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(54) **VIBRATION DAMPENING RAILWAY TIE BOOT**

(71) Applicant: **Press-Seal Corporation**, Fort Wayne, IN (US)

(72) Inventors: **Jimmy D. Gamble**, Avilla, IN (US); **Robert R. Slocum**, Fort Wayne, IN (US)

(73) Assignee: **Press-Seal Corporation**, Fort Wayne, IN (US)

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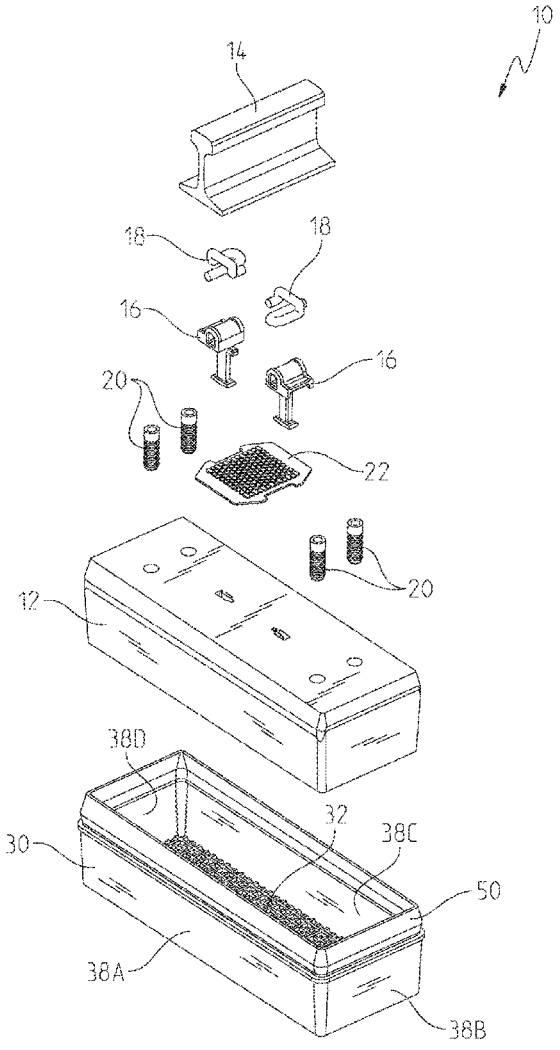
CPC ***E01B 1/005*** (2013.01); *E01B 2204/09* (2013.01); *E01B 2204/01* (2013.01); ***E01B 3/28*** (2013.01)

(57) **ABSTRACT**

A vibration dampening boot for railway tie blocks and a method of manufacturing railway tie block assemblies. The boot includes a bottom wall with resilient tie block contact structures disposed at different heights for initial tie block support and variable vibration dampening. The upper portion of the boot terminates in a removable wall connected to the side walls of the boot by a relatively thin tear strip to enable direct pouring of cast material, such as concrete or epoxy, into the boot for casting the tie block, with the wall removable after installation of the tie block assembly into a railway bed. In this manner, the boot may be used with pre-cast tie blocks as well as accommodate direct casting of the tie blocks within the boot to form a tie block assembly.



