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(54) **REINFORCED DILATATION JOINT FOR ROAD AND RAILROAD APPLICATIONS**

(57) The present invention relates to a reinforced expansion joint (10) for road and rail applications, comprising:
- an upper central flat block (11), with a reinforcement armature (12);
- two lower lateral flat blocks (13, 14), with a respective reinforcement armature (15, 16);
the upper central flat block (11) and the lower lateral flat blocks (13, 14) being connected by means of respective first elastically deformable junction sections (17, 18).

Said reinforced expansion joint (10) also comprises:
- two upper lateral flat blocks (19, 20), positioned on opposite sides of the upper central flat block (11), connected to the two lower lateral flat blocks (13, 14) through corresponding second elastically deformable junction sections (21, 22);
- two opposite end blocks (25, 26), each developing from an upper lateral flat block (19, 20) downwards, with respect to an arrangement of use;
- a reinforcement armature (23, 24), positioned inside each of the upper lateral flat blocks (19, 20) and configured in such a way as to extend in the upper portion (25a, 26a) of the respective end block (25, 26);
- an anchoring armature (27, 28) positioned inside the lower part (25b, 26b) of a corresponding end block (25, 26).

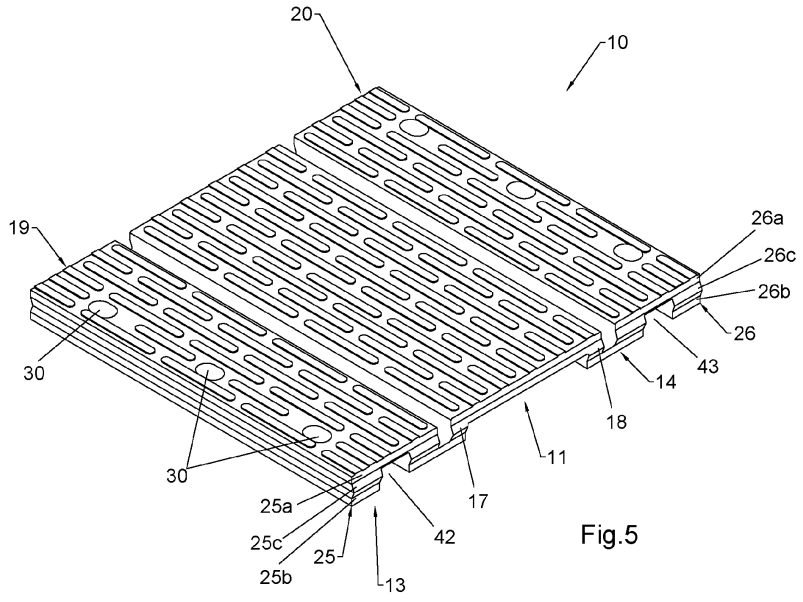

Fig.5

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Description

[0001] The invention relates to a reinforced expansion joint for road and rail applications.

[0002] In particular, the present invention has as its object an expansion and waterproof joint, particularly designed for applications in the road and civil sectors, having a modular composition of studied elements of reinforced elastomer.

[0003] It is now known that one of the main functions of an expansion joint is to ensure the continuity of the road surface, ensuring the flatness thereof in order to ensure a smooth and comfortable driving even at the expansion joint itself.

[0004] Another important function of an expansion joint is to allow the development of structural deformations, of a road section or a railway section, related to thermal variations or other factors, such as an earthquake.

[0005] In essence, the expansion joint must allow the increase or decrease in the size of the gap, or the space, existing between two opposing structural elements, where the change in the gap can be related to any phenomenon, or thermal gradient, or earthquake, or oscillation, or other phenomena involving a shift of the parts between which the gap is defined.

[0006] In practice, the purpose of an expansion joint is to ensure the load-bearing coverage of the gap underlying the joint in the field of the slidings for which the expansion joint is designed.

[0007] It is also essential that an expansion joint is able to guarantee the impermeability of the gap to which it is applied.

[0008] The expansion joint object of the present invention is referable to the type of joints identified as "bridge plate" expansion joints.

[0009] Basically, these are expansion joints in which the required sliding is developed by exploiting the shear deformation of flat rubber blocks suitably positioned with respect to each other.

[0010] These flat rubber blocks are connected together so as to form the real joint by means of rubber junction portions and vulcanized steel metal sheets within the same flat blocks.

[0011] It should be remembered that the technological process of vulcanisation is a well-known industrial process through which, by means of the combined action of heat and pressure, steel elements, also known as 'armature', placed together with raw rubber inside a mould, are made to adhere closely to the rubber itself, giving rise to a product having the same geometry as that of the mould used, at the same time giving the rubber making up the product mechanical characteristics according to the chemical characteristics of the rubber used.

[0012] Figures 1, 2 and 3 show schematically a typical example of a "bridge plate" type expansion joint in its neutral configuration (Figure 1), in the maximum contraction configuration (Figure 2), and in the maximum extension configuration (Figure 3), so as to make clear its operating principle.

[0013] An expansion joint of known type shown in Figures 1, 2 and 3 is wholly referred to therein as A1.

[0014] Such an expansion joint A1 comprises:

- an upper central flat block B,
- two lower lateral flat blocks C and D.

[0015] In the normal arrangement of use of the expansion joint A1, the upper central flat block B is placed above the two lower lateral flat blocks C and D, and is partially superimposed on them.

[0016] The flat blocks are developed in mutually parallel planes.

