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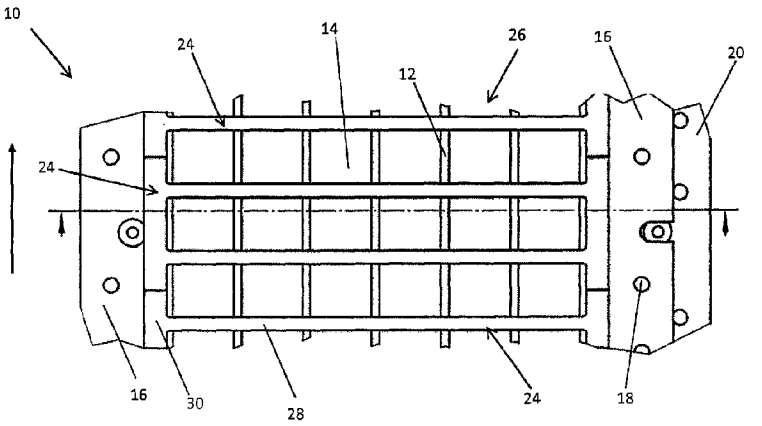
(54) Titre : SEGMENT DE CRIBLE MUNI D'UNE PROTECTION CONTRE L'USURE ET PROCEDE DE FABRICATION D'UN SEGMENT DE CRIBLE

(54) Title: SCREEN SEGMENT HAVING A WEAR PROTECTION AND METHOD FOR PRODUCING A SCREEN SEGMENT



(57) Abrégé/Abstract:
Disclosed is a screen segment of a screening device for separating or classifying applied material, especially mineral particulate materials such as oil sand, into at least two grain fractions, wherein the screen segment comprises a base plate essentially in the form of a screen and having a multitude of screen passages, wherein at least one antiwear unit has been mounted on the base plate, wherein the antiwear unit has been formed from a metal matrix composite material having an antiwear insert made of a cemented carbide and/or of ceramic. Also disclosed is a method of producing such a screen segment of a screening device for separating or classifying applied material.

Abstract

Disclosed is a screen segment of a screening device for separating or classifying applied material, especially mineral particulate materials such as oil sand, into at least two grain fractions, wherein the screen segment comprises a base plate essentially in the form of a screen and having a multitude of screen passages, wherein at least one antiwear unit has been mounted on the base plate, wherein the antiwear unit has been formed from a metal matrix composite material having an antiwear insert made of a cemented carbide and/or of ceramic. Also disclosed is a method of producing such a screen segment of a screening device for separating or classifying applied material.

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Screen segment having a wear protection and method for producing a screen segment

The invention relates to a screen segment and to a screening device having an antiwear unit. The invention further relates to a method of producing a screen segment.

Raw materials, especially mineral particulate materials, for example oil sand, coal and ores, such as iron ore and nickel ore, are processed using screening devices having a multitude of screen segments that classify the material which is to be comminuted or has already been comminuted into at least two grain fractions by means of vibration. Such a screening device is described, for example, in DE102007034512B3.

The materials to be classified are frequently highly abrasive materials having high hardness. Significant wear occurs here on the surface of the screen segments, which results in very short maintenance intervals and high processing costs of the screen segments.

WO 2017009288 A1 already discloses a screen having a multitude of antiwear elements in plate form that form the surface of the screen. These antiwear elements are extremely wear-resistant, but at the same time are also relatively brittle in the event of any impact stress. Such percussive stresses frequently occur in the application region of the screening device where the material to be classified is applied to the screening device. This frequently leads to very high wear and damage to the overall screen, which can also result in shutdown of the entire screening plant.

From this starting point, it is an object of the present invention to provide a screen segment for a screening device that has high wear resistance when used for classification of highly abrasive materials and is simultaneously not at risk of fracture or detachable by the impact stress of the material to be classified in the operation of the screening device.

In selected embodiments this object is achieved in accordance with a screen segment and by a method of producing a screen segment as herein disclosed. Advantageous developments will be apparent from the various embodiments described.

