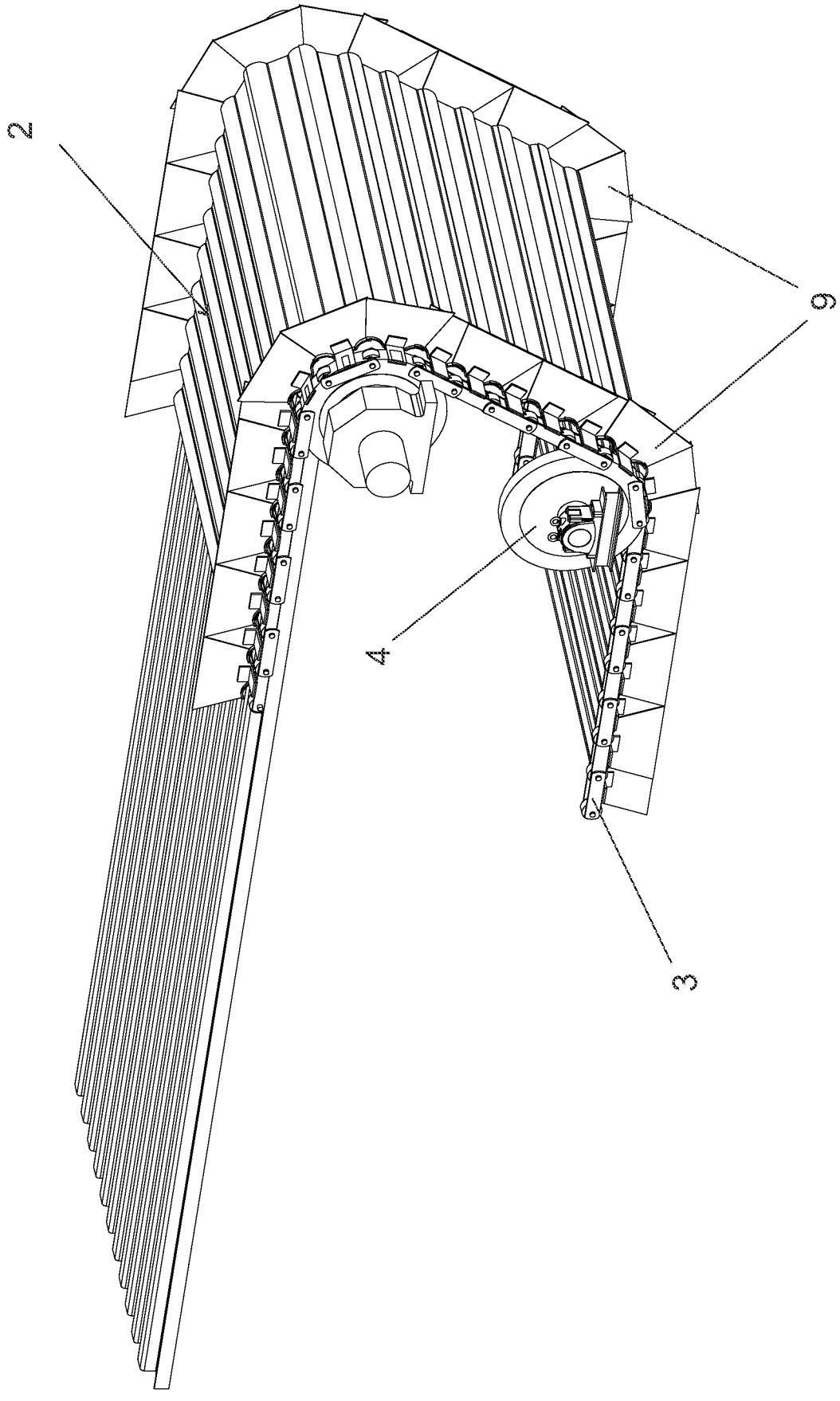


FIG 4

FIG 5



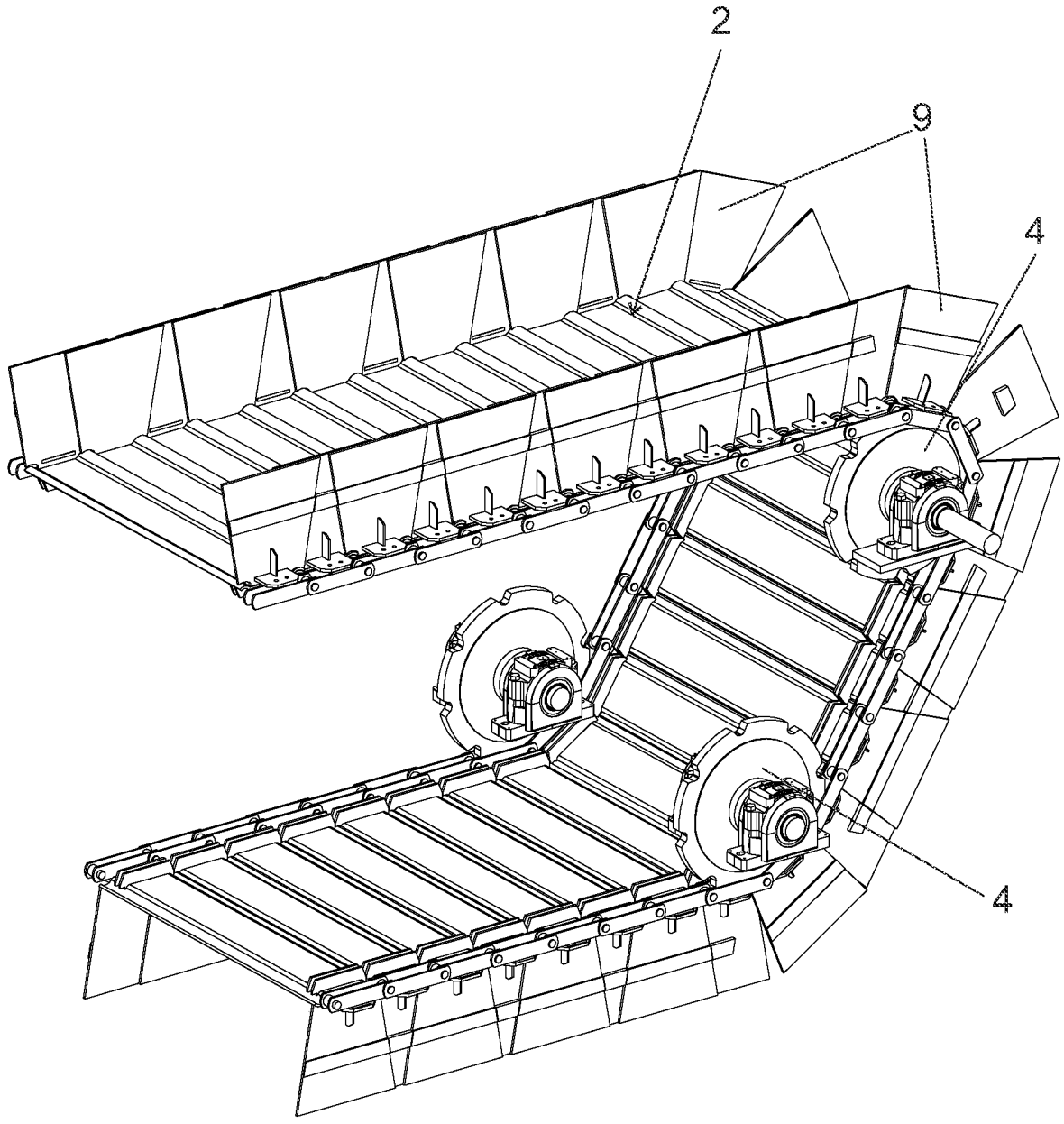


FIG 6

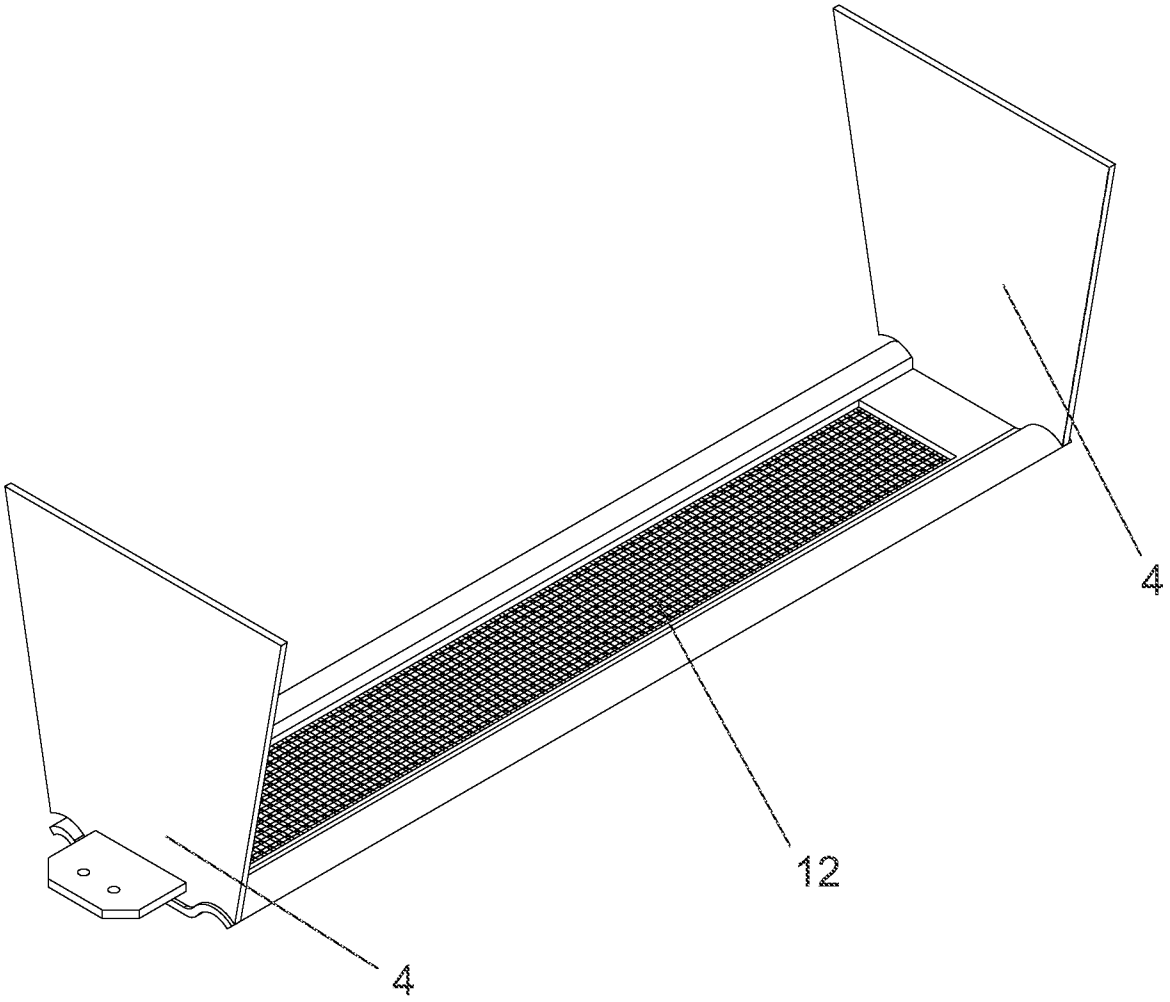


FIG 7

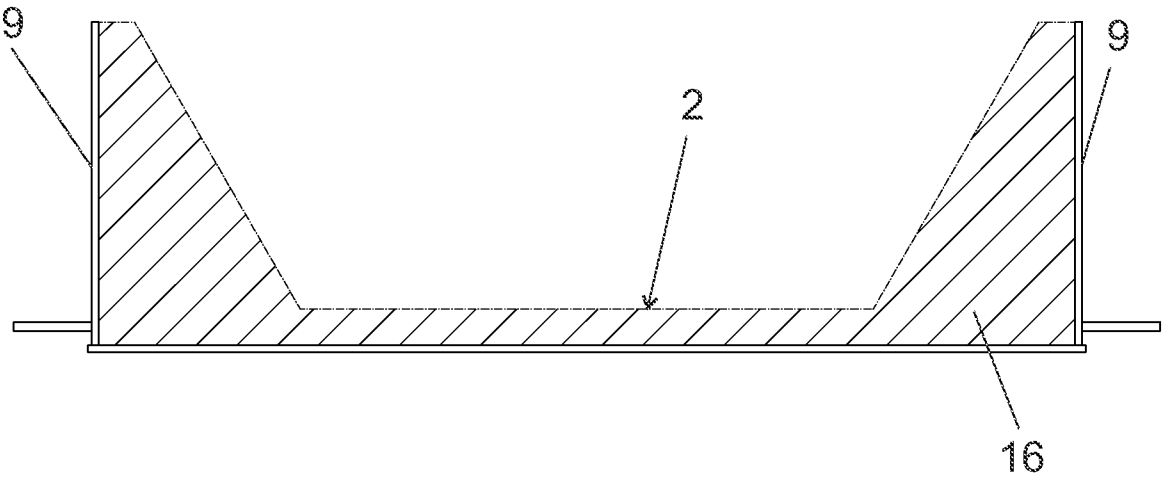


FIG 8

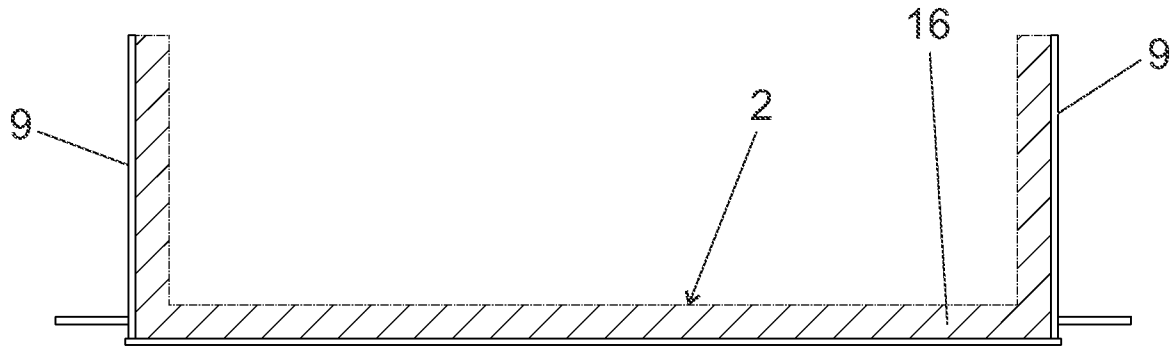


FIG 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2016/050803

A. CLASSIFICATION OF SUBJECT MATTER
INV. F27B21/06 C22B1/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F27B F27D C22B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 991 315 A (FALCK GLENN H [US]) 12 February 1991 (1991-02-12) column 2, line 49 - line 20; figures 1-6 column 4, line 20 - line 49 column 5, line 4 - line 20; claims 1-3	1,5-9, 12,13, 17-19,21
X	DE 27 42 100 A1 (POLYSIUS AG) 29 March 1979 (1979-03-29) claims 1-5; figures 2-5	1,4-9, 12,13, 16-21
A	US 3 790 337 A (CONNELL J) 5 February 1974 (1974-02-05) the whole document	1,12,13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
13 July 2017	24/07/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Gavriliu, Alexandru

1

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2016/050803

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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