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(54) Benævnelse: **VIBRATIONSSIGTE**

(56) Fremdragne publikationer:
EP-A1- 1 946 851
EP-A1- 2 850 938
EP-A2- 1 719 560
GB-A- 2 134 214
US-A1- 2012 111 774

DESCRIPTION

[0001] This invention relates to a vibrating screen of the type comprising a base positioned in a lower part and a vibrating structure positioned in an upper part, with a plurality of elastic elements interposed between them, for connecting them and allowing the vibrating structure to elastically oscillate relative to the base. A vibrating unit is mounted on the vibrating structure to make the latter vibrate relative to the base. The upper structure comprises a plurality of sieves that are angled or parallel relative to a horizontal plane. They are positioned in such a way as to cause the outfeed of the material divided into different particle size measurement ranges.

[0002] In particular, this invention can be applied for vibrating screens intended for selecting aggregates to be used in applications such as the production of bituminous macadams and the production of concretes.

[0003] In order to be able to achieve high levels of productivity and good screening results, on one hand the screen must have relatively large dimensions and on the other hand a suitable vibration and acceleration must be imparted to it, which may therefore reach even very high values (preferably using a small slope for the various sieves).

[0004] Patent application EP 1 719 560 A2, which relates to the same type of screens as this invention, gives a rapid overview of known vibrating screen sizing and design problems.

[0005] As indicated in that patent application, in particular, without changing the overall structure too much, in order to be able to increase the performance of the vibrating screens, it would be necessary to pursue two contradictory courses of action. In fact, whilst on one hand it would be necessary to considerably stiffen their structure, on the other hand it would be appropriate to reduce their mass.

[0006] Whilst in traditional vibrating screens the vibrating structure comprises two mainly flat walls constituted of a single metal plate that is relatively thick, in an attempt to improve performance, patent application EP 1 719 560 A2 proposed an embodiment in which the walls are at least partly constituted of two plate sheets positioned side by side and close to each other for forming a narrow hollow space between them. A plurality of interconnecting elements is present in the hollow space. The two plate sheets also have different thicknesses. Preferably, one of the two sheets is twice as thick as the other.

[0007] Moreover, according to that document, the wall only comprises two sheets in the upper half, whilst only the outer sheet is present in the lower half. The beam that supports the vibrating unit is connected only to the outer sheets of the two walls.

[0008] Therefore, in other words, patent application EP 1 719 560 A2 suggests that the previously known screens be changed by applying on the upper part of the inner side of each wall a reinforcement constituted of an additional plate sheet drawn near to the self-same wall

and connected to it by means of various elements.

[0009] Although patent application EP 1 719 560 A2 boasts presumed advantages of the embodiment which forms its subject matter compared with prior art screens, on one hand as yet there are no known industrial applications that can effectively demonstrate actual achievement of such advantages, and on the other hand it has several obvious disadvantages at a construction level. In particular, the disadvantages are first linked to the need to apply a second plate sheet on the inner side of the vibrating structure, while leaving the structural functions (such as sustaining the beam that supports the vibrating unit or sustaining the sieves) to be performed by only the outer plate. In fact, to do that, the inner plate has to be prepared with a whole series of openings to allow the passage of the beam and of the supporting elements for the sieves. Moreover, inevitably, the presence of two sheets on the inner sides of the walls, however close they may be to the outer sheets, reduces the working width of the sieves.

[0010] Moreover, tests and simulation performed by the Applicant have allowed it to be established that the solution described in that patent application would not, in reality, be able to achieve the vibrating structure rigidity results claimed.

[0011] A different solution is proposed in EP 1 946 851 A1 where it is suggested to reinforce lateral walls of vibrating screens with C-shaped chamfered hollow profiles placed with their hollow space facing the lateral walls.

[0012] Another kind of vibrating screen without reinforcing structures for lateral walls is described in GB 2 134 214 A.

[0013] In this context the technical purpose which forms the basis of this invention is to provide a vibrating screen which overcomes the above-mentioned disadvantages.

[0014] In particular, the technical purpose of this invention is to provide a vibrating screen with simple construction and that has a structural rigidity considerably greater than the screens currently on the market and which can, therefore, be made to operate with performance that is better than the performance of prior art screens.

[0015] The technical purpose specified and the aims indicated are substantially achieved by a vibrating screen made as described in the appended claims.