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Certain embodiments provide a screen segment of a screening device for separating or classifying feed into at least two grain fractions, in a first aspect, comprises a base plate which is essentially in the form of a screen and has a multitude of screen passages, wherein at least one antiwear unit has been mounted on the base plate. The antiwear unit has been formed from a metal matrix composite material having an antiwear insert made of a hard metal and/or made of ceramic. In certain embodiments the metal matrix composite material comprises a metal matrix material and wherein the antiwear insert has been at least partly cast into the metal matrix material of the antiwear unit.

A metal matrix composite material is understood to mean a material made of a metal matrix material, for example steel, into which the antiwear insert made of a hard metal and/or made of ceramic has been cast.

A screen segment forms at least part of a screening device, especially the screen surface of a screening device. Preferably, multiple screen segments are arranged alongside one another to form a screen surface. It is also conceivable that a screening device has just one screen segment that forms the screen surface.

The material to be classified is, for example, mineral particulate materials, for example oil sand, coal and ores, such as iron ore and nickel ore, or else cement clinker.

The base plate preferably forms the lower region of the screen segment facing away from the material to be classified, and is especially in plate form with a multitude of screen passages. The screen passages of the screen segment serve to classify the material, with material having a size below a particular grain size falling through the screen passages and the material above the particular grain size falling laterally off the surface of the screening device. The screen passages are, for example, in round or rectangular form and arranged in rows with respect to one another, such that a maximum number of screen passages are arranged alongside one another. For example, the screen passages are equally spaced apart from one another and have identical or different sizes. The antiwear unit especially forms at least part of the surface of the screen

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segment. The antiwear unit serves to protect the surface of the base plate of the screen segments from wear. More particularly, direct impact of the material to be classified on the surface of the base plate is prevented, with the material to be classified first falling onto the antiwear unit and then reaching the base plate.

The antiwear unit is preferably in one-piece form with the metal matrix composite material. A metal matrix composite material is understood to mean a material made of a metal matrix material, for example steel, into which an insert made of a hard metal and/or of ceramic has been cast. A metal matrix composite material with an antiwear insert made of a hard metal or of ceramic offers the advantage of high wear resistance of the antiwear unit. The antiwear insert has preferably been manufactured from a pulverulent and/or granular mixture of particles (grains) comprising ceramic, aluminum and/or carbides such as boron carbide, tungsten carbide, silicon carbide, for example by mixing the mixture with a binder, heating, especially blowing with gas, and baking. More particularly, the mixture is heated in a mold that is flexible, for example, and corresponds to the counterpart of the antiwear insert. Subsequently, the mixture cools down and hardens to become a very wear-resistant body having a porous structure.

In a first embodiment, the antiwear insert is disposed on the surface of the antiwear unit. The antiwear insert preferably forms the surface of the antiwear unit. The surface of the antiwear unit faces in the direction of the material to be classified and forms the surface that the material to be classified meets first in operation of the screening device. The underside of the antiwear unit has preferably been formed from a more ductile material, such as steel. The wear insert made of hard metal or ceramic offers particularly high wear protection, and the forming of just part of the antiwear unit from the more costly material offers a means of reducing the total costs of the antiwear unit. The antiwear insert preferably extends over the entire surface area of the antiwear unit.

In a further embodiment, the antiwear unit has been manufactured by a casting method. For example, the antiwear unit has been fully cast except for the wear insert. The manufacture of the antiwear unit by casting offers a very simple and inexpensive manufacturing method, wherein even complex shapes can be manufactured easily.

In a further embodiment, the antiwear unit has an antiwear element mounted on a lateral face of the antiwear unit that faces outward. The antiwear element has preferably been formed from a sintered hard metal, for example tungsten carbide, titanium carbide, boron carbide, niobium carbide, chromium carbide or ceramic, or from a mixture of these materials. For example, the antiwear unit has a recess in which the antiwear unit has been mounted. The antiwear element ensures additional wear protection on the lateral faces of the antiwear unit that face outward.

In a further embodiment, the antiwear element has been cohesively bonded, especially welded, sintered, adhesive bonded or soldered, to the antiwear unit. In a further embodiment, the antiwear insert has been formed from hard metal, for example tungsten carbide, titanium carbide, boron carbide, niobium carbide, chromium carbide or ceramic, or from a mixture of these materials.