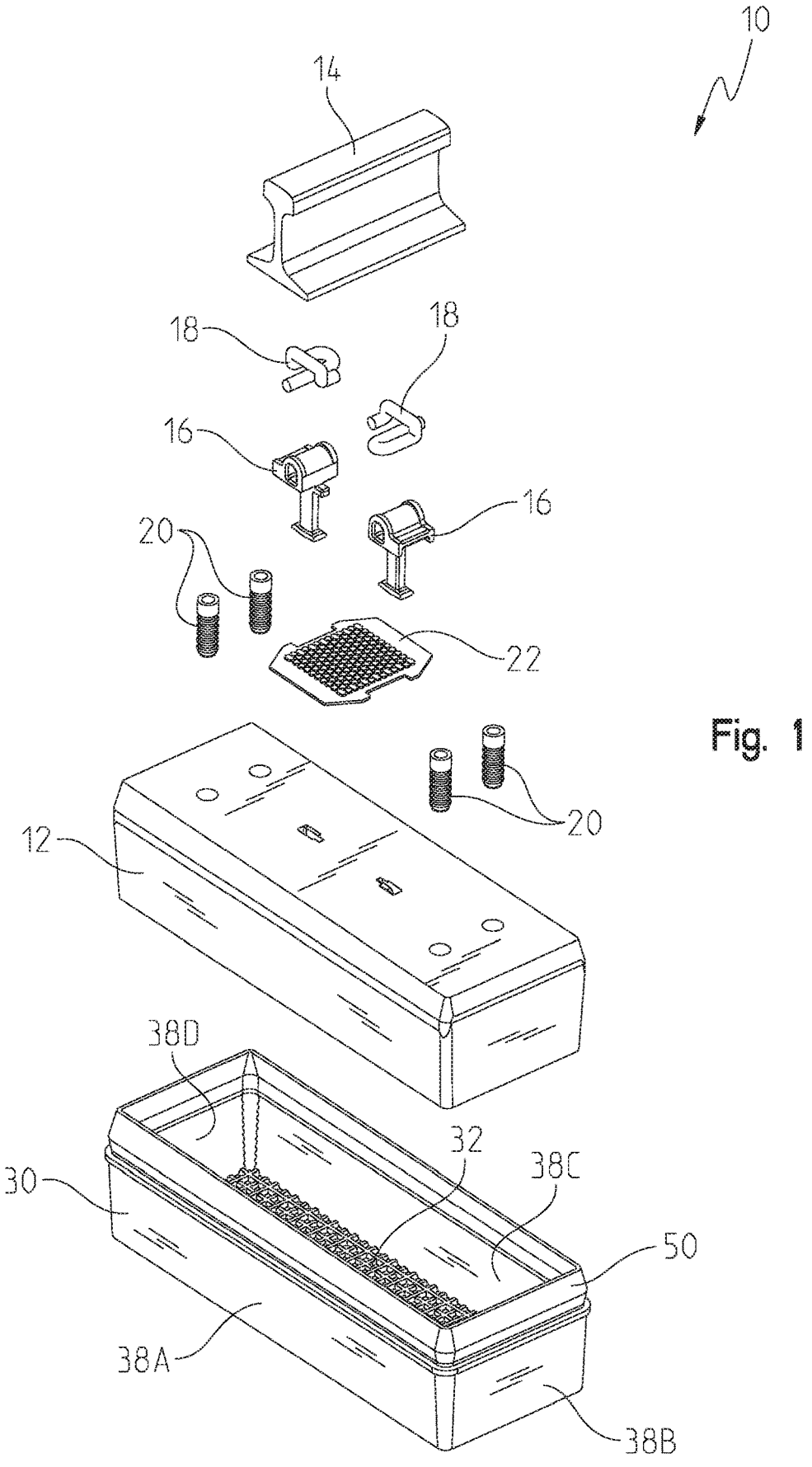


Fig. 1

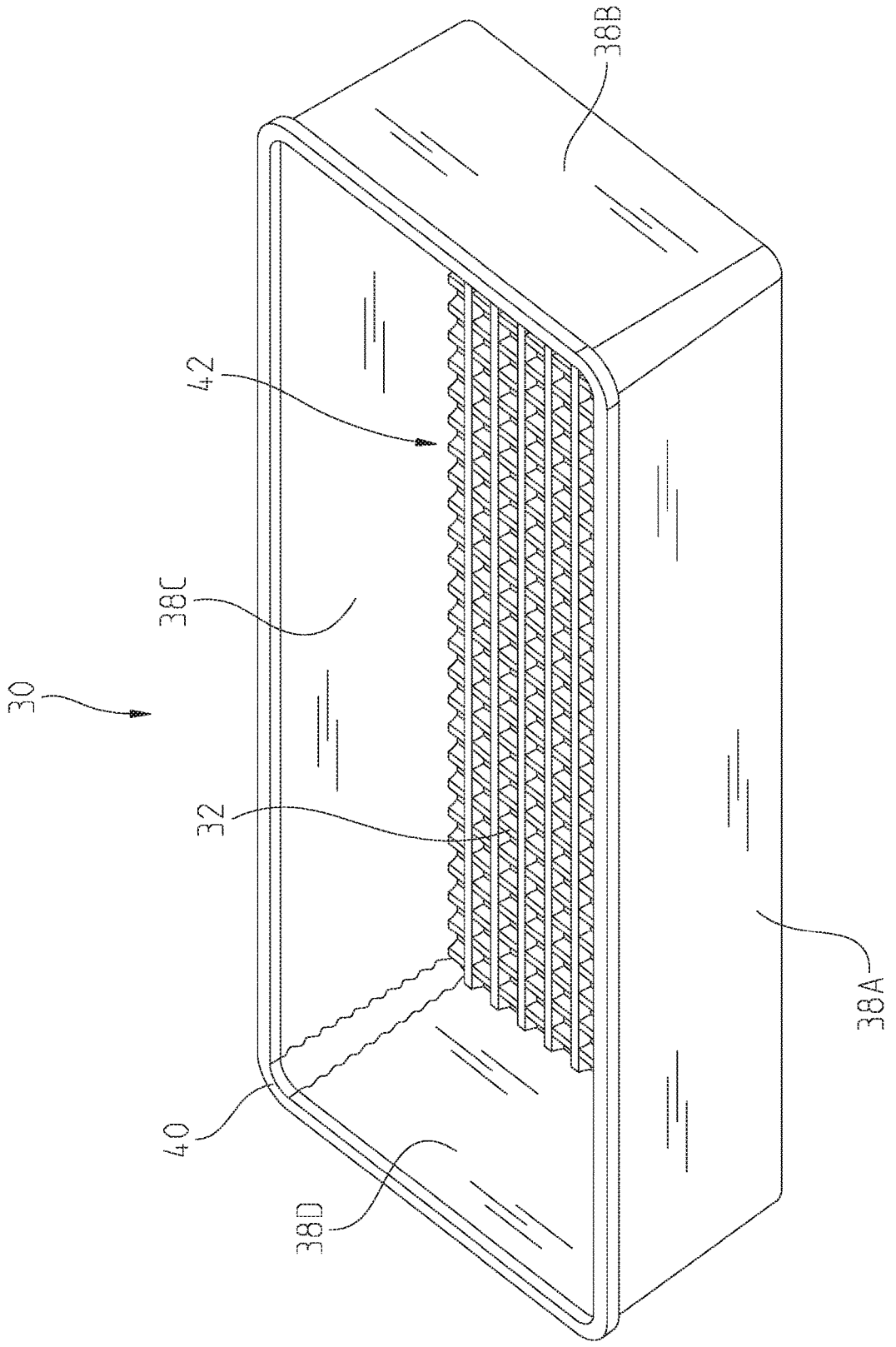


Fig. 2

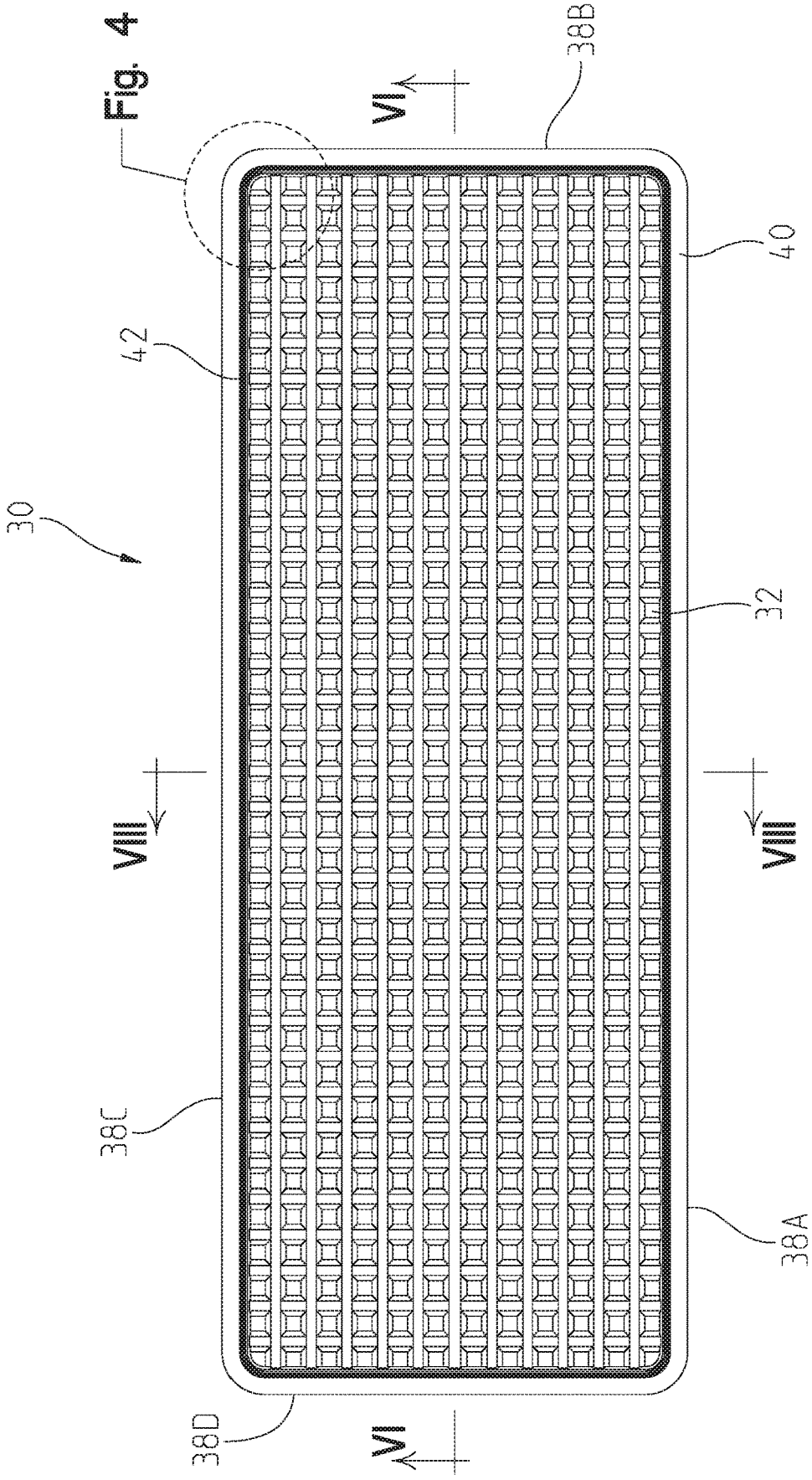


Fig. 3

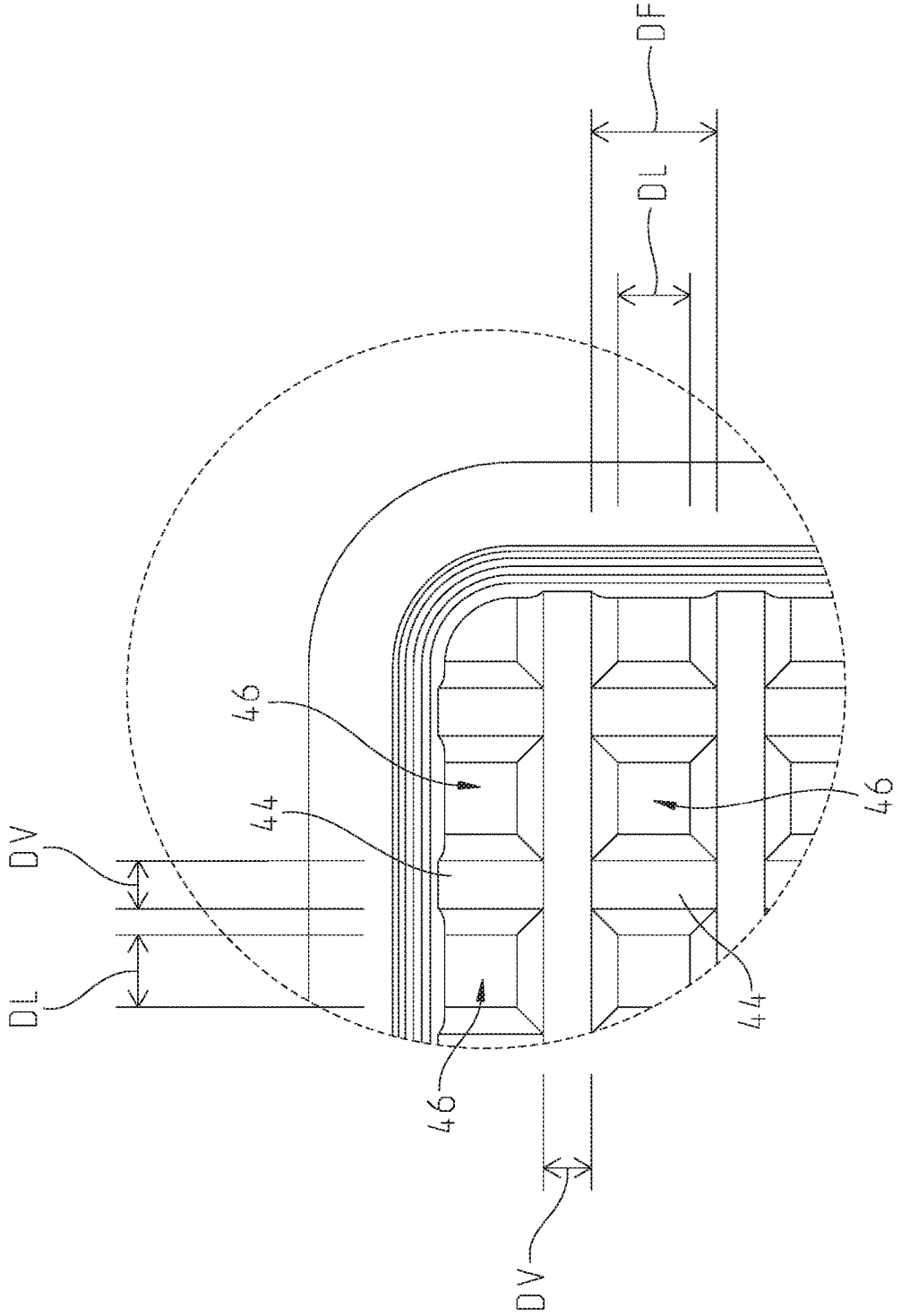