[0017] The upper central flat block B and the lower lateral flat blocks C and D are connected by means of respective elastically deformable junction sections E and F.

[0018] A metal reinforcing plate H1 is incorporated in the upper central flat block B and extends within the block itself substantially over its entire width and over its entire length.

[0019] Corresponding metal plates H2 and H3 are embedded also in the lower lateral flat blocks C and D.

[0020] The metal plates H2 and H3 allow the anchoring to the ground, by means of threaded fixing systems, of the lower lateral flat blocks C and D.

[0021] The expansion joint A1 also comprises end portions L and M developing upwards along the respective opposite edges of the lower lateral flat blocks C and D, at which the through holes for the ground anchoring screws are defined.

[0022] The upper surfaces of the upper central flat block B and the end portions L and M lie on the same plane, which in use is the transit plane, i.e., the plane on which the wheels of the vehicles run.

[0023] A gap K1 and K2 is defined between the upper central flat block B and an end portion L and M respectively, which gap widens or narrows according to the reciprocal movement of the two opposite road sections between which the expansion joint is fixed.

[0024] The flat blocks B, C and D, the junction sections E and F and the end portions L and M are integrated into a single plastic body, for example of vulcanized rubber, as described above.

[0025] The end portions L and M are not reinforced; such end portions L and M define a rest sidewall for a corresponding lateral screed for the connection to, for example, the road asphalt.

[0026] The geometric configuration shown in these figures 1, 2 and 3 is the typical configuration used by almost all manufacturers for the realization of expansion joints with maximum sliding, i.e., with a deformation in the direction of travel, up to 150 mm, that is joints with a maximum extension capacity of 75 mm and a maximum contraction capacity of 75 mm.

[0027] Above this sliding value, that is 150 mm, expansion joint manufacturers currently use "multiple" geometric configurations of the illustrated configuration, as ex-

emplified in the section of figure 4.

[0028] For the expansion joints with a sliding capacity higher than 150 mm, the number of bridge plate elements indeed is increased and new elements are inserted, generally always in symmetry, referred to as 'transition elements', whose purpose is to increase the number of flat blocks of reinforced rubber that with their displacement guarantee the required performance to the expansion joint.

[0029] The expansion joint A2 of figure 4 comprises substantially the same elements as the expansion joint A1 of figures 1 to 3, with the addition of:

- two upper lateral flat blocks W and S, positioned on opposite sides of the upper central flat block B, connected to the end portions L and M which define corresponding second junction sections L and M, and are added to the first junction sections E and F;
- two external lower lateral flat blocks U and V, arranged externally to the two lower lateral flat blocks C and D;
- elastically deformable junction sections R and T between the upper lateral flat blocks W and S and the external lower lateral flat blocks U and V.

[0030] Also in this known expansion joint A2 the external lower lateral flat blocks U and V comprise respective end portions Y and Z developing upwards along the respective opposite edges of the external lower lateral flat blocks U and V, at which the through holes for the ground anchoring screws are defined.

[0031] In this expansion joint A2 also the end portions Y and Z are reinforced by means of a steel profile H6 and H7 respectively, shaped like an "L", whose horizontal part allows the external lower lateral flat blocks U and V to be anchored to the ground, while the vertical part reinforces the central and upper part of the same end portion Y and Z.

[0032] This expansion joint A2 comprises four gaps K1, K2, K3 and K4.

[0033] The expansion joints A1 and A2 described above can change their length in the direction of travel, i.e., the direction in which the vehicles run over them, thanks to the elastically deformable junction sections E, F, L, M, R and T which, by deforming elastically in shear, allow the upper flat blocks to move away or closer.

[0034] The expansion joint A1 having two gaps K1 and K2 has two elastically deformable junction sections E and F.

[0035] The expansion joint A2 having four gaps K1, K2, K3 and K4 has instead six elastically deformable junction sections E, F, L, M, R and T.

[0036] The need to increase the number of flat blocks in reinforced rubber, as the need for the sliding of the expansion joint increases, derives from the limitations placed on some of the geometric elements that make this type of expansion joint.

[0037] The first limitation is related to the width of the single transversal gap of an expansion joint that one can have in the phase of maximum extension, that is the maximum distance in the direction of travel between two flanked upper flat blocks; this maximum width is fixed in literature at 80 mm, a value beyond which there is an exponential increase in the stresses transmitted by the wheels of transiting vehicles to the structure of the joint itself when these vehicles engage the gap.

[0038] The second limitation concerns the maximum tangential deformation imposed on the single junction sections connecting the flat blocks, which is comprised between values of 0.7 and 1.2 of the height value of the junction section itself.

[0039] Therefore, for slidings equal to and greater than 200 mm, that is between +100 mm and -100 mm, it is necessary to achieve this overall sliding by dividing and distributing the deformation over a number of elastically deformable junction sections greater than two, both in order to avoid too high, that is too thick, expansion joints and to avoid gaps greater than 80 mm at maximum extension.

[0040] At present, manufacturers of expansion joints are making this technical requirement a reality by arranging several elastically deformable junction sections in series, until the development and therefore the desired performance in terms of overall sliding are obtained.

[0041] It is evident how an expansion joint obtained in this way is characterized by a plurality of transversal gaps to each of which the development of a portion of the overall required sliding is assigned.

[0042] It is also evident that each transversal gap represents a direct source of noise when a gap is crossed and engaged by a wheel of a vehicle transiting on the expansion joint which, it is worth remembering, engages the transversal gaps in a direction, corresponding to the above-mentioned direction of travel, orthogonal to them with respect to their longitudinal development direction.