In a further embodiment, the antiwear insert has been at least partly cast into the antiwear unit. The antiwear unit preferably has a multitude of antiwear inserts cast at least partly into the antiwear unit. The relatively simple production method of casting of the antiwear unit makes it possible to arrange a multitude of antiwear inserts in such a way that the regions of the antiwear unit that are subject to high wear have an antiwear insert. For example, the multitude of antiwear inserts comprises a multitude of particles, especially hard metal or ceramic particles or diamonds. Preferably, each antiwear insert consists of exactly one particle, with arrangement of the antiwear inserts in unordered fashion in the metal matrix material. For example, the antiwear insert is in such a form that the metal matrix material infiltrates into the antiwear insert and hence a cohesive bond is established.

In a further embodiment, the antiwear insert has a thickness of about 5 mm to 50 mm, preferably 10 mm to 15 mm. Preferably, the antiwear insert has at least one land or multiple lands that extend along the base plate. The base plate also has, for example, a securing region on each of its long sides and a classification region with a multitude of screen passages between the securing regions. The securing region serve to secure the base plate, for example on a carrier of the screening device. The antiwear element preferably extends from a securing

region across the classification region to the opposite securing region. More particularly, the antiwear unit is at least partly spaced apart from the base plate and preferably has projections that abut the base plate and recesses spaced apart from the base plate. This enables, for example, the mounting of additional wear protection onto the base plate.

In a further embodiment, the antiwear insert has a porous structure, the antiwear insert preferably having a multitude of pores, for example in homogeneous distribution and/or form. For example, the pores are in the form of a honeycomb. This offers the advantage that the metal matrix material from which the antiwear unit is cast infiltrates into the antiwear insert and a particularly firm bond between the antiwear insert made of hard metal and/or ceramic and the metal matrix material is established. The antiwear insert is preferably in one-piece form and, for example, in plate form.

In a further embodiment, the antiwear unit has at least one land and two flange regions each bonded to one end of the land, with bonding of the flange region of the antiwear unit to the base plate. For example, the flange region is cohesively, form-fittingly or force-fittingly bonded to, especially screwed onto, the base plate. The antiwear unit has preferably exactly two lands. For example, the antiwear unit has more than two lands, especially three, four or five lands. The lands preferably extend orthogonally to the direction of movement of the material to be classified and along the base plate. The lands have, for example, a distance from one another that corresponds roughly to the diameter of the screen passages or is greater than the diameter of the screen passages.

The invention additionally encompasses a screening device having at least one screen segment as described above, at least one vibration generator connected to the at least one screen segment, in order to cause it to vibrate. The screening device especially has an application region to which the material to be classified is applied, and an ejection region from which the classified material leaves the screening device. The antiwear units are preferably mounted solely in the application region, such that the material applied to the screening device first hits the antiwear unit. Preferably, the screening device has a multitude of screen segments having screen passages, wherein the size of the screen passages of the screen segments and the

distance of the antiwear units from one another, especially of the lands of the antiwear units from one another, is at least partly different over the length of the screening device.

The invention also encompasses a method of producing a screen segment of a screening device for separating or classifying applied material, especially mineral particulate materials such as oil sand, into at least two grain fractions, wherein the screen segment comprises a base plate which is essentially in the form of a screen and has a multitude of screen passages, and the method has the steps of:

- positioning an antiwear insert made of a hard metal and/or ceramic in a casting mold for casting of an antiwear unit,
- casting the antiwear unit, such that the antiwear insert is at least partly enclosed by the casting material of the antiwear unit and
- mounting the antiwear insert on the base plate.

The advantages and elucidations described with reference to the screen segment also apply to the method of producing a screen segment in a corresponding manner for a method.

In one embodiment, an antiwear element made of a hard metal and/or ceramic is mounted on the cast antiwear unit. The antiwear element is preferably cohesively bonded to the antiwear unit.

Description of the drawings

The invention is elucidated in detail hereinafter by multiple working examples with reference to the appended figures.

Fig. 1 shows a schematic diagram of a section of a screen segment with an antiwear unit in a top view according to a working example.

Fig. 2 shows a schematic diagram of a screen segment with an antiwear unit in section view according to the working example of fig. 1.