Fig. 4

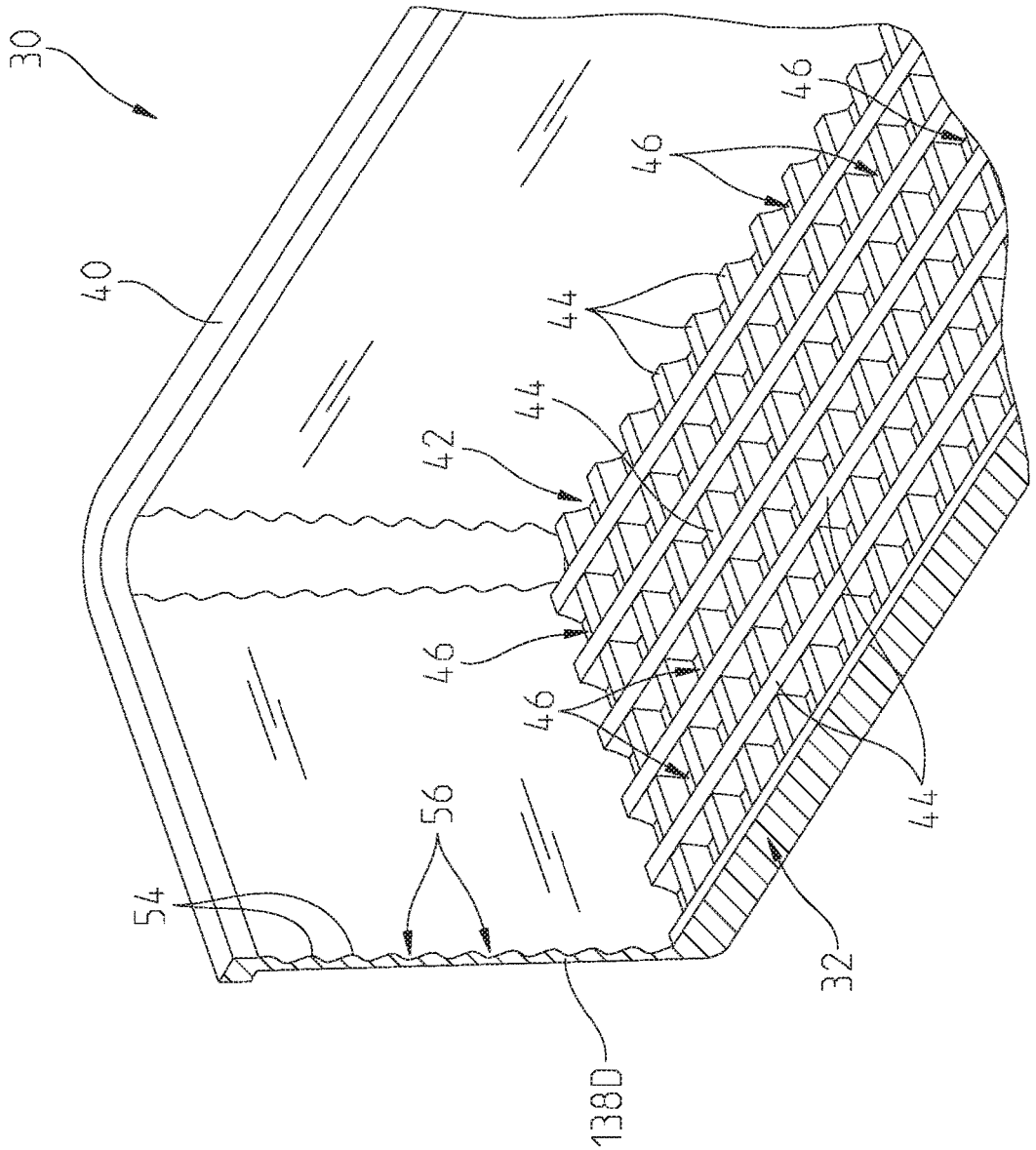


Fig. 5

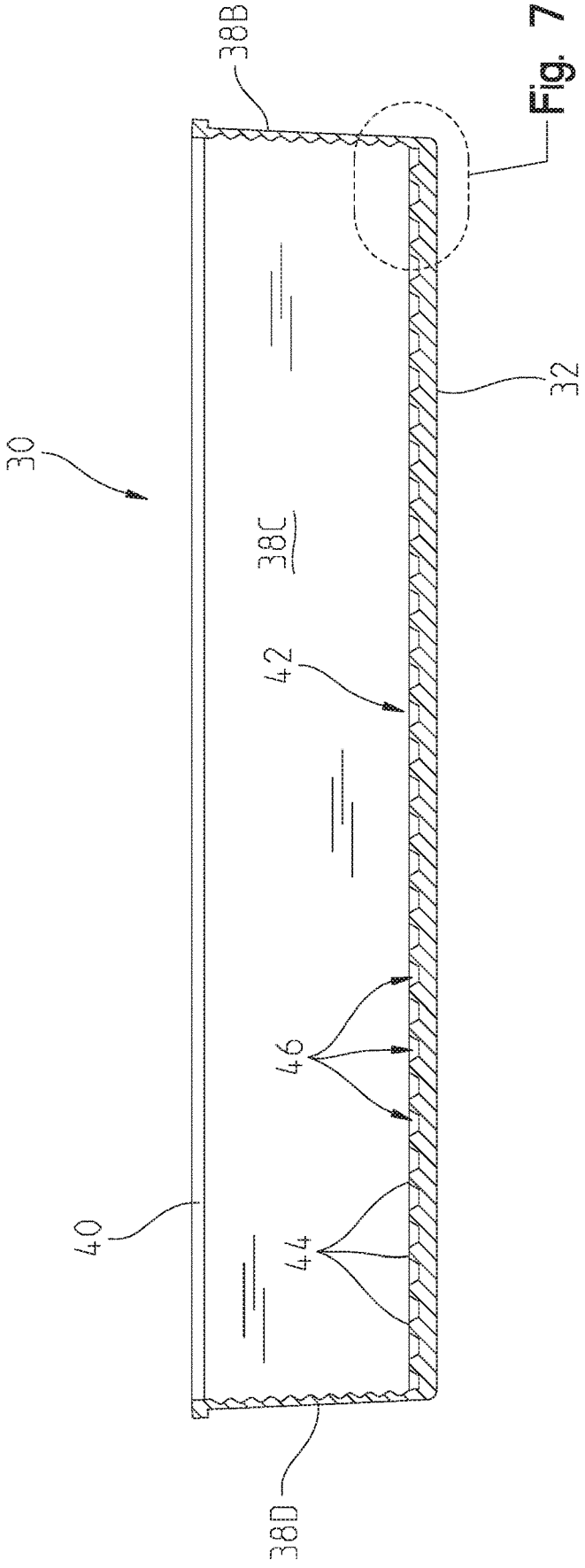


Fig. 6

Fig. 7

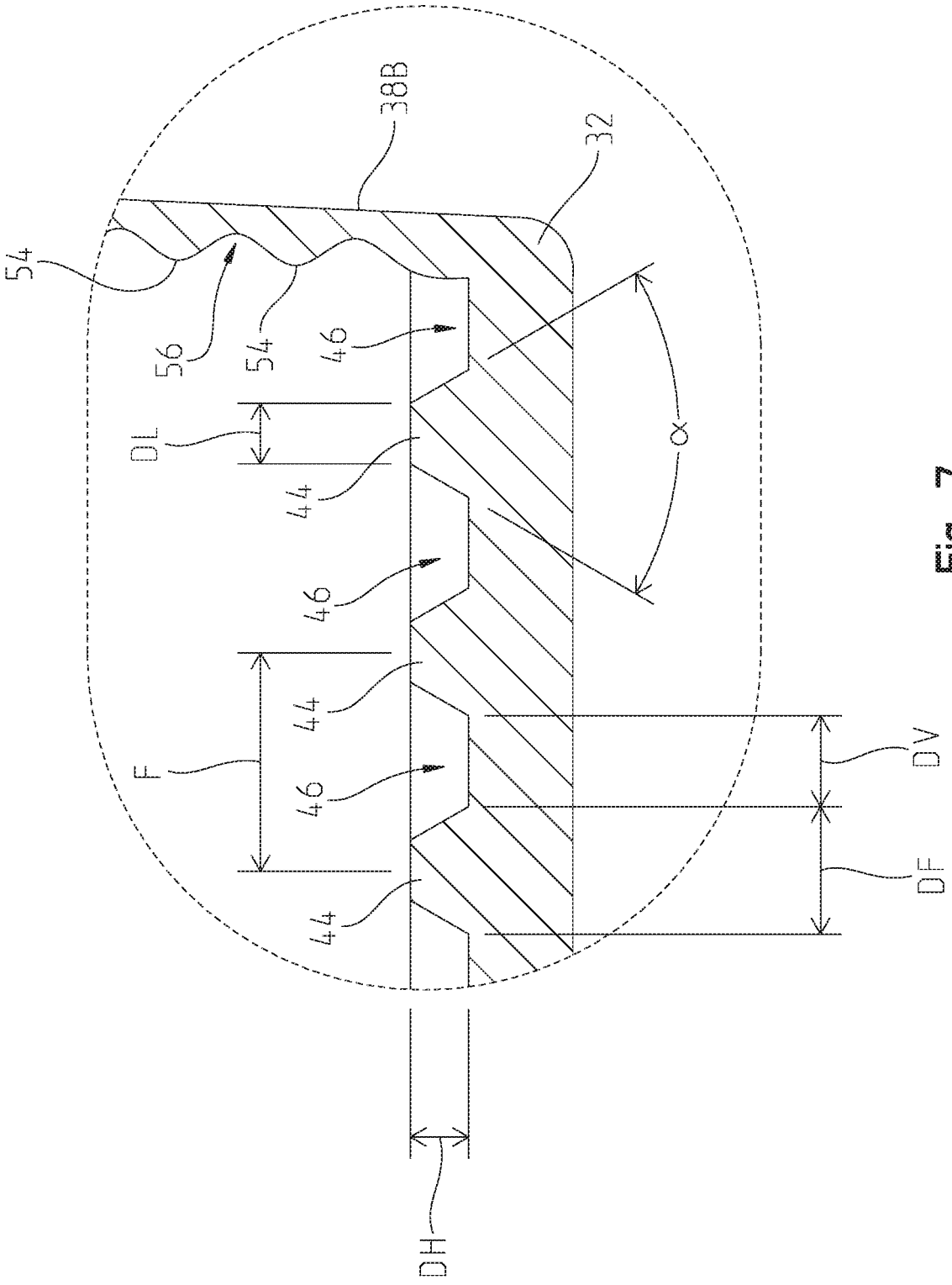