[0016] Further features and the advantages of this invention are more apparent in the detailed description, with reference to the accompanying drawings which illustrate several preferred, non-limiting embodiments of a vibrating screen, in which:

- Figure 1 is a schematic side view of a vibrating screen made in accordance with this invention;
- Figure 2 is an axonometric view of a vibrating structure of the screen of Figure 1,

longitudinally sectioned at a middle plane of it;

- Figure 3 is an axonometric view of the sectioned vibrating structure of Figure 2 from an opposite viewpoint;
- Figure 4 is a side view of the sectioned vibrating structure of Figure 2, highlighting with dashed lines a plurality of screening elements;
- Figure 5 is a side view of the sectioned vibrating structure of Figure 2, highlighting in transparency several inner reinforcing parts;
- Figure 6 is an axonometric view of a box-shaped reinforcing structure of the vibrating structure of Figure 3;
- Figure 7 is a side view of the box-shaped reinforcing structure of Figure 6, highlighting with dashed lines the inner parts;
- Figure 8 is a schematic cross-section of a preferred form of the box-shaped reinforcing structure; and
- Figures 9 and 10 are side views of two alternative embodiments of the vibrating structure, highlighting with dashed lines possible limited zones of application of a box-shaped reinforcing structure.

[0017] With reference to the above-mentioned figures, the numeral 1 denotes in its entirety a vibrating screen according to this invention.

[0018] Similarly to prior art screens, even the screen that forms the subject matter of this invention comprises a base 2 positioned in a lower part, a vibrating structure 3 positioned in an upper part, and a plurality of elastic elements 4 interposed between the base 2 and the vibrating structure 3 for connecting them and allowing the vibrating structure 3 to elastically oscillate relative to the base 2. In the preferred embodiment, in particular, there are four elastic elements 4 positioned at the four vertices of a rectangle, each of which comprises one or more helical springs placed side by side.

[0019] At least one vibrating unit 5 is mounted on the vibrating structure 3 for, in use, causing the vibrating structure 3 to vibrate relative to the base 2. In the preferred embodiment the vibrating unit 5 is of the mechanical type with eccentric rotating masses. But in general, it may be made in any way suitable for the purpose. However, preferably, it is a vibrating unit 5 able to generate reciprocating vibration. In the known way, it is also advantageously mounted in the highest part of the vibrating structure 3.

[0020] The vibrating structure 3 in turn comprises a supporting frame 6 which supports a plurality of screening elements 7 (typically perforated plates or nets that act as a sieve). The screening elements 7 are positioned on multiple levels one above the other and are vertically spaced. Moreover, a screening element 7 positioned at one level comprises screening openings having a size smaller than those of the screening elements 7 positioned at the higher levels. In this way, the screen causes division of the various particle size measurements of the aggregates being processed on the different levels with decreasing size from top to bottom.

[0021] Advantageously, the screening elements 7 are each supported by a plurality of elongate supporting elements 8 positioned substantially horizontally and perpendicular to a main line of extension of the vibrating screen 1 (the length in the accompanying figures). The elongate supporting elements 8 of each screening element 7 are also positioned in such a way that the respective screening element 7 has a predetermined slope from the infeed section 9 of the vibrating screen 1 located near to one of the smaller sides, towards the outfeed section 10 located at the other small side (Figure 4).

[0022] The supporting frame 6 comprises two lateral walls 11. Each lateral wall 11 comprises an inner main surface 12 facing towards the other lateral wall 11, and an outer main surface 13 positioned on the opposite side to the inner main surface 12. The screening elements 7 are positioned between the inner main surfaces 12. Moreover, in the embodiment illustrated, the elongate supporting elements 8 are fixed to the lateral walls 11 at the inner main surfaces 12.

[0023] The vibrating structure 3 also comprises a load-bearing beam 14, which is rigidly interconnected between the lateral walls 11 and which extends horizontally above all of the screening elements 7. The vibrating unit 5 is advantageously mounted on the load-bearing beam 14. In particular, the load-bearing beam 14 is fixed to the lateral walls 11 at supporting portions 15 of the related inner main surfaces 12.

[0024] Moreover, according to a first innovative aspect of this invention, for each lateral wall 11 the supporting frame 6 comprises at least one box-shaped reinforcing structure 16 that is hollow inside and that is applied to the outer main surface 13 of the related lateral wall 11.

[0025] According to the preferred embodiment of this invention, each box-shaped reinforcing structure 16 is applied exclusively to a limited part 17 of the related outer main surface 13, in particular to a limited part 17 of the outer main surface 13 that forms at least one ring surrounding a portion of the self-same outer main surface 13 to which, in contrast, the box-shaped reinforcing structure 16 is not applied.

[0026] Depending on the embodiments, that limited part 17 of each outer main surface 13 may form either a single ring 18 or a plurality of rings 18 that each surround a portion of the self-same outer main surface 13 to which the box-shaped reinforcing structure 16 is not applied.