Fig. 3 shows a schematic diagram of a section of a screen segment with an antiwear unit in section view according to a working example.

Fig. 1 and 2 show a screen segment 10 for classifying coarse-grain material, especially mineral material from an opencast mine, mineral particulate materials, for example oil sand, coal and ores, such as iron ore and nickel ore, or else cement clinker, into at least two grain sizes. The screen segment 10 has a base plate 12 having a multitude of screen passages 14 that extend through the base plate 12. The screen passages 14 are preferably spaced apart uniformly from one another and arranged in rows alongside one another. By way of example, the screen passages 14 are square, although different shapes, for example circular, rectangular or polygonal, are conceivable. The base plate 12 is disposed on the underside, especially on the side of the screen segment 10 remote from the material to be classified, and has been formed, for example, from steel, especially a heat-resistant steel. By way of example, the base plate 12 has a rectangular cross section.

The top side of the screen segment 10 is understood to mean the side that first comes into contact with the material to be classified when it is applied to the screen segment. The underside is the opposite side remote from the material.

The base plate 12 is in the form of a screen and has, for example, a multitude of parallel bars uniformly spaced apart that are aligned in longitudinal direction, especially in movement direction of the material to be classified. Orthogonally thereto, the base plate 12 has a multitude of parallel bars spaced apart uniformly, which cross the bars running in longitudinal direction and form the screen passages 14. The orthogonal bars of the base plate 12 are not visible in the view of fig. 1.

The base plate 12 has, on each of its sides running in longitudinal direction, a securing region 16 having an essentially flat surface and no screen passages 14. The securing regions 16 each have a multitude of securing holes 18, by means of which the screen segment 10 is secured on a carrier 20, for example by means of screws. A classification region 26 having a multitude of screen passages 14 is formed between two securing regions 16 of a base plate 12.

The screen segment 10 additionally has a multitude of antiwear unit 24 mounted on the base plate 12. The antiwear units 24 are each mounted on the securing region 16 of the base plate 12 and extend from one securing region 16 through the classification region 26 to the opposite securing region 16. An antiwear unit 24 of the working example of figs. 1 and 2 has two parallel lands 28 that extend, by way of example, transverse to the direction of movement of the material to be classified. It is likewise conceivable that the lands extend along the bars of the base plate 12 in the direction of movement of the material to be classified. The lands 28 are joined to one another at their ends by means of a flange region 30 that runs roughly orthogonally to the lands 28. The flange regions 30 of the antiwear units 24 are screwed to the base plate 12 by means of screws 22. It is likewise conceivable to secure the antiwear units 24 on the base plate 12 by means of a cohesive bond, such as welding or adhesive bonding. In the working example of figs. 1 and 2, the antiwear unit 24 is secured on the base plate 24 solely by means of the flange regions 30. It is likewise possible to secure the antiwear units 24 on further regions of the base plate 12, especially on the bars of the base plate 12 that run transverse to the lands 28 of the antiwear units 24. The antiwear unit 24 has, on the underside of the lands, projections 32 that abut the base plate 12. The projections abut, by way of example, the bars of the base plate 12 that run transverse to the lands 28 of the antiwear unit 24, such that the antiwear unit 24 is spaced apart from the bars of the base plate 12 that run parallel to the lands of the antiwear unit 24. The antiwear unit 24 may, for example, also abut or be secured over the entire length of the top side of the base plate 12.

Fig. 3 shows a detail of the antiwear unit 24, showing the region of the antiwear unit 24 screwed to the base plate 12 in a cross section. The antiwear unit 24 is formed from a metal matrix composite material having an antiwear insert 34 made of a hard metal or ceramic. The antiwear insert 34 is disposed on the surface of the antiwear unit 24 and forms, by way of example, the entire surface of the antiwear unit 24. The antiwear insert 34 may, for example, also form just part of the surface of the antiwear unit 24. The antiwear insert 34 comprises, for example, tungsten carbide, ceramic, titanium carbide, boron carbide or chromium carbide and has a porous or honeycomb structure. The antiwear insert 34 is in one-piece form and has, for example, a thickness of 5 mm to 50 mm, preferably 10 mm to 15 mm. The antiwear unit 24 has