Fig. 7

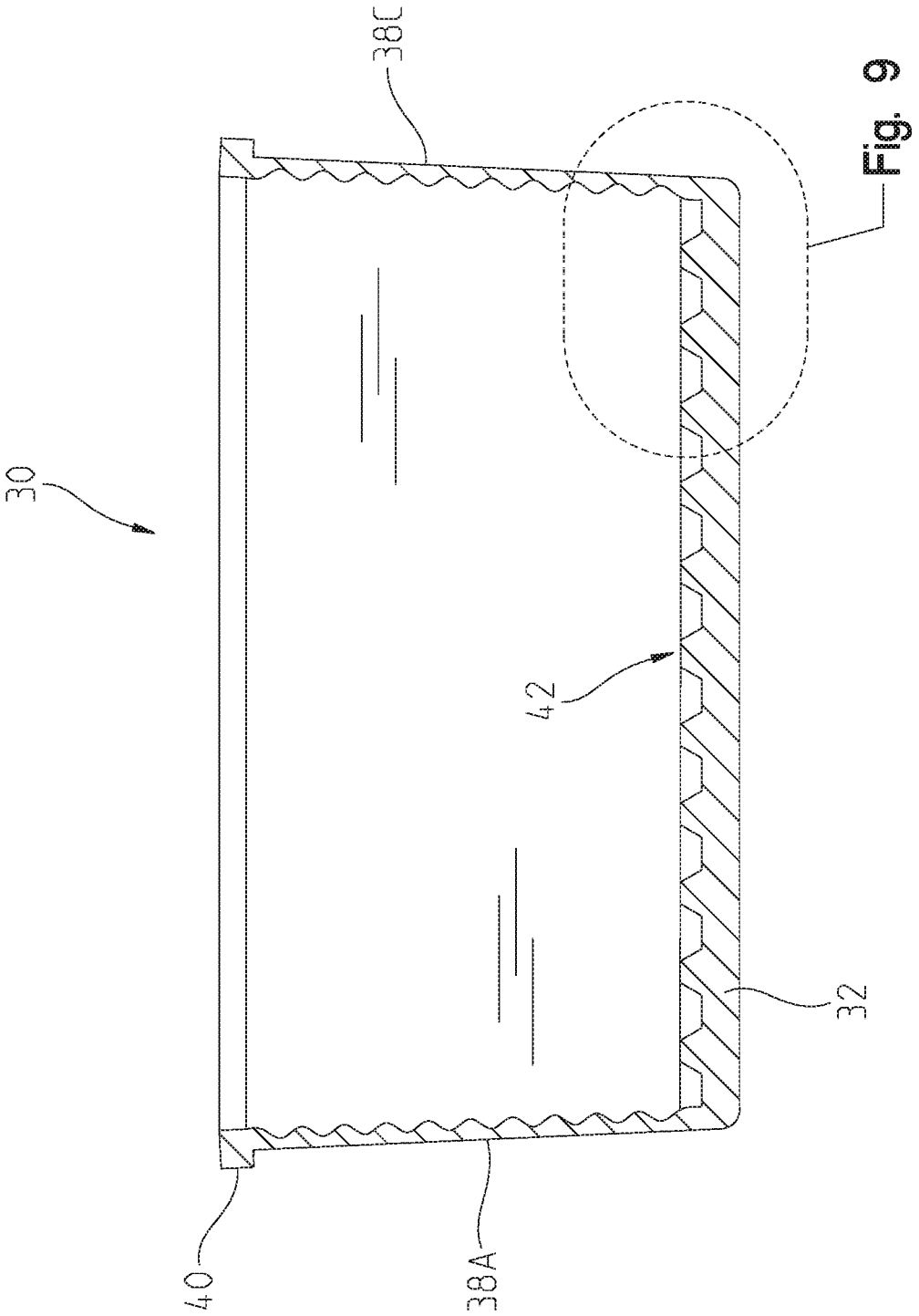


Fig. 8

Fig. 9

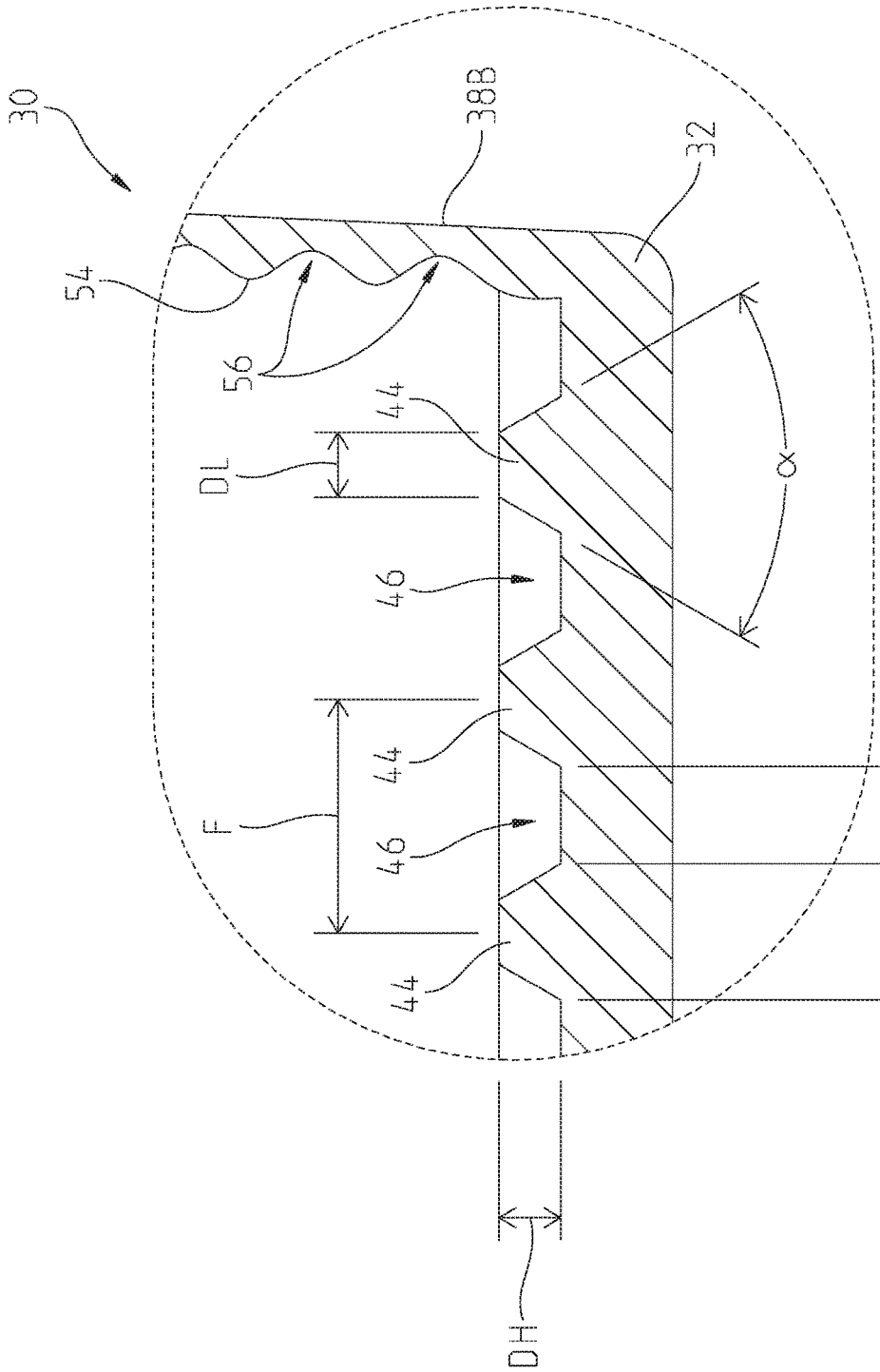


Fig. 9

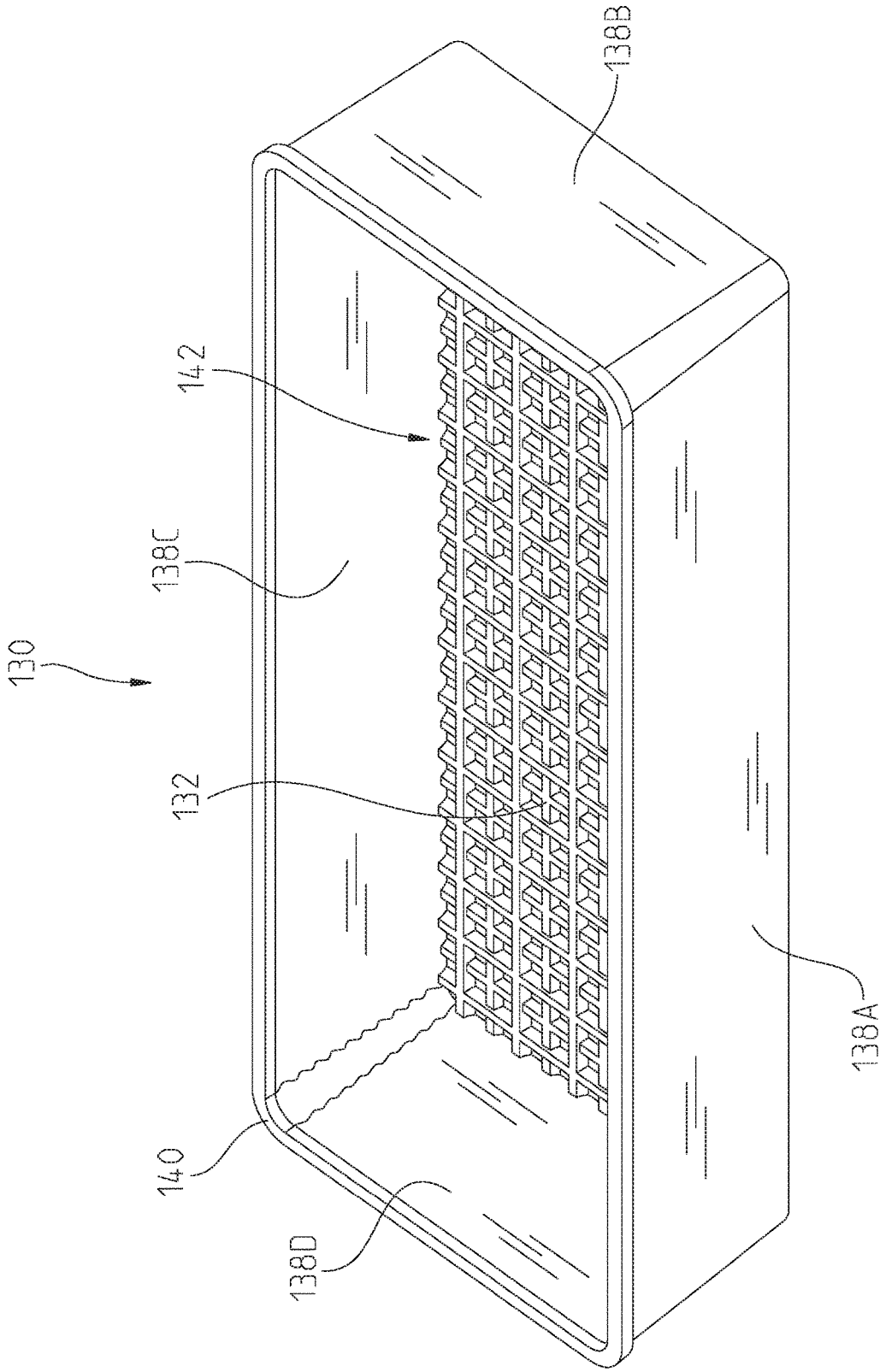


Fig. 10