[0027] Therefore, seen from the side (as in Figures 7, 9 and 10), each box-shaped reinforcing structure 16 in turn also has a shape that forms at least one ring 18 (only one in Figures 7 and 10, but five in Figure 9). Depending on the embodiments, the reinforcing structure may be located only on part of the respective lateral wall 11 (in the upper part in Figure 7) or may affect the entire lateral wall as in Figures 9 and 10.

[0028] Moreover, advantageously, the box-shaped reinforcing structure 16 is present at supporting flanges 19 by means of which the vibrating structure 3 is connected to the elastic elements 4, and/or to the zones of the outer main surfaces 13 positioned at the supporting portions 15 made on the inner main surfaces 12. Those zones are therefore part of the

respective limited part 17 of the outer main surface 13 that forms at least one ring 18.

[0029] In the preferred embodiment, each box-shaped reinforcing structure 16 is connected to the related lateral wall 11 by means of a plurality of bolts 20. In particular, advantageously, for each box-shaped reinforcing structure 16, at least several bolts 20 connect the box-shaped reinforcing structure 16 both to the related lateral wall 11 and to one of the elongate supporting elements 8 of at least one screening element 7. In particular, in the preferred embodiment, two or more bolts 20 connect the box-shaped reinforcing structure 16 to the same elongate supporting element 8.

[0030] Also, preferably, at least several, but preferably all of the bolts 20 completely pass through the related box-shaped reinforcing structure 16. Furthermore, in this case, advantageously, at least for several of the bolts 20 that completely pass through the box-shaped reinforcing structure 16, the box-shaped reinforcing structure 16 internally comprises a tubular insert 21 extending perpendicularly to a main plane of extension of the lateral wall 11, the bolt 20 being positioned through the inside of this insert. Advantageously, the tubular insert 21 is welded to the rest of the box-shaped reinforcing structure 16.

[0031] As regards the form of each box-shaped reinforcing structure 16, in the preferred embodiment illustrated in the accompanying figures it comprises first a main reinforcing body 22 which, in a plane perpendicular to the main plane of extension of the outer main surface 13, has a C-shaped cross-section (the shape and the size of the C may vary from one zone to the next). In particular, the central part of the C is applied to the related outer main surface 13 whilst the two arms of the C extend substantially perpendicularly to, and away from, the main plane of extension of the related outer main surface 13. The box-shaped reinforcing structure 16 also comprises at least one closing element 23 applied to the main reinforcing body 22 so that together with the latter it forms a box-shaped element. Seen in cross-section, as in Figure 8, the closing element 23 is fixed to the arms of the C advantageously by welding.

[0032] To allow the passage of the bolts 20, suitable through holes are made in the main reinforcing body 22, the closing element 23, the lateral wall 11 and if necessary in the elongate element.

[0033] In general, both the main reinforcing body 22 and the closing element 23 may be made either as one piece or as a plurality of pieces that are drawn near each other and interconnected if necessary.

[0034] Depending on requirements and on the shape of the box-shaped reinforcing structure 16, there may be additional reinforcing and/or stiffening elements inside it.

[0035] For example, each box-shaped reinforcing structure 16 may comprise a plurality of stiffening walls 24 mounted inside the main reinforcing body 22 and welded to it. Advantageously, the stiffening walls 24 extend perpendicularly to the related outer main surface 13, preferably from one arm of the C to the opposite arm.

[0036] Furthermore, advantageously, the box-shaped reinforcing structure 16 comprises a plurality of stiffening walls 24 that are angled relative to one another and constrained to each other in order to form a stiffening frame 25, at the supporting flanges 19 and/or at the zones of the outer main surfaces 13 positioned at the supporting portions 15 made on the inner main surfaces 12.

[0037] Depending on requirements, the thicknesses of the various parts of the box-shaped reinforcing structure 16 may be different to one another (for example, in the same box-shaped reinforcing structure 16, 3 mm, 5 mm and 14 mm thicknesses may be used simultaneously).

[0038] Operation of the screen according to this invention is similar to that of conventional screens.

[0039] However, this invention brings important advantages.

[0040] Preliminary checks and tests carried out by the Applicant allowed it to be established that thanks to this invention it is possible to significantly increase the performance of a vibrating screen.

[0041] Moreover, it was possible to increase the structural resistance to fatigue of the screen without excessively altering its mass.

[0042] In particular, by applying a box-shaped reinforcing structure such as that in the figures to an existing vibrating screen having the following limit performance values (dictated by mechanical resistance):

- maximum acceleration achievable 4.8 g (where g, obviously, indicates the acceleration of gravity);
- mass (screen + material) 3446 kg;
- maximum intensity of the sinusoidal force applicable by the vibrating unit 85 kN;

it has been possible to increase those limit performance values to the following values:

- maximum acceleration achievable 12 g;
- mass (screen + material) 5240 kg;
- maximum intensity of the sinusoidal force applicable by the vibrating unit 220 kN.