been formed from the metal matrix material, the antiwear insert 34 being at least partly surrounded by and especially cast into the metal matrix material. The metal matrix material is, for example, heat-resistant steel and/or a steel having a hardness of about 150 – 400 HB (Brinell). A heat-resistant steel is understood to mean a thermally stable steel having a high chromium/nickel content and having thermal stability up to 650°C, especially up to 1000°C. Such steels are, for example, austenitic chromium-nickel steels, for example GX25CrNiSi18-9, GX40CrNiSi25-12, GX40NiCrSiNb35-26. Steels heat-resistant to 600°C are, for example, steels according to DIN EN 10213. Steels heat-resistant to 1200°C are, for example, steels according to DIN EN 10295. The lower region of the antiwear unit that faces in the direction of the base plate 12 is formed from the metal matrix material.

An antiwear element 36 has been mounted on the antiwear unit 24. The antiwear element has been formed, for example, from ceramic and/or a hard metal, such as tungsten carbide, titanium carbide, boron carbide or chromium carbide. The antiwear element 36 has been mounted on, preferably welded, soldered, adhesive bonded or screwed to, the flange region 30, especially on the lateral face of the antiwear unit 24 that faces outward.

In the manufacture of the antiwear unit 24, a the antiwear insert 34 made of ceramic or hard metal, such as tungsten carbide, titanium carbide, boron carbide, niobium carbide or chromium carbide, or a mixture of these materials, is positioned, for example secured, in a casting mold for casting of the antiwear unit 24. The antiwear insert 34 is in the form of a plate, for example, and is positioned on the top side, especially the lateral face of the antiwear unit that faces in the direction of the material to be classified. Subsequently, the antiwear unit 24 is cast from the metal matrix material, such that the antiwear insert 34 is surrounded at least partly by the casting material of the antiwear unit 24, with infiltration of the casting material, for example, into the porous structure of the antiwear insert 34. More particularly, the antiwear insert 34 is completely surrounded by the casting material.

The antiwear element 36 is subsequently secured on, especially soldered to, on the antiwear unit 24. Preferably, the antiwear unit 24 is processed beforehand on the bonding surfaces that

are bonded to the antiwear element 36, such that the bonding surfaces have a low roughness of RZ = 1.6-10 and/or RA = 0.4-1, preferably RZ = 6.

For example, a multitude of such screen segments 10 is arranged successively in an inclined plane on a carrier 20 and forms a screening apparatus. A screen segment 10 is aligned, for example, at an angle to the horizontal of about 5-20°, such that material to be classified which is applied to the screen segment 10 is moved along the surface of the screen segment 10 and hence efficient classification is achieved over the entire surface area of the screening device. The direction of movement of the material to be classified is identified by way of example in fig. 1 by an arrow. However, it is likewise possible that the direction of movement of the material runs orthogonally thereto, this being dependent on the position of the screen segment 10 in a screening device. In operation of the screening apparatus, this is driven by means of a drive (not shown), for example a vibration generator, in such a way that the screen segments 10 are moved in a vibrating motion, such that the material applied to the screening apparatus is optimally classified. More particularly, the screening device has at least one application region and at least one ejection region, and the antiwear units are mounted in the application region on the screen segment or a multitude of screen segments. The antiwear units 24 enable effective protection of the base plate 12 from wear, especially in the application region of the screening device in which the material to be classified hits the surface of the screening device. By means of the screw connections, the antiwear units in the event of wear can simply be detached from the base plate 12 and exchanged.

List of reference numerals

10	screen segment
12	base plate
14	screen passages
16	securing region
18	securing holes
20	carrier
22	screw
24	antiwear unit
26	classification region
28	lands
30	flange region
32	projection
34	antiwear insert
36	antiwear element

Claims

1. A screen segment of a screening device for separating or classifying feed material into at least two grain fractions, wherein the screen segment comprises a base plate essentially in the form of a screen having a multitude of screen passages, wherein at least one antiwear unit has been mounted on the base plate, wherein the antiwear unit has been formed from a metal matrix composite material having an antiwear insert made of a hard metal and/or of ceramic,
wherein the metal matrix composite material comprises a metal matrix material and wherein the antiwear insert has been at least partly cast into the metal matrix material of the antiwear unit.