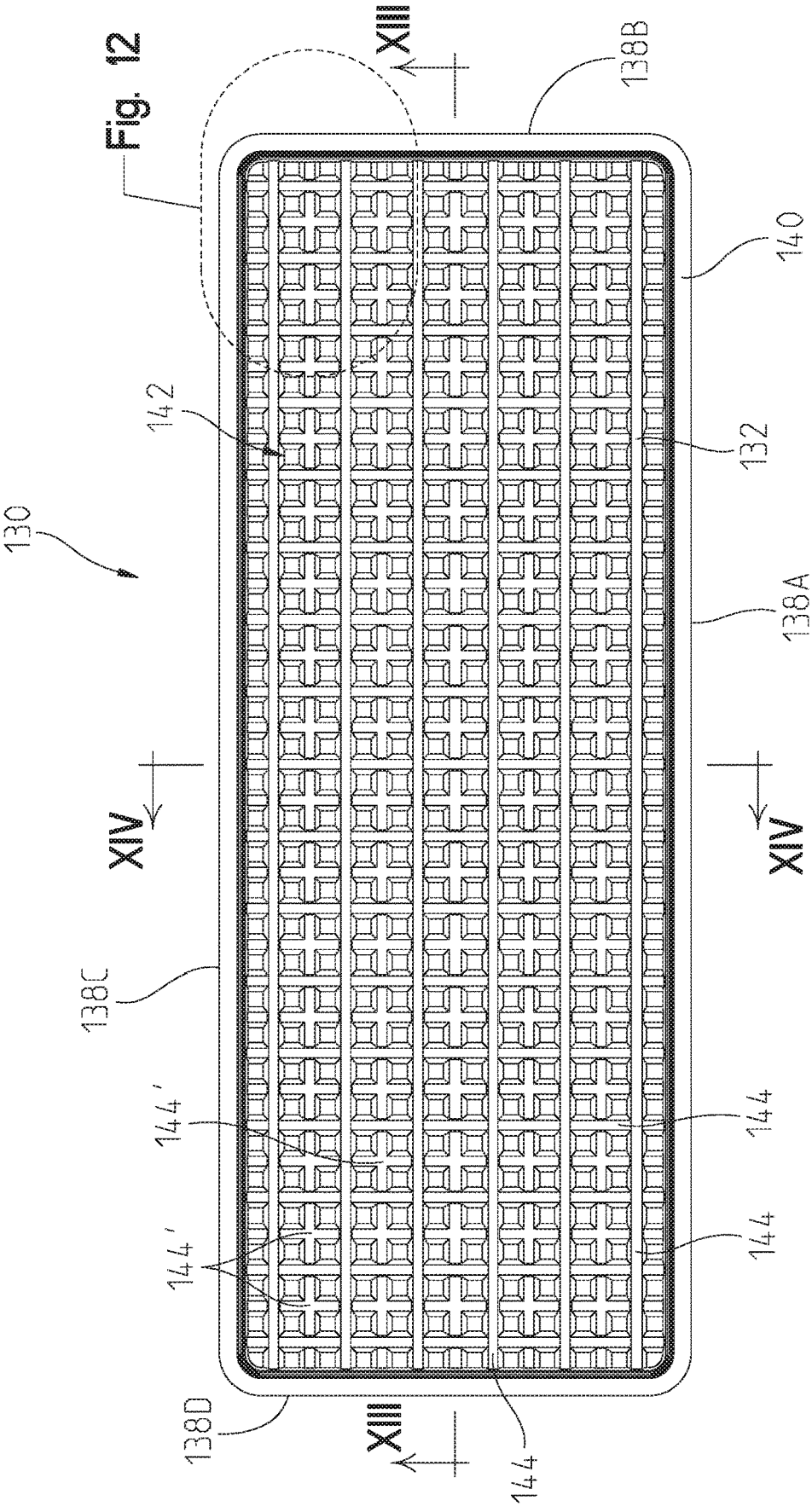


Fig. 12
XIII
138B
140
142
132
130
XIV
XIV
138A
138C
144'
144
144'
144
138D
XIII
144

Fig. 11

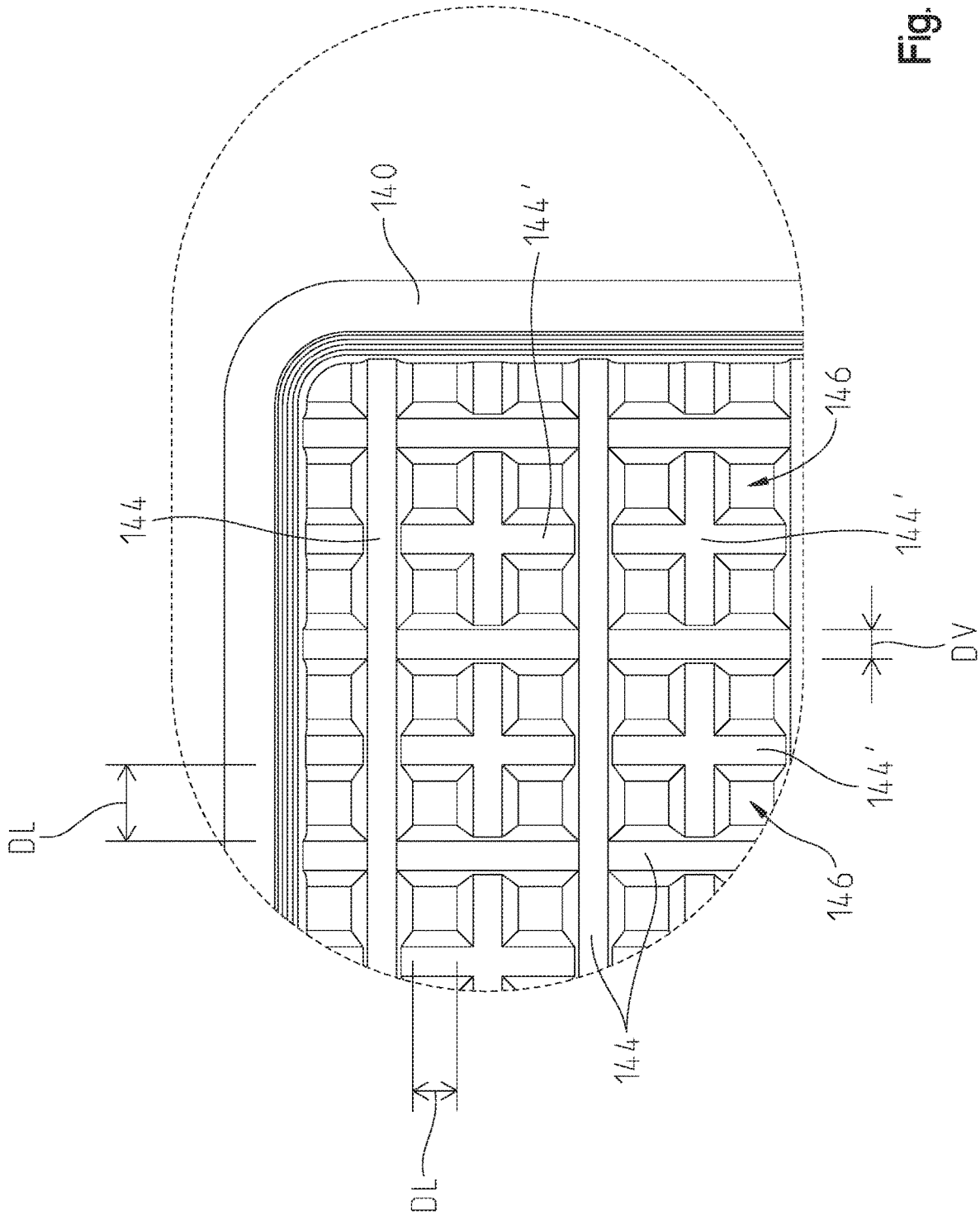


Fig. 12