[0043] Finally, it should be noticed that this invention is relatively easy to produce and that even the cost linked to implementing the invention is not very high.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP1719560A2 **[0004]** **[0006]** **[0008]** **[0009]**
- EP1946851A1 **[0011]**
- GB2134214A **[0012]**

Patentkrav

1. Vibrationssigte omfattende:

en base (2) placeret i en nedre del;

en vibrationsstruktur (3) placeret i en øvre del;

en flerhed af elastiske elementer (4) indskudt mellem basen (2) og vibrationsstrukturen (3) til at forbinde dem og tillade vibrationsstrukturen at (3) svinge elastisk i forhold til basen (2); og

mindst en vibrationsenhed (5) monteret på vibrationsstrukturen (3);

hvor:

vibrationsstrukturen (3) omfatter en støtteramme (6), på hvilken en flerhed af sigteelementer (7) er monteret, hvor sigteelementerne er indrettet på flere niveauer med den ene over den anden og vertikalt anbragt med mellemrum, hvor et sigteelement (7) placeret på et niveau omfatter sigteåbninger med en størrelse, som er mindre end sigteåbningerne af sigteelementerne (7) placeret på højere niveauer;

støtterammen (6) omfatter to sidevægge (11) og, for hver sidevæg (11), mindst en forstærkningsstruktur (16) anbragt på den sidevæg; og

hvor sidevæggene (11) hver omfatter en indvendig hovedoverflade (12), som vender mod den anden sidevæg (11), og en udvendig hovedoverflade (13), placeret på den modsatte side af den indvendige hovedoverflade (12), idet sigteelementerne (7) er placeret mellem de indvendige hovedoverflader (12); og **kendetegnet ved, at** hver forstærkningsstruktur (16) betragtet i sig selv, er kasseformet, er hul indeni og omfatter en væg anbragt på den udvendige hovedoverflade (13) af den tilhørende sidevæg (11).

2. Vibrationssigten ifølge krav 1, **kendetegnet ved, at** hver kasseformet forstærkningsstruktur (16) udelukkende er anbragt på en begrænset del (17) af den tilhørende udvendige hovedoverflade (13).

3. Vibrationssigten ifølge krav 2, **kendetegnet ved, at** nævnte begrænsede del (17) af hver udvendig hovedoverflade (13) danner mindst en ring (18), som omslutter et afsnit af den selvsamme udvendige hovedoverflade (13), på hvilken

den kasseformede forstærkningsstruktur (16) ikke er anbragt.

4. Vibrationssigten ifølge krav 3, **kendetegnet ved, at** nævnte begrænsede del (17) af hver udvendig hovedoverflade (13) danner en flerhed af ringe (18), som hver omslutter et afsnit af den selvsamme udvendige hovedoverflade (13), på hvilken den kasseformede forstærkningsstruktur (16) ikke er anbragt.

5. Vibrationssigten ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** vibrationsstrukturen (3) også omfatter en lastbærende stang (14), stift forbundet mellem sidevæggene (11) og strækkende sig horisontalt over alle sigteelementerne (7), hvor vibrationsenheden (5) er monteret på den lastbærende stang (14).

6. Vibrationssigten ifølge krav 5 når det er afhængigt af krav 3, **kendetegnet ved, at** den lastbærende stang (14) er fastgjort på sidevæggene (11) ved støtteafsnit (15) af de tilhørende indvendige hovedoverflader (12), og **ved, at** på hver udvendig hovedoverflade (13), ved nævnte støtteafsnit (15), er det muligt at identificere en zone, som er del af nævnte begrænsede del (17), som danner mindst en ring (18), og på hvilken den kasseformede forstærkningsstruktur (16) er anbragt.

7. Vibrationssigten ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** hver kasseformet forstærkningsstruktur (16) er forbundet med den tilhørende sidevæg (11) ved hjælp af en flerhed af bolte (20).

8. Vibrationssigten ifølge krav 7, **kendetegnet ved, at** for hver kasseformet forstærkningsstruktur (16) forbinder mindst adskillige bolte (20) den kasseformede forstærkningsstruktur (16) både med den tilhørende sidevæg (11) og med et langstrakt støtteelement, som stift forbinder de indvendige hovedoverflader med hinanden og støtter mindst et sigteelement (7).