2. The screen segment according to claim 1, wherein the feed material is a mineral crushed material.

3. The screen segment according to claim 2, wherein the mineral crushed material is an oil sand.

4. The screen segment according to any one of claims 1 to 3, wherein the antiwear insert is disposed on the surface of the antiwear unit.

5. The screen segment according to any one of claims 1 to 4, wherein the antiwear unit has been produced by a casting method.

6. The screen segment according to any one of claims 1 to 5, wherein the antiwear unit includes an antiwear element mounted on an outward-facing lateral face of the antiwear unit.

7. The screen segment according to claim 6, wherein the antiwear element is cohesively bonded to the antiwear unit.

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8. The screen segment according to claim 7, wherein the cohesive bond has been formed by welding, sintering, adhesive bonding or soldering.

9. The screen segment according to any one of claims 1 to 8, wherein the antiwear insert and/or the antiwear element, comprises tungsten carbide, ceramic, titanium carbide, boron carbide, niobium carbide or chromium carbide or a mixture of these materials.

10. The screen segment according to any one of claims 1 to 9, wherein the antiwear insert has a thickness of about 5 mm to 50 mm.

11. The screen segment according to claim 10, wherein the antiwear insert has a thickness of 10 mm to 15 mm.

12. The screen segment according to any one of claims 1 to 11, wherein the antiwear insert has a porous structure.

13. The screen segment according to any one of claims 1 to 12, wherein the antiwear unit has at least one land and two flange regions each connected to one end of the land and wherein at least one of the flange regions of the antiwear unit is / are bonded to the base plate .

14. The screen segment according to any one of claims 1 to 13, wherein the antiwear unit has projections that abut the base plate.

15. A screening device having at least one screen segment as defined in any one of claims 1 to 14 and at least one vibration generator connected to the at least one screen segment in order to cause it to vibrate.

16. A method of producing a screen segment of a screening device for separating or classifying feed material into at least two grain fractions, wherein the screen segment comprises a base plate which is essentially in the form of a screen having a multitude of screen passages, the method comprising the steps of:

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positioning an antiwear insert made of a hard metal or ceramic in a casting mold for casting of an antiwear unit,

casting the antiwear unit with a metal matrix material, such that the antiwear insert is at least partly enclosed by the metal matrix material of the antiwear unit and is cast into metal matrix material of the antiwear unit, and

mounting the antiwear insert on the base plate.

17. The method according to claim 16, wherein the feed material is a mineral crushed material.

18. The method according to claim 17, wherein the mineral crushed material is an oil sand.

19. The method as claimed in any one of claims 16 to 18, wherein an antiwear element made of a hard metal or ceramic is mounted on the cast antiwear unit.