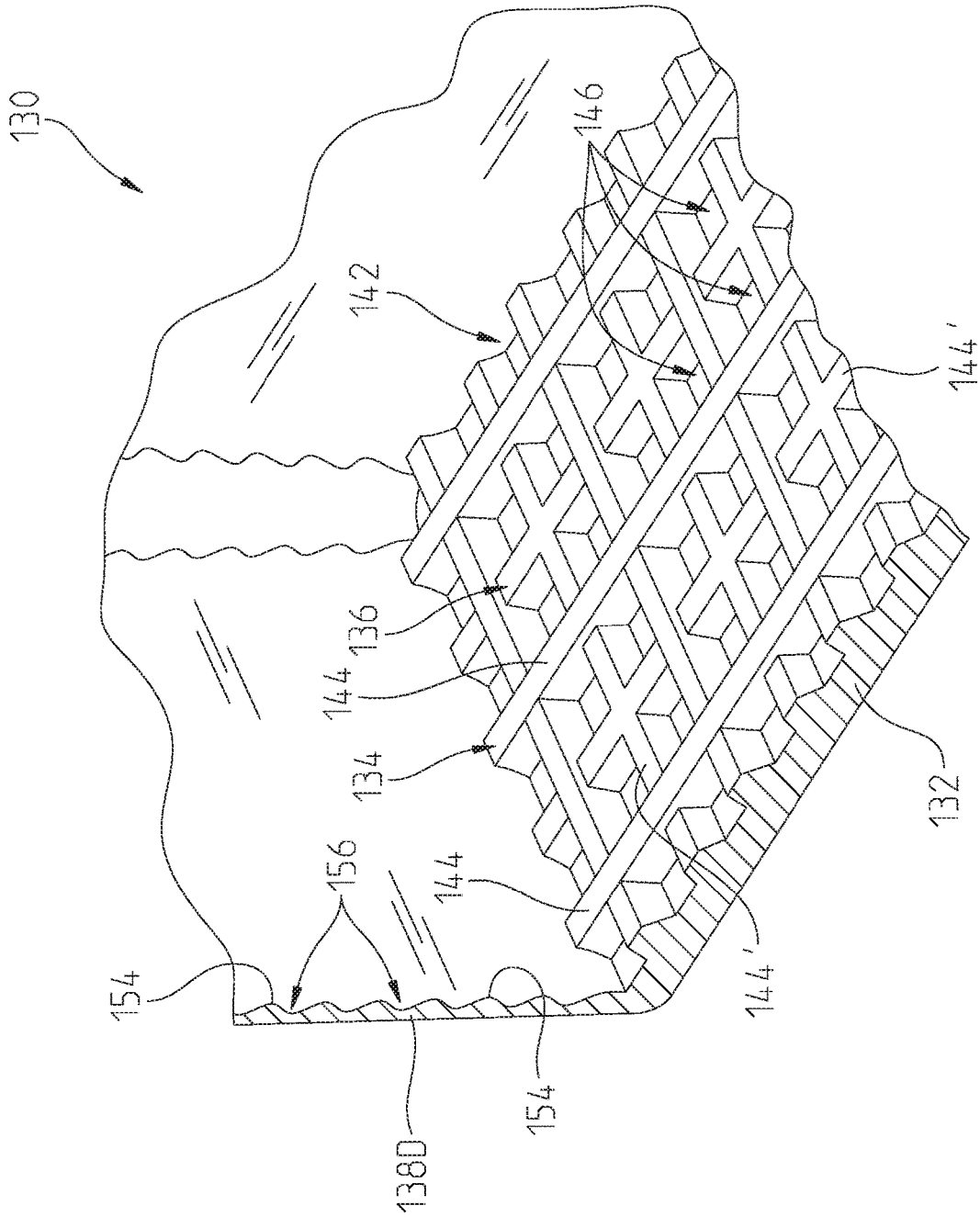


Fig. 13

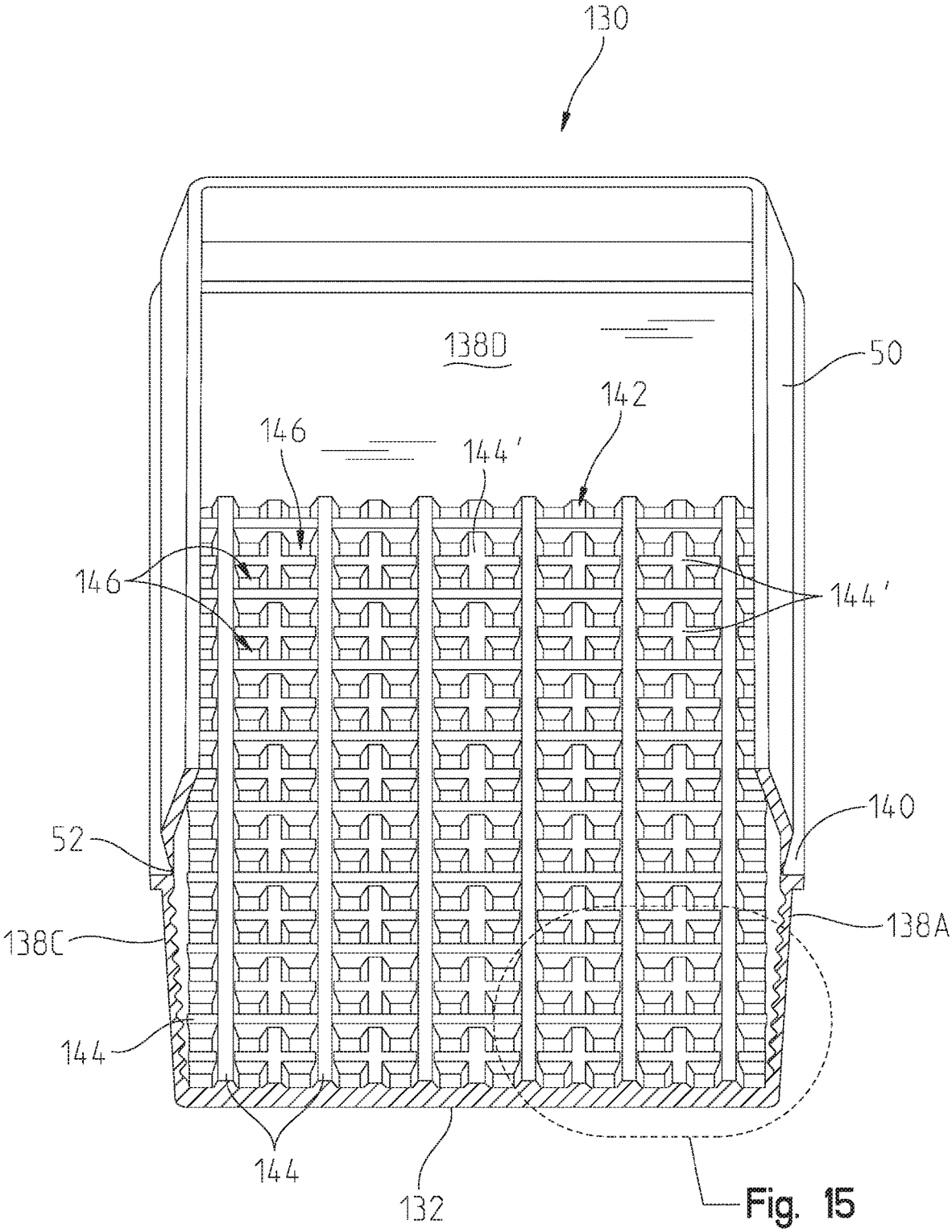


Fig. 15

Fig. 14

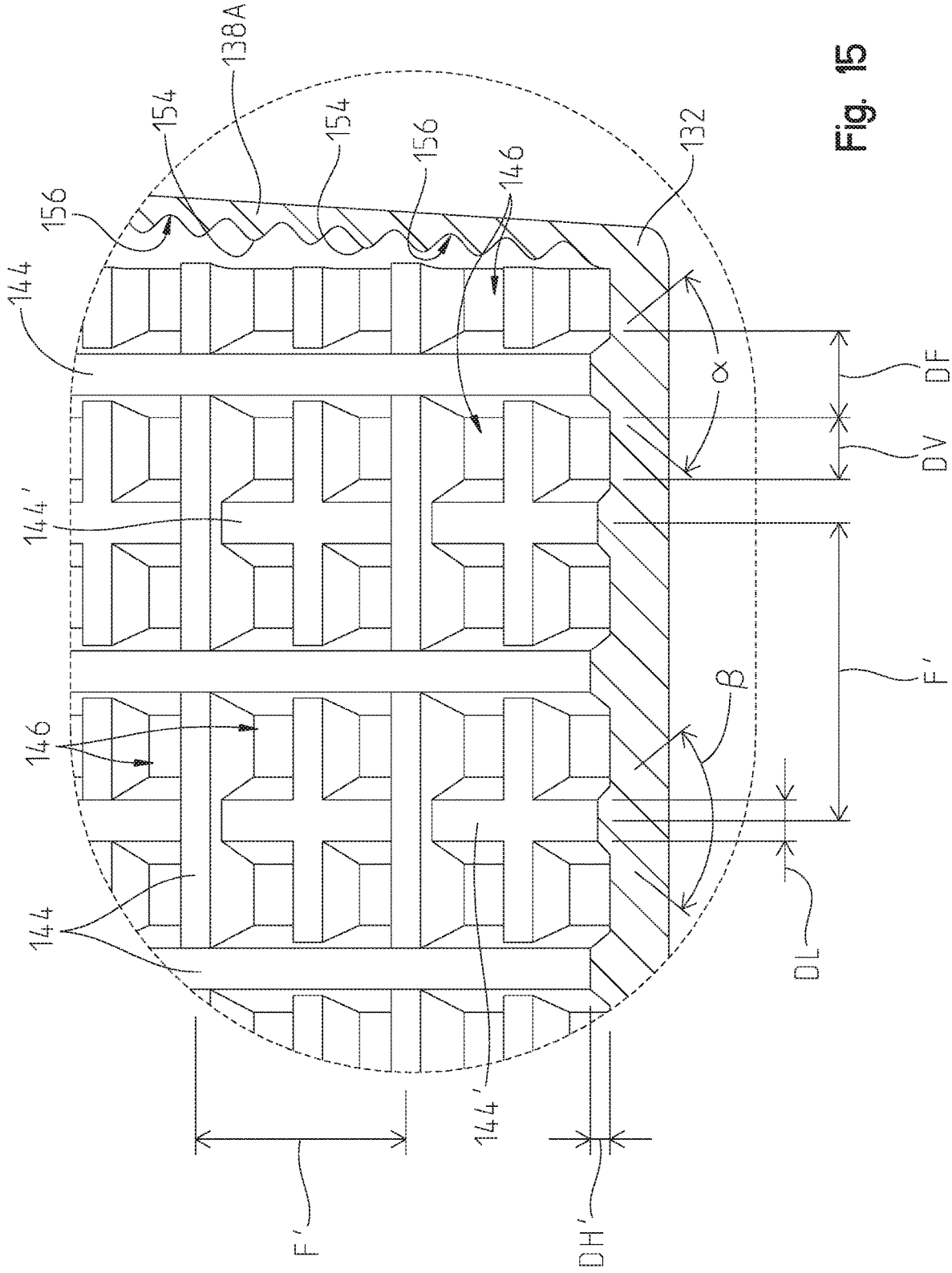


Fig. 15