[0043] The origin of the noise is constituted by the impact of the vehicle wheels on the edge "coming out" from the gap, an impact that, in addition to the noise produced, inevitably produces a dynamic stress on the expansion joint and from this to the structure.

[0044] The presence of the transversal gaps on expansion joints must be considered a "necessary evil", "evil" because they are a source of noise and dynamic stresses, "necessary" because these gaps are those allowing the required slidings of the joint.

[0045] The task of the present invention is to develop a reinforced expansion joint for road and rail applications capable of obviating the limitations and drawbacks of expansion joints known today.

[0046] In particular, one object of the invention is to develop a reinforced expansion joint capable of slidings higher than 150 mm while minimizing the number of gaps.

[0047] Another object of the invention is to develop a reinforced expansion joint which is quieter than the known type joints.

[0048] Again, one object of the invention is to develop

a reinforced expansion joint that is more compact than expansion joints capable of slidings higher than 150 mm of known type.

[0049] The above-mentioned task as well as the above-mentioned objects are achieved by a reinforced expansion joint for road and rail applications according to claim 1.

[0050] Further features of the reinforced expansion joint according to claim 1 are described in the dependent claims.

[0051] The aforesaid task and objects, together with the advantages that will be mentioned hereinafter, are indicated by the description of an embodiment of the invention, which is given by way of non-limiting example with reference to the attached drawings, where:

- figure 1 represents a sectional side view of a road expansion joint of known type, in a first operating arrangement;
- figure 2 represents the expansion joint of figure 1 in a second operating arrangement;
- figure 3 represents the joint of figures 1 and 2 in a third operating arrangement;
- figure 4 represents a sectional side view of a further expansion joint of known type;
- figure 5 represents a perspective view of a reinforced expansion joint according to the invention;
- figure 6 represents a sectional side view of the reinforced expansion joint according to the invention in a first operating arrangement;
- figure 7 represents a sectional side view of the reinforced expansion joint according to the invention in a second operating arrangement;
- figure 8 represents a sectional side view of the reinforced expansion joint according to the invention in a third operating arrangement.

[0052] With reference to the above-mentioned figures, a reinforced expansion joint for road and rail applications according to the invention is indicated as a whole by numeral **10.**

[0053] Said reinforced expansion joint **10** comprises:

- an upper central flat block **11,** inside which a reinforcement armature **12** is incorporated,
- two lower lateral flat blocks **13** and **14,** inside each of said lower lateral flat blocks **13** and **14** a respective reinforcement armature **15** and **16** being incorporated.

[0054] With respect to an arrangement of use, the upper central flat block **11** is placed above the two lower lateral flat blocks **13** and **14.**

[0055] The upper central flat block **11** and the lower lateral flat blocks **13** and **14** are connected by means of respective first elastically deformable junction sections **17** and **18.**

[0056] The reinforced expansion joint **10** according to the invention further comprises:

- two upper lateral flat blocks **19** and **20,** positioned on opposite sides of the upper central flat block **11,** connected to said two lower lateral flat blocks **13** and **14** through corresponding second elastically deformable junction sections **21** and **22;** the upper surfaces of the upper central flat block **11** and of the upper lateral flat blocks **19** and **20** lie on the same plane, which in use is a transit plane; the lower lateral flat blocks **13** and **14** lie below said transit plane;
- two opposite end blocks **25** and **26,** each developing from a said upper lateral flat block **19** and **20** downwards with respect to an arrangement of use;
- a reinforcement armature **23** and **24,** positioned inside each of the upper lateral flat blocks **19** and **20** and configured in such a way as to extend in the upper portion **25a** and **26a** of the respective end block **25** and **26;**
- an anchoring armature **27** and **28** positioned inside the lower part **25b** and **26b** of a corresponding end block **25** and **26.**

[0057] A first variable width gap **40** is defined between the upper central flat block **11** and a first upper lateral flat block **19**; a second variable width gap **41** is defined between the upper central flat block **11** and a second upper lateral flat block **20**.

[0058] A lower variable width recess **42** and **43** is defined between a lower lateral flat block **13** and **14** and a corresponding flanked end block **25** and **26.**

[0059] Said lower variable width recesses **42** and **43** are configured to each define an external lateral variable width gap, each external lateral variable width gap being placed below a corresponding upper lateral flat block **19** and **20.**

[0060] Such lower variable width recesses **42** and **43** substantially define 'covered' or inverted gaps, thanks to which the movement away from or approach between a lower lateral flat block **13** and **14** and a corresponding flanked end block **25** and **26** is permitted as if there were a gap open upwards in a known manner, but without having the interruption of the structural continuity caused by a normally upwards facing gap.

[0061] The reinforcement armatures **12, 23, 24** of the upper central flat block **11** and of the upper lateral flat blocks **19** and **20** respectively each comprise at least one upper metal plate.

[0062] Such upper metal plates develop on the same reference plane P.

[0063] The reinforcement armature **12** of the upper central flat block **11** comprises a main metal plate **12a** and an auxiliary metal plate **12b.**

[0064] Said auxiliary metal plate **12b** is placed below the main metal plate **12a**.

[0065] The reinforcement armatures **15** and **16** and the anchoring armatures **27** and **28** each comprise at least one respective lower metal plate.