9. Vibrationssigten ifølge krav 7 eller 8, **kendetegnet ved, at** mindst adskillige af nævnte bolte (20) passerer fuldstændigt igennem den tilhørende kasseformede forstærkningsstruktur (16), og **ved, at**, mindst for adskillige af boltene (20), som passerer fuldstændigt gennem den, omfatter den kasseformede

forstærkningsstruktur (16) også, for hver bolt (20), mindst en rørformet indsats (21), som strækker sig vinkelret på et hovedudstrækningsplan af sidevæggen (11) og indeni hvilken, bolten (20) er placeret.

10. Vibrationssigten ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** hver kasseformet forstærkningsstruktur (16) omfatter et hovedforstærkningslegeme (22) som, i et plan vinkelret på et hovedudstrækningsplan af den udvendige hovedoverflade (13), er C-formet med en midterdel af C'et anbragt på den tilhørende udvendige hovedoverflade (13), og arme af C'et strækkende sig i alt væsentligt vinkelret på, og væk fra, hovedudstrækningsplanet af den tilhørende udvendige hovedoverflade (13), og mindst et lukkeelement (23) anbragt på hovedforstærkningslegemet (22) mellem armene af C'et, hvor nævnte væg af forstærkningsstrukturen anbragt på den tilhørende udvendige hovedoverflade (13) af den tilhørende sidevæg (11) består af nævnte midterdel af C'et.

11. Vibrationssigten ifølge krav 10, **kendetegnet ved, at** hver kasseformet forstærkningsstruktur (16) også omfatter en flerhed af afstivningsvægge (24) monteret indeni hovedforstærkningslegemet (22) og svejset derpå, hvor afstivningsvæggene (24) strækker sig vinkelret på den tilhørende udvendige hovedoverflade.

12. Vibrationssigten ifølge krav 11 når det er afhængigt af krav 6, **kendetegnet ved, at** hver forstærkningsstruktur omfatter en flerhed af afstivningsvægge (24) ved det tilhørende støtteafsnit af den indvendige hovedoverflade (12), hvor afstivningsvæggene (24) af nævnte flerhed er vinklet i forhold til hinanden og begrænset til hinanden for at danne en afstivningsramme (25).