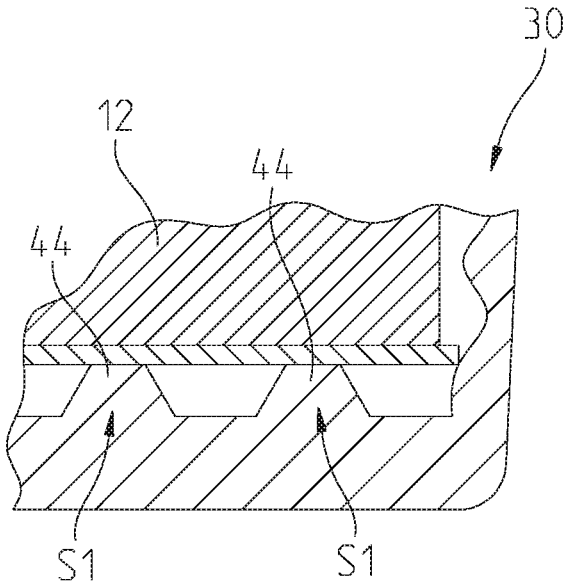


Fig. 16

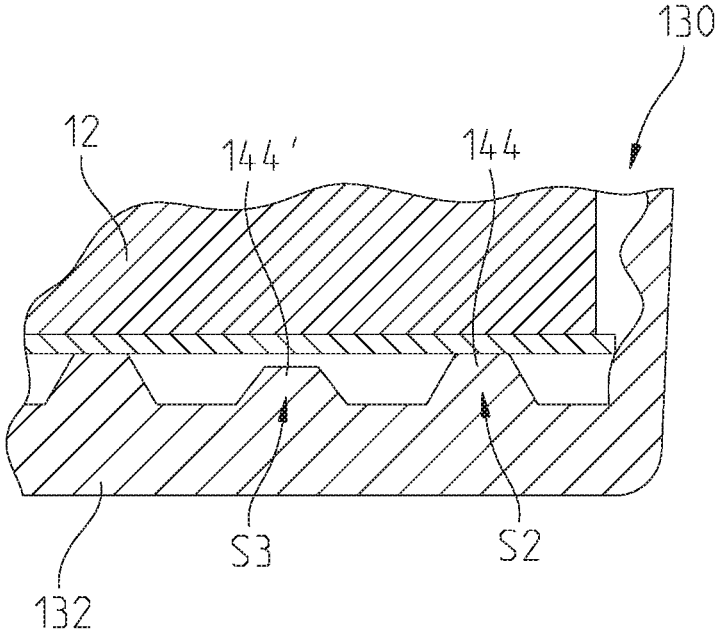


Fig. 17

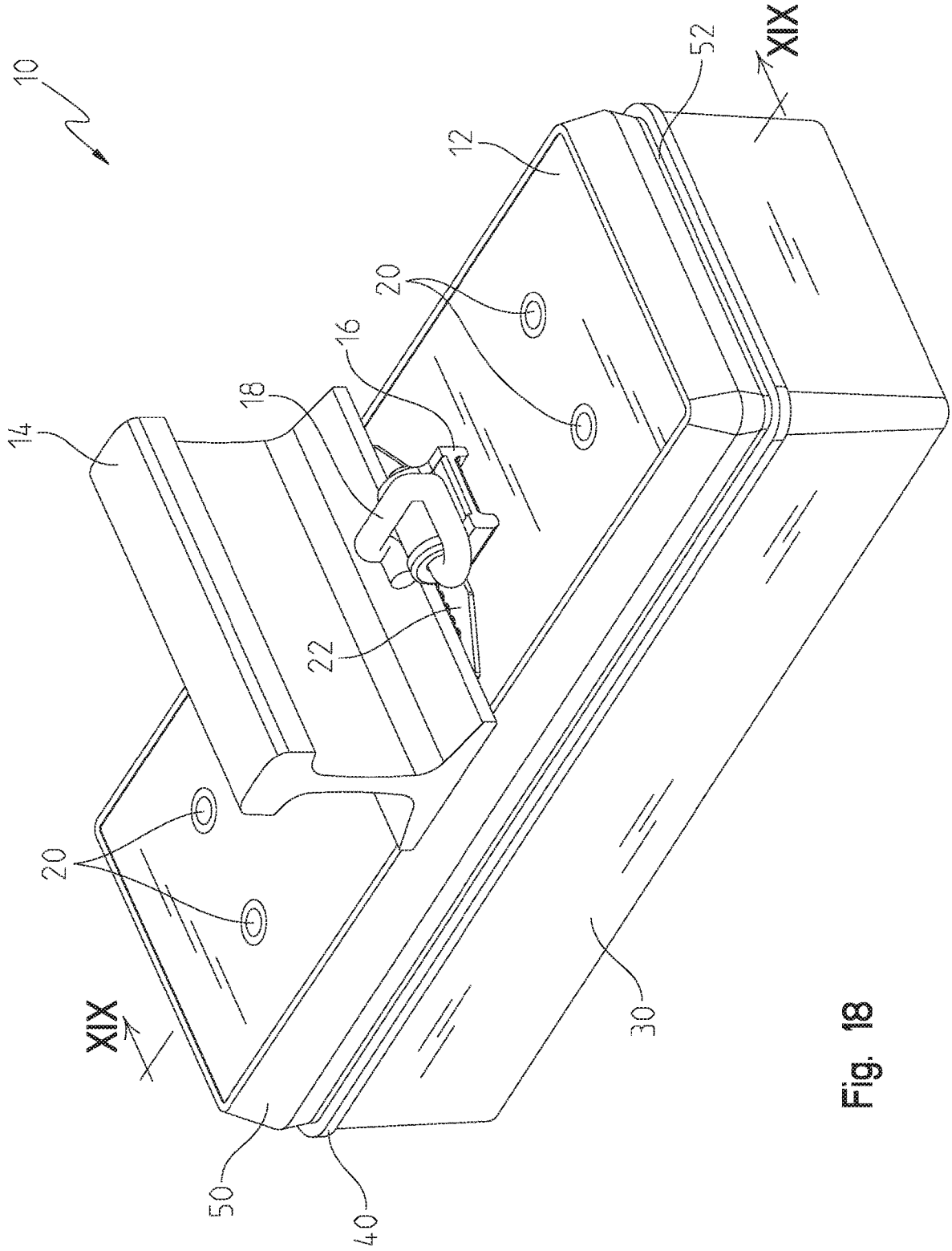
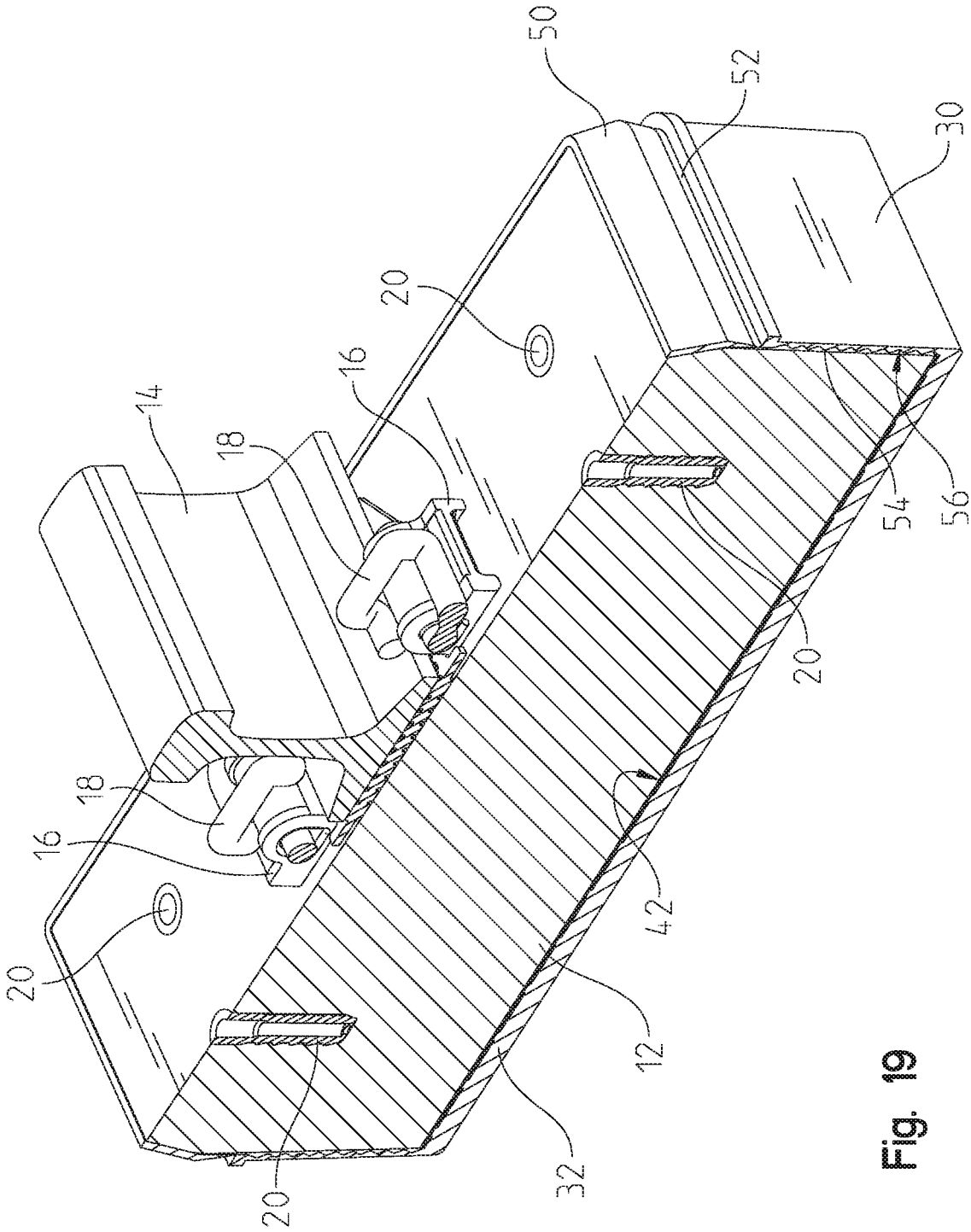