[0066] A central portion **25c** and **26c** of the end blocks **25** and **26** is sandwiched between an outer zone **23a** and **24a** of the reinforcement armature **23** and **24** of a said corresponding upper lateral flat block **19** and **20** and a corresponding anchoring armature **27** and **28.**

[0067] The upper central **11,** lower lateral **13** and **14,** upper lateral **19** and **20** flat blocks, the end blocks **25** and **26** and the elastically deformable junction sections **17, 18, 21, 22** are part of a single body made of plastic material.

[0068] The reinforcement armatures **12, 15, 16, 23, 24** and the anchoring armatures **27, 28** are embedded and incorporated inside said single body in plastic material.

[0069] In particular, the single plastic body is made of vulcanized synthetic rubber.

[0070] Each of said end blocks **25** and **26** comprises niches **30** for accessing the respective anchoring armature **27** and **28.**

[0071] The anchoring armatures **27** and **28** are known to have through holes for inserting a threaded fastener, such as a threaded bar, for fixing to an underlying slab.

[0072] The reinforced expansion joint **10** according to the invention therefore has a metal plate, i.e., the corresponding reinforcement armature **23** and **24,** also in each of the two opposite end blocks **25** and **26** which opposite end blocks **25** and **26** are directly on the border with the road pavement, except for a lateral cement mortar screed not illustrated for simplicity's sake and of a type known in itself.

[0073] In this way, the wheels of a vehicle immediately find a stable support from the very first approach to the reinforced expansion joint **10,** unlike to what happens with the known expansion joints exemplified in Figures 1 and 4, where the corresponding end portions L and M, Y and Z have no reinforcement armature in the upper part developing over the whole extension of the upper part itself.

[0074] In this way, the end blocks **25** and **26** develop their deformation below the corresponding reinforcement plate **23** and **24,** i.e., the reinforcement armature **23** and **24** which protects the respective lower recess **42** and **43** underlying it from the impact of the vehicle wheels.

[0075] The result is a reinforced expansion joint **10** that is more compact, quieter and less impactful to the structure.

[0076] A further advantage of positioning the first reinforcement plate **23** and **24,** i.e. of the reinforcement armature **23** and **24** of the end blocks **25** and **26,** at the extrados of the reinforced expansion joint **10,** is that this first reinforcement plate **23** and **24** contributes to the transverse stiffening of the joint itself, working as a "sandwich" with the anchoring zone in which the anchoring reinforcement **27** and **28** is positioned on which slotted through holes are obtained, for the insertion of the anchoring screws for which said anchoring reinforcement acts as a contrast for their tightening.

[0077] As can be seen in figure 4, nowadays the stiffening of the end blocks, if any, is carried out using a steel profile, indicated with H6 and H7 in figure 4, usually shaped as an "L", as a reinforcement element in the anchoring zone.

[0078] This "L" stiffening is not able to support the load of a wheel transiting on the end portion Y and Z with consequent inhomogeneous crushing of the end portion Y and Z itself, and consequent generation of an effective gap K3 greater than the ideal expected one.

[0079] During the vulcanization phase, a slotted recess **30** is obtained in the rubber thickness placed at the slotted hole, in order to allow the housing of the head and of the relative washer of the anchoring screw, so that nothing protrudes from the thickness of the synthetic rubber body of the reinforced expansion joint **10** and so that it cannot in any way interfere with the flow of the vehicles on it.

[0080] This technical solution can obviously be used for any reinforced expansion joint, both for road and rail use, and above all for any sliding interval, preferably but not limited to, higher than 100 mm.

[0081] It has in practice been established that the invention achieves the intended task and objects.

[0082] In particular, a reinforced expansion joint **10** has been developed by the invention, which makes it possible to reduce to only two, that is, the gaps **40** and **41** in figures 6, 7 and 8, the gaps required to make an expansion joint having a total sliding capacity equal to and greater than 200 mm, instead of four gaps like in the joints of the known type.

[0083] In particular, with the invention, a reinforced expansion joint has been developed which is quieter than known type joints, due to the halved number of gaps, i.e., zones of increased noise at the transit of vehicle wheels.

[0084] In addition, with the invention, a reinforced expansion joint has been developed which is more compact than the expansion joints capable of slidings greater than 150 mm of the known type, and which therefore requires less space in the direction of travel, and fewer special materials to be set up.

[0085] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; moreover, all the details may be replaced by other technically equivalent elements.

[0086] In practice, the components and materials used, as long as they are compatible with the specific use, as well as the contingent dimensions and shapes, can be any according to the needs and the prior art.

[0087] Where the characteristics and techniques mentioned in any claim are followed by reference notes, such reference notes should be intended as having been added for the sole purpose of increasing the intelligibility of the claims and consequently such reference notes have no limiting effect on the interpretation of each element identified by way of example by such reference notes.