DRAWINGS

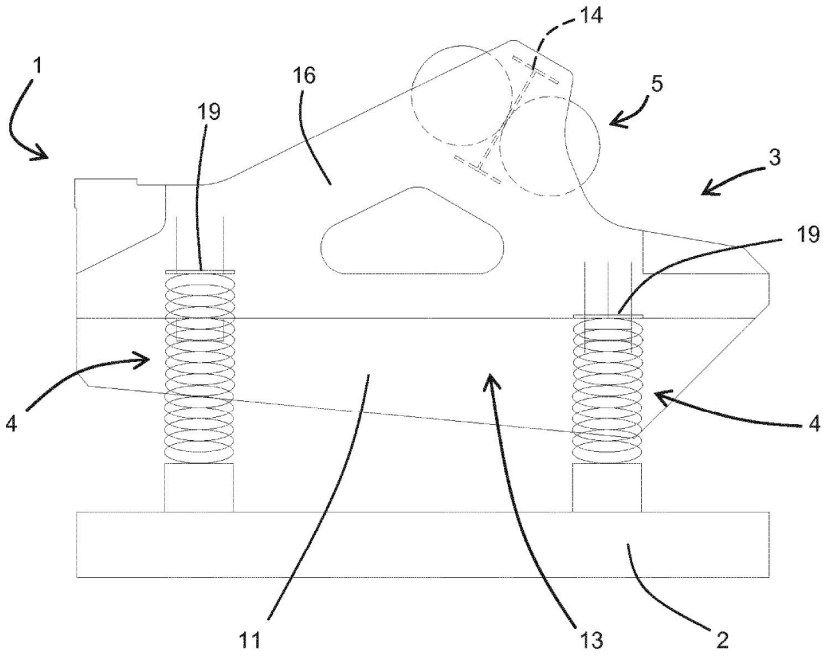

FIG. 1

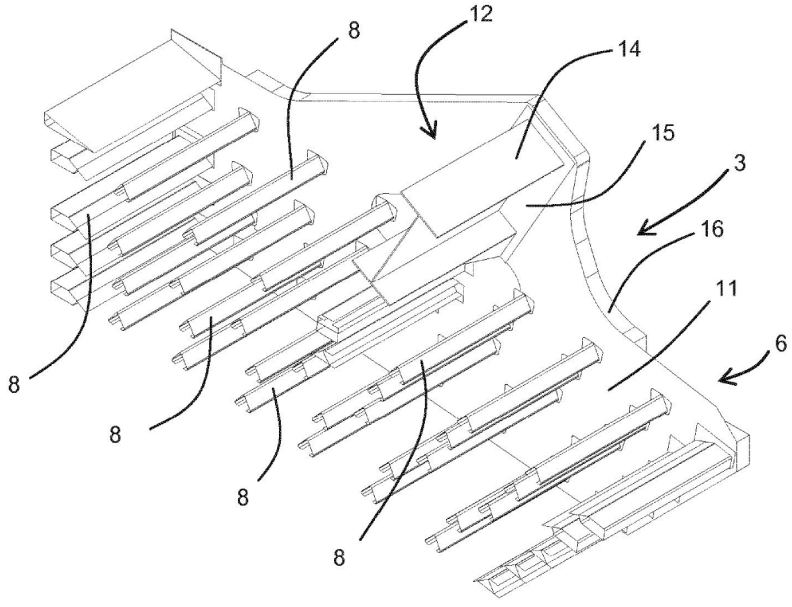

FIG. 2

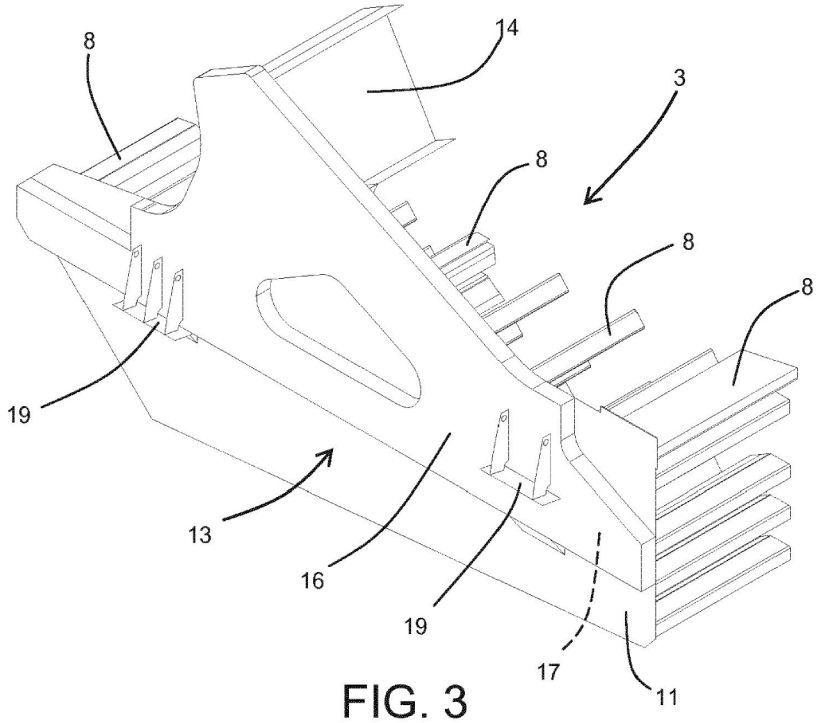

FIG. 3

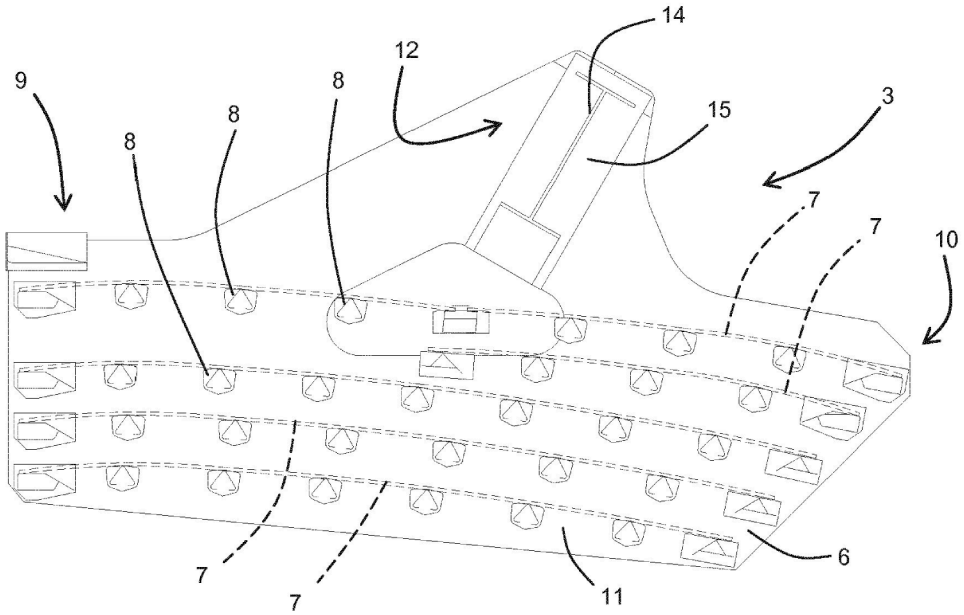

FIG. 4

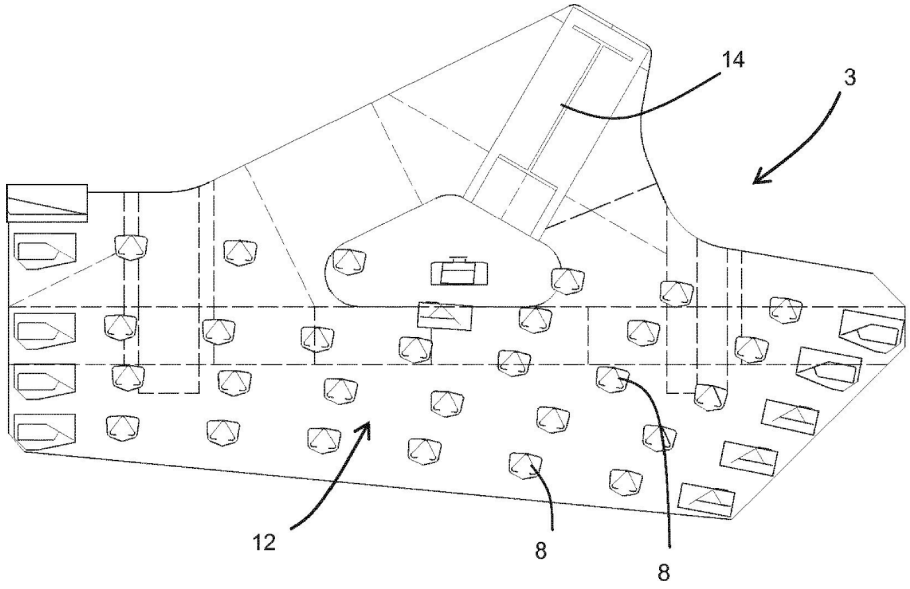

FIG. 5

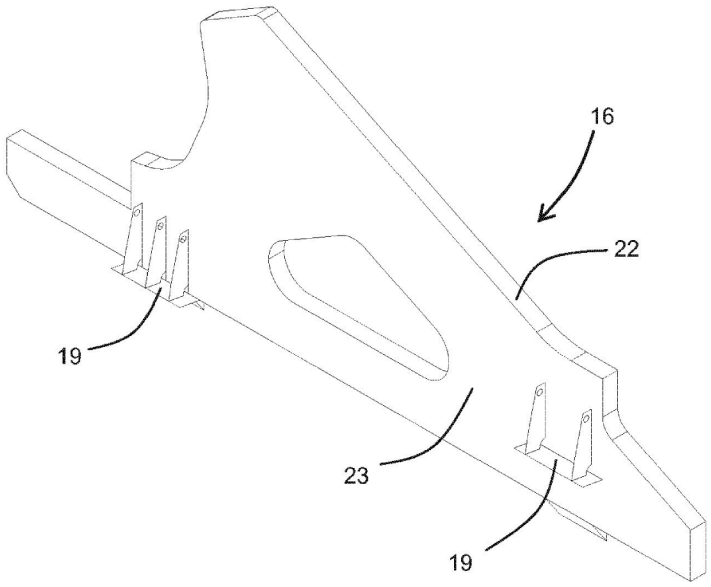

FIG. 6

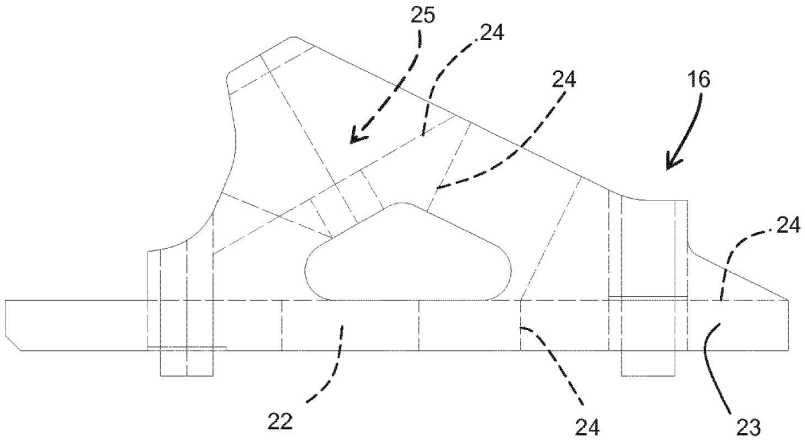

FIG. 7

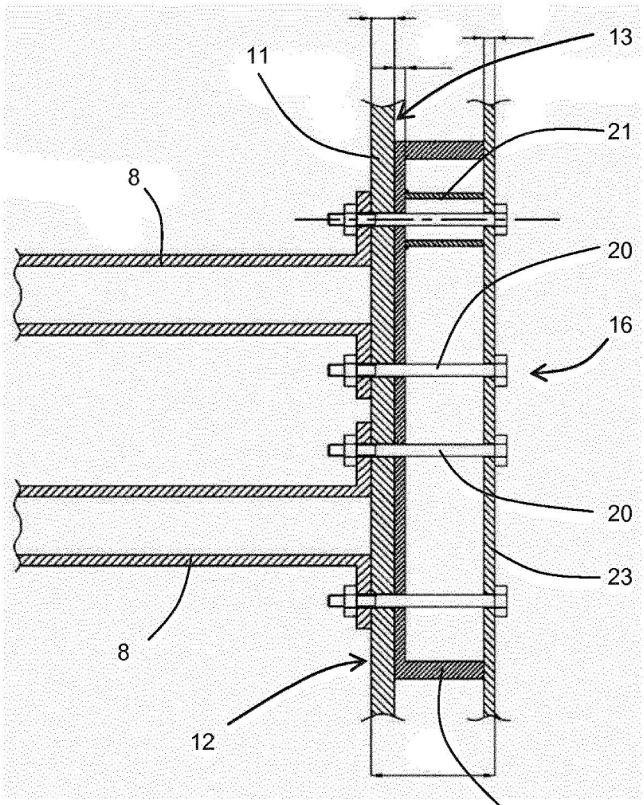

FIG. 8

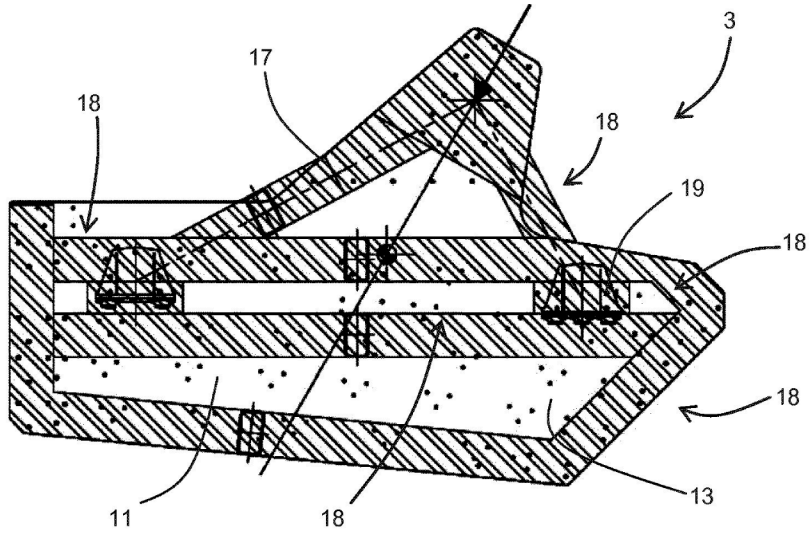

FIG. 9

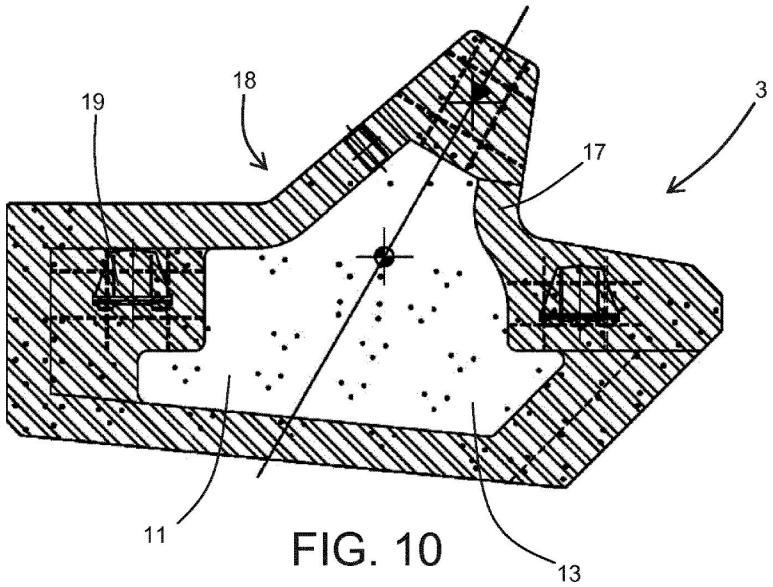

FIG. 10