Fig. 18



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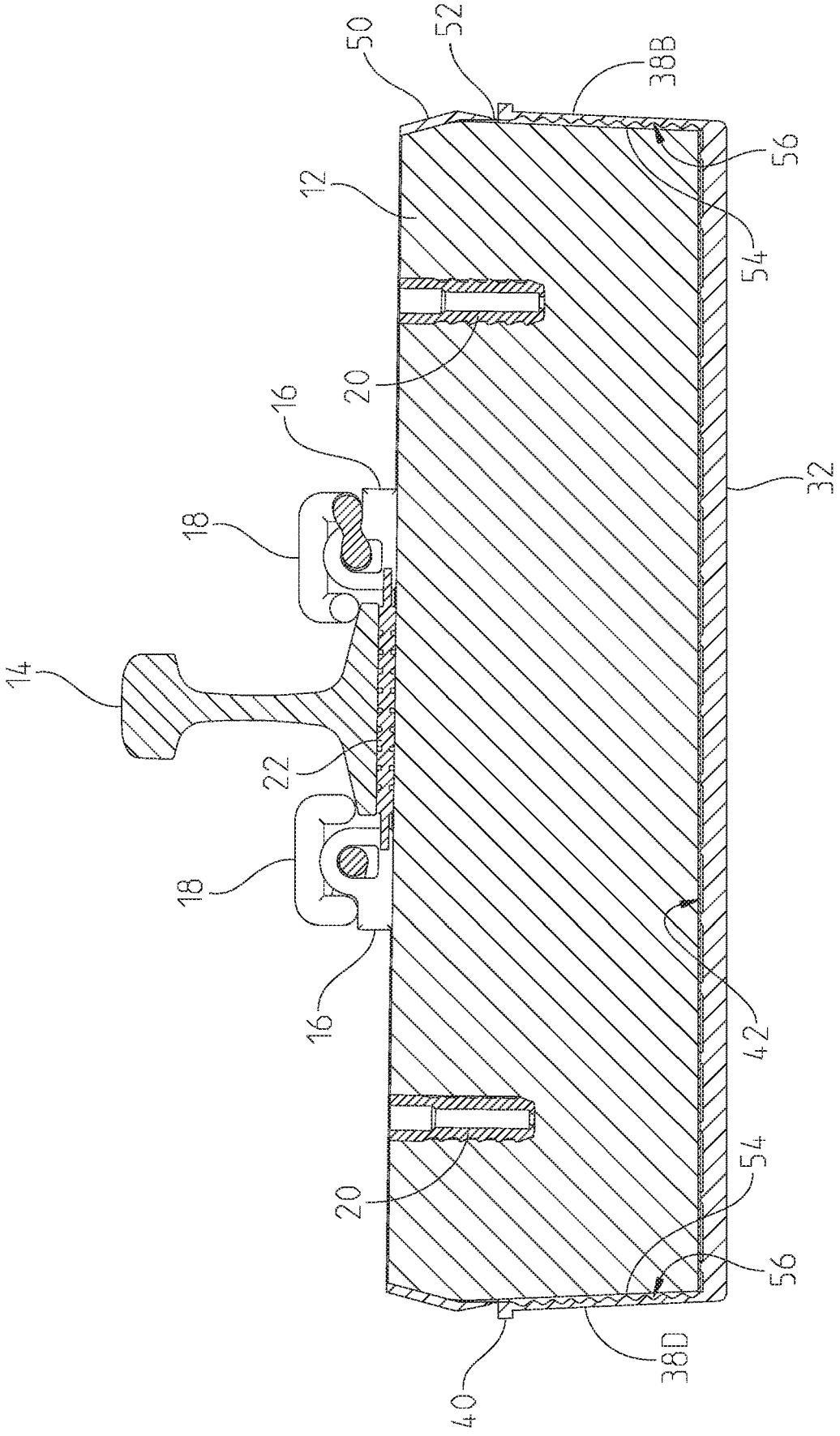

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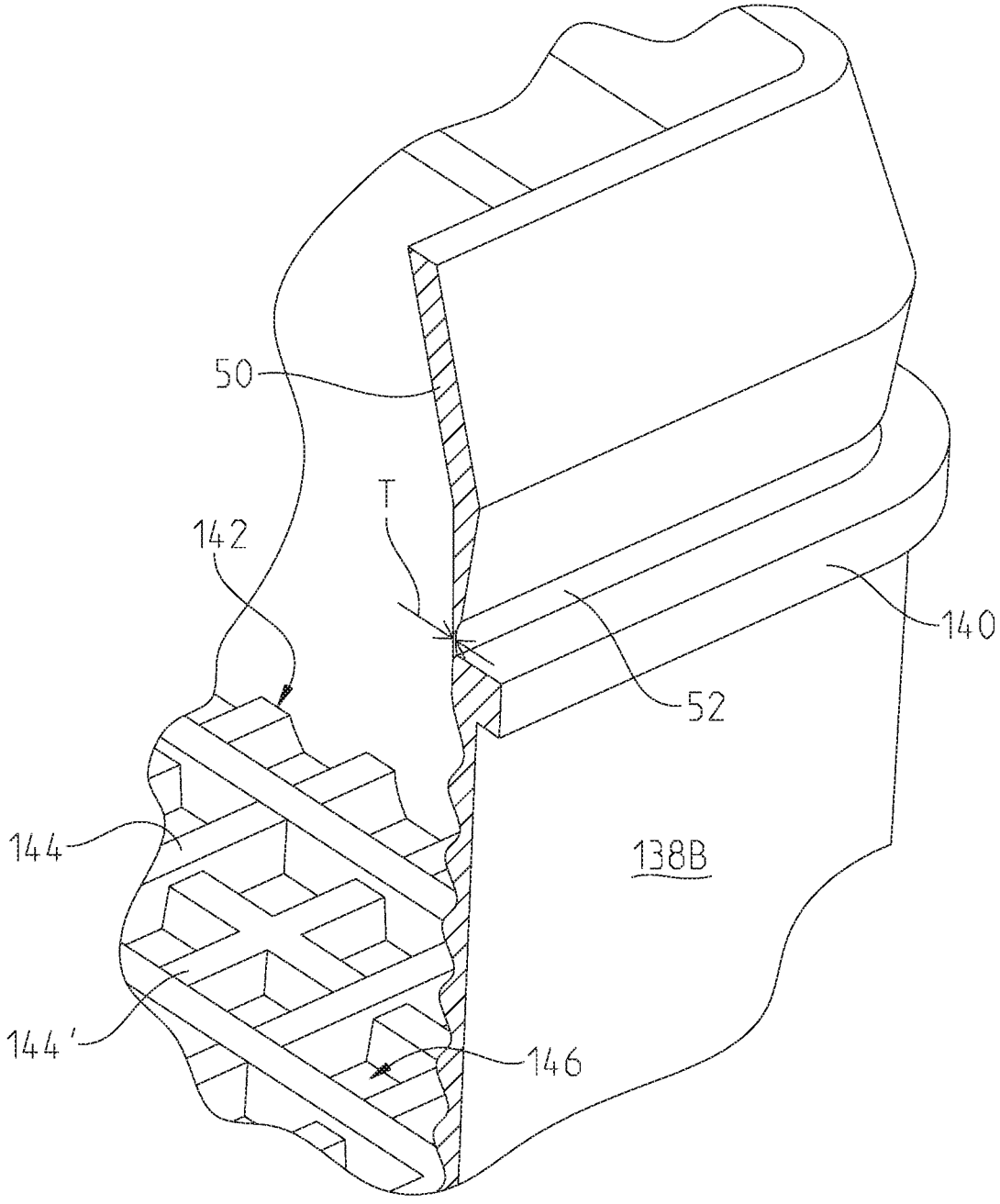
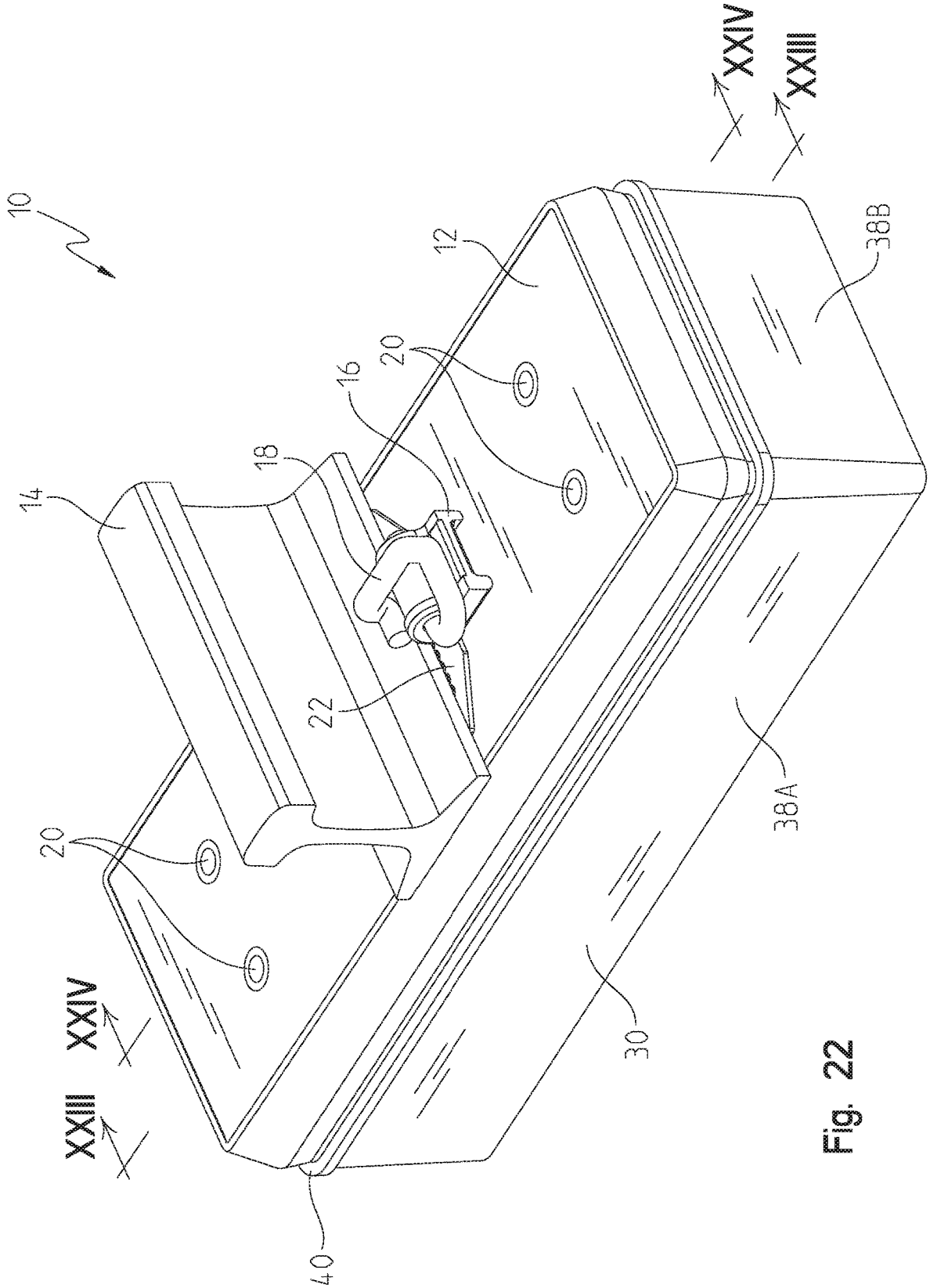


Fig. 21



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