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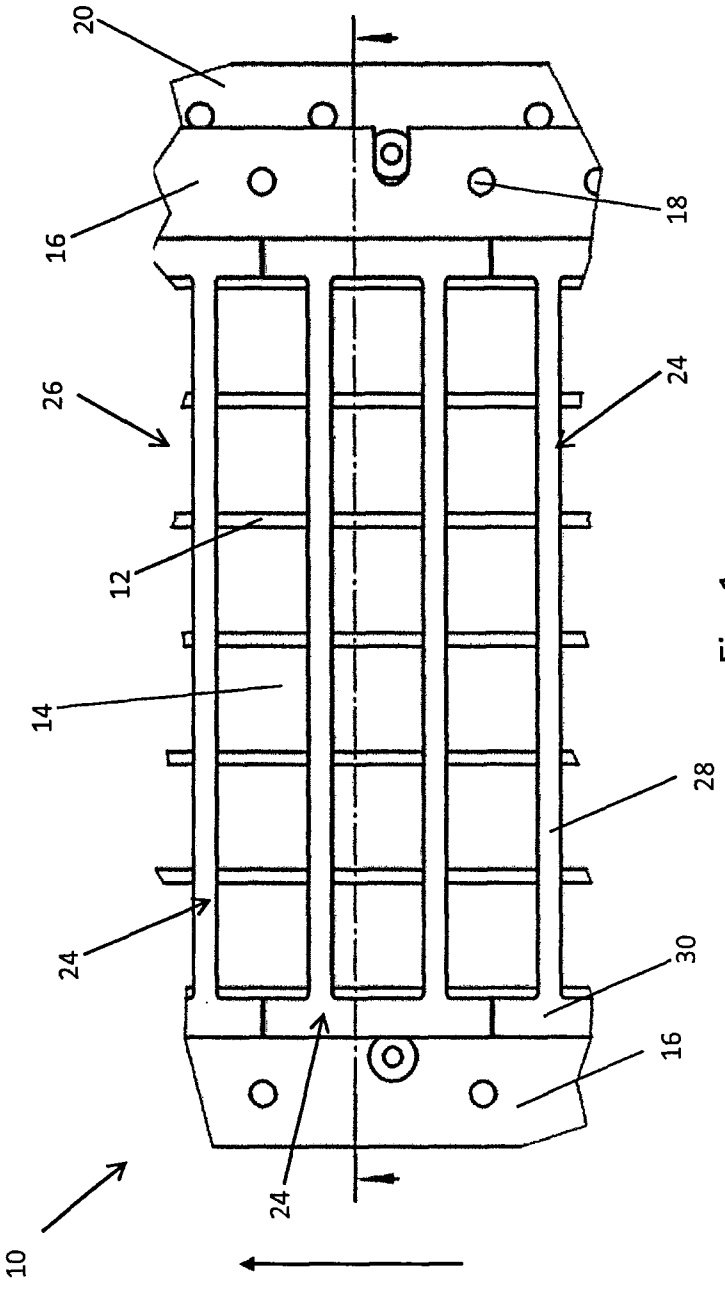