Claims

1. Reinforced expansion joint (10) for road and rail applications, comprising:

   - an upper central flat block (11), inside which a reinforcement armature (12) is incorporated;
   - two lower lateral flat blocks (13, 14), inside each of said lower lateral flat blocks (13, 14) a respective reinforcement armature (15, 16) being incorporated,

   with respect to an arrangement of use, said upper central flat block (11) being placed above said two lower lateral flat blocks (13, 14),
   said upper central flat block (11) and said lower lateral flat blocks (13, 14) being connected by means of respective first elastically deformable junction sections (17, 18),
   said reinforced expansion joint (10) being **characterized in that** it comprises:

   - two upper lateral flat blocks (19, 20), positioned on opposite sides of the upper central flat block (11), connected to said two lower lateral flat blocks (13, 14) through corresponding second elastically deformable junction sections (21, 22), the upper surfaces of said upper central flat block (11) and of said upper lateral flat blocks (19, 20) lying on the same plane, which in use is a transit plane, said lower lateral flat blocks (13, 14) lying below said transit plane;
   - two opposite end blocks (25, 26), each developing from a said upper lateral flat block (19, 20) downwards, with respect to an arrangement of use;
   - a reinforcement armature (23, 24), positioned inside each of said upper lateral flat blocks (19, 20) and configured in such a way as to extend in the upper part (25a, 26a) of the respective end block (25, 26);
   - an anchoring armature (27, 28) positioned inside the lower part (25b, 26b) of a corresponding end block (25, 26);

   a first variable width gap (40) being defined between said upper central flat block (11) and a said first upper lateral flat block (19), a second variable width gap (41) being defined between said upper central flat block (11) and a said second upper lateral flat block (20), a lower variable width recess (42, 43) being defined between a said lower lateral flat block (13, 14) and a corresponding flanked end block (25, 26), said lower variable width recesses (42, 43) being configured to each define an external lateral variable width gap, each external lateral variable width gap being placed below a corresponding upper lateral flat block (19, 20).

2. Reinforced expansion joint according to claim 1, **characterized in that** a central portion (25c, 26c) of said end blocks (25, 26) is sandwiched between an outer zone (23a, 24a) of said reinforcement armature (23, 24) of a said corresponding upper lateral flat block (19, 20) and a said corresponding anchoring armature (27, 28).

3. Reinforced expansion joint according to claim 1, **characterized in that** said reinforcement armatures (12, 23, 24) of said upper central flat block (11) and of said upper lateral flat blocks (19, 20) each comprise at least an upper metal plate, said upper metal plates developing on the same reference plane (P).

4. Reinforced expansion joint according to one or more of the preceding claims, **characterized in that** said reinforcement armatures (15, 16) and said anchoring armatures (27, 28) each comprise at least one respective lower metal plate.

5. Reinforced expansion joint according to one or more of the preceding claims, **characterized in that** said upper central (11), lower lateral (13, 14), upper lateral (19, 20) flat blocks, said end blocks (25, 26) and said elastically deformable junction sections (17, 18, 21, 22) are part of a single body made of plastic material.

6. Reinforced expansion joint according to one or more of the preceding claims, **characterized in that** said reinforcement armatures (12, 15, 16, 23, 24) and said anchoring armatures (27, 28) are embedded and incorporated inside said single body in plastic material.

7. Reinforced expansion joint according to claim 5, **characterized in that** said single plastic body is made of vulcanized synthetic rubber.

8. Reinforced expansion joint according to one or more of the preceding claims, **characterized in that** each of said end blocks (25, 26) comprises niches (30) for accessing the respective anchoring armature (27, 28).