Fig. 1

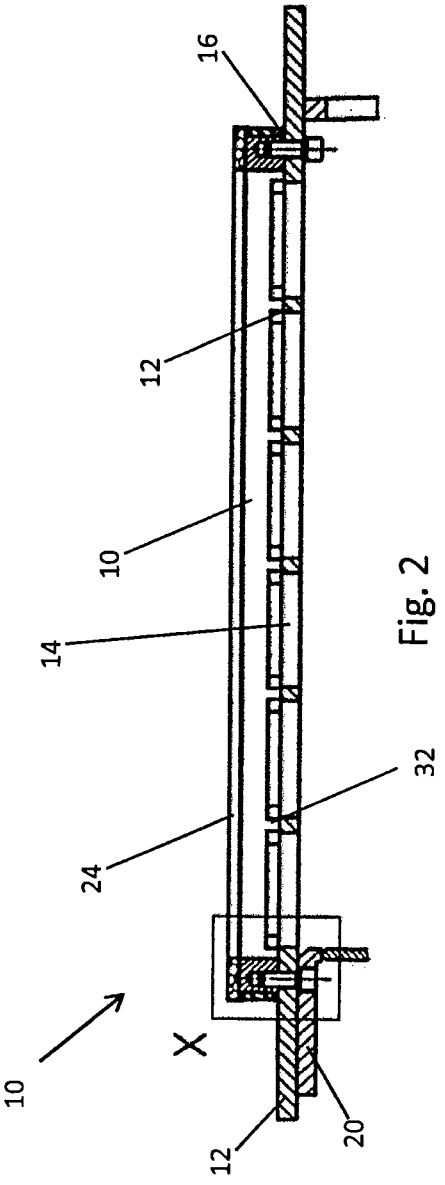


Fig. 2

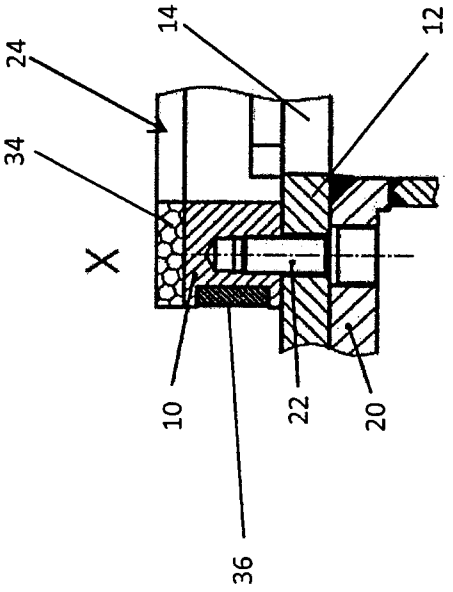
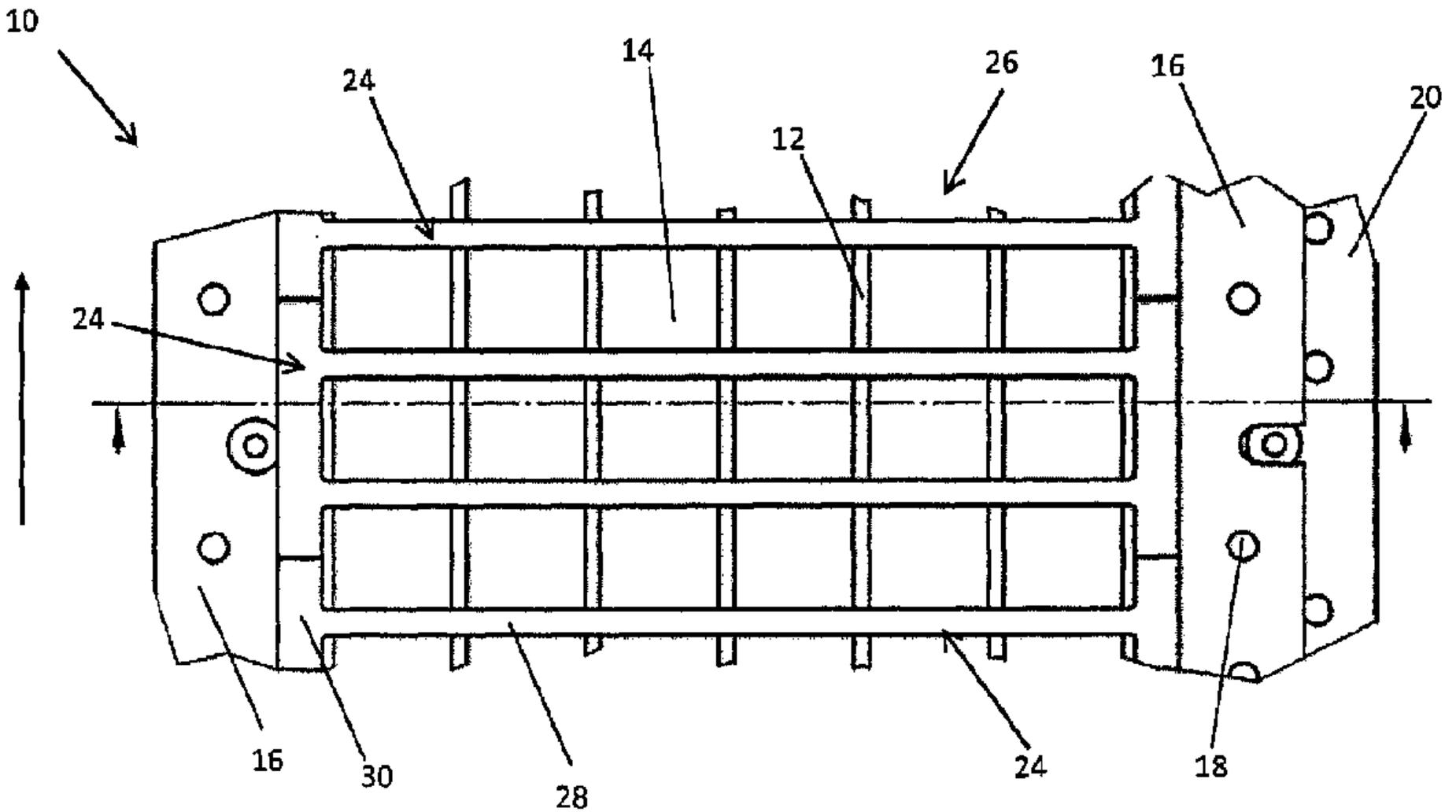


Fig. 3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