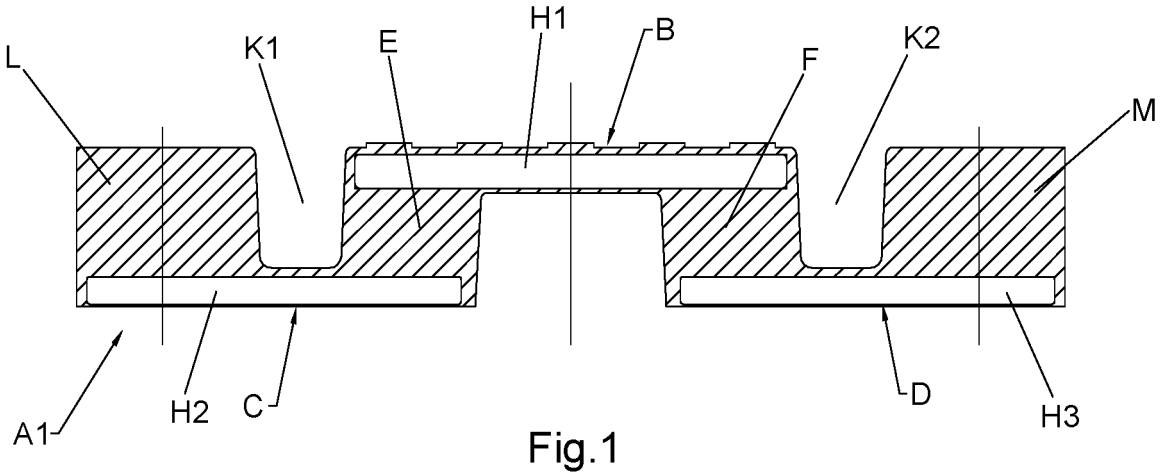


Fig.1

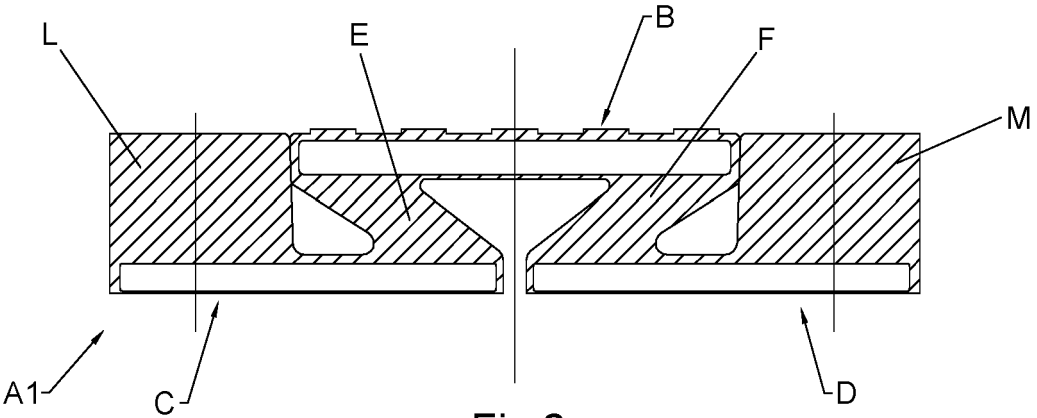


Fig.2

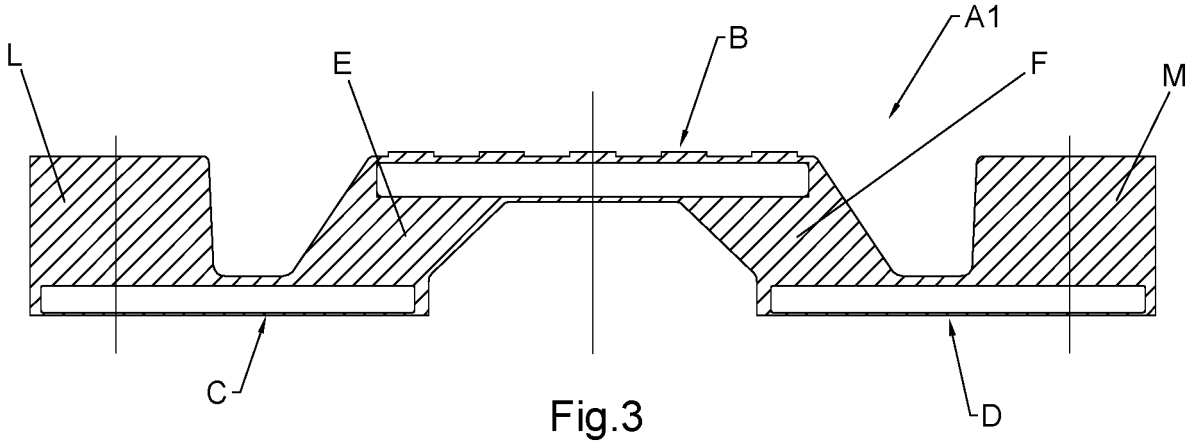
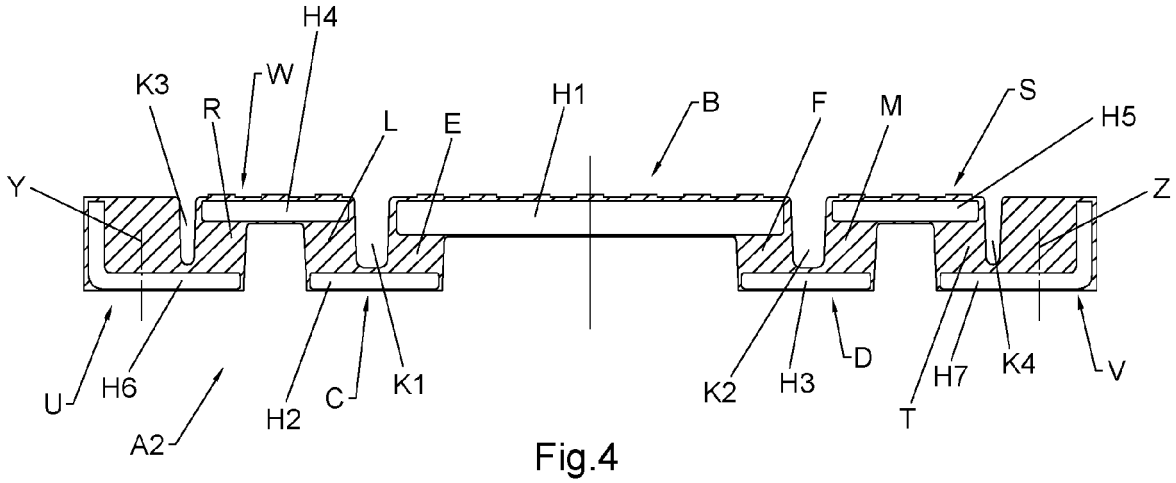


Fig.3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K3
W
R
L
E
H1
B
F
M
S
H5
Y
Z
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H6
A2
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K2
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D
T
H7
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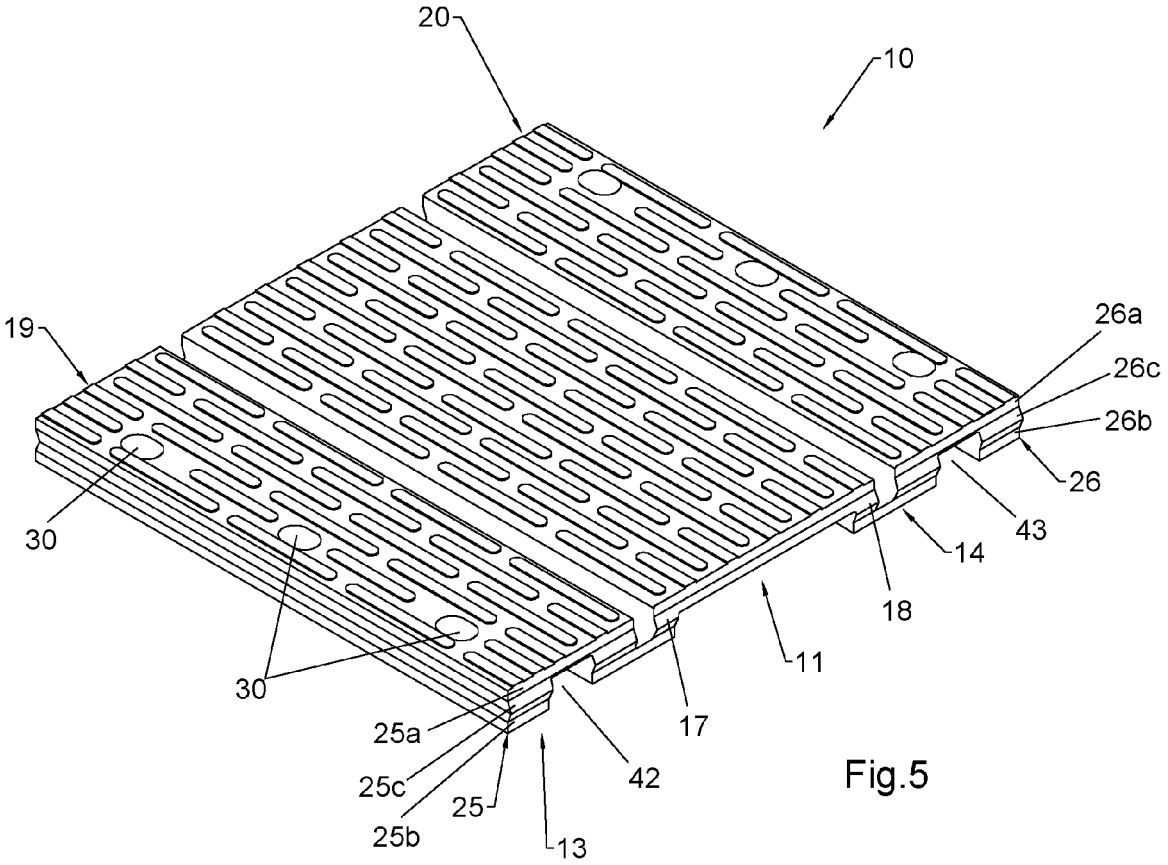
Fig.4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10
19
26a
26c
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25c
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13

Fig.5

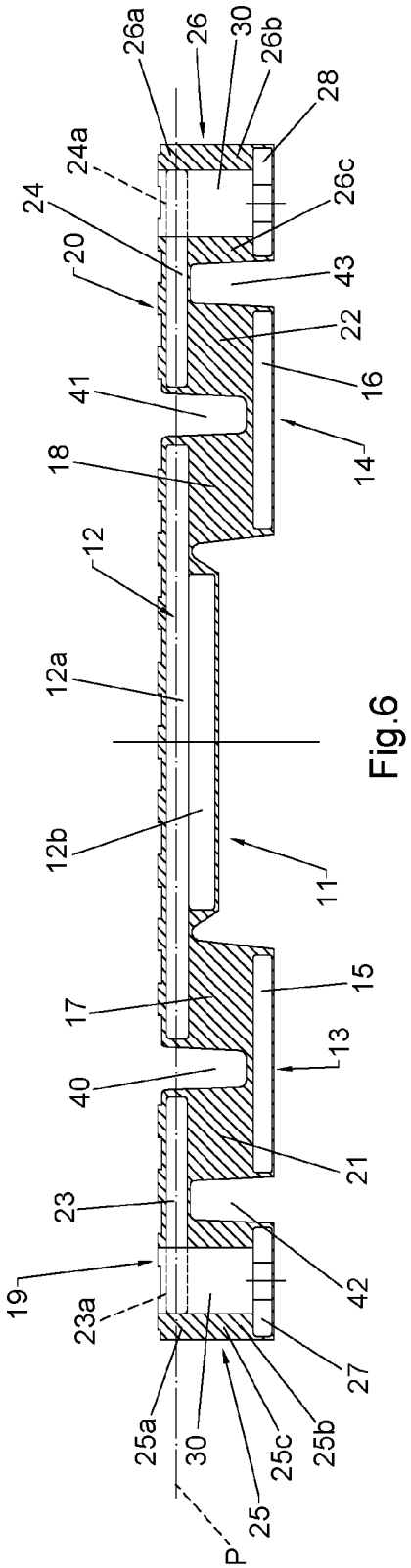

Fig.6

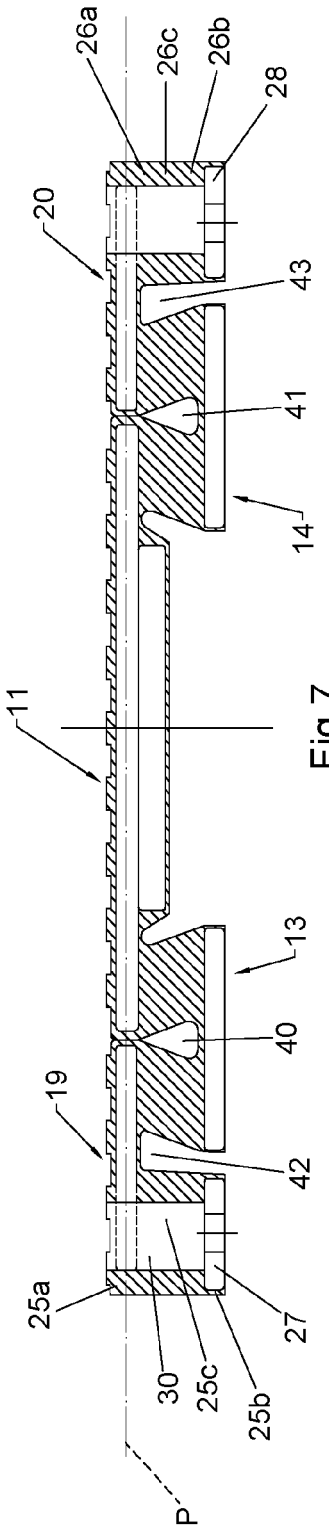

Fig.7

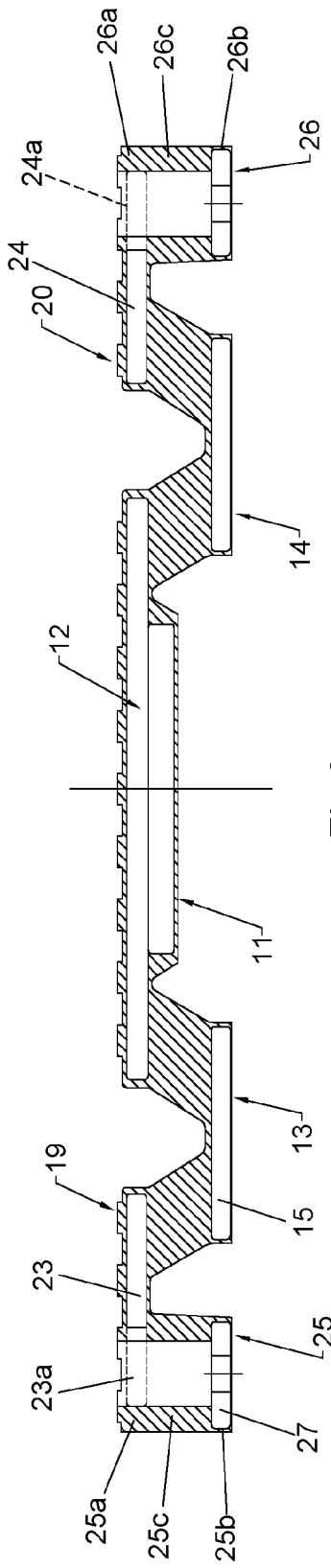

Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 3317

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 4 022 538 A (WATSON STEWART C ET AL) 10 May 1977 (1977-05-10) * column 1, lines 7-30,42-62 * * column 2, line 18 - column 3, line 15 * * column 4, line 12 - column 5, line 19 * * figures 2-5 * -----	1,3-8 2	INV. E01C11/12 E01C11/10 E01D19/06 E04B1/68
X A	DE 17 59 470 B1 (GUTEHOFFNUNGSHUETTE STERKRADE) 7 October 1971 (1971-10-07) * the whole document * -----	1,3-8 2	
A	US 3 758 220 A (HEIN R) 11 September 1973 (1973-09-11) * column 1, lines 4-11 * * column 2, lines 24-39 * * column 2, line 42 - column 3, line 5 * * column 3, lines 38-45 * * column 4, line 40 - column 5, line 12 * * figures 1,7 * -----	1-8	
A	GB 1 510 622 A (TIPPETT S) 10 May 1978 (1978-05-10) * page 1, lines 9-96 * * page 2, lines 106-121 * * page 3, line 51 - page 4, line 50 * * figures 1-3 * -----	1-8	TECHNICAL FIELDS SEARCHED (IPC) E01C E01D E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 September 2021	Kremsler, Stefan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 17 3317

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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28-09-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4022538 A	10-05-1977	AU 5698373 A	19-12-1974
		CA 983756 A	17-02-1976
		DE 2330640 A1	17-01-1974
		ES 216371 U	01-08-1976
		ES 416070 A1	01-07-1976
		GB 1439157 A	09-06-1976
		HK 30277 A	24-06-1977
		IT 988910 B	30-04-1975
		JP S559481 B2	10-03-1980
		JP S4951735 A	20-05-1974
		US 4022538 A	10-05-1977
DE 1759470 B1	07-10-1971	AT 295585 B	10-01-1972
		BE 732325 A	01-10-1969
		DE 1759470 B1	07-10-1971
		ES 165967 U	01-07-1971
		FR 2007833 A1	16-01-1970
		GB 1223802 A	03-03-1971
		NL 6906733 A	06-11-1969
US 3758220 A	11-09-1973	AT 320003 B	27-01-1975
		AU 464081 B2	14-08-1975
		BE 784243 A	18-09-1972
		CA 957887 A	19-11-1974
		CH 560807 A5	15-04-1975
		DE 2228599 A1	09-08-1973
		DK 139686 B	26-03-1979
		ES 403577 A1	01-05-1975
		FR 2169028 A1	07-09-1973
		GB 1353709 A	22-05-1974
		IT 956964 B	10-10-1973
		JP S4886334 A	14-11-1973
		JP S5146333 B2	08-12-1976
		LU 66381 A1	23-01-1973
		NL 7300768 A	31-07-1973
		NO 134920 B	27-09-1976
		US 3758220 A	11-09-1973
		ZA 723360 B	28-02-1973
GB 1510622 A	10-05-1978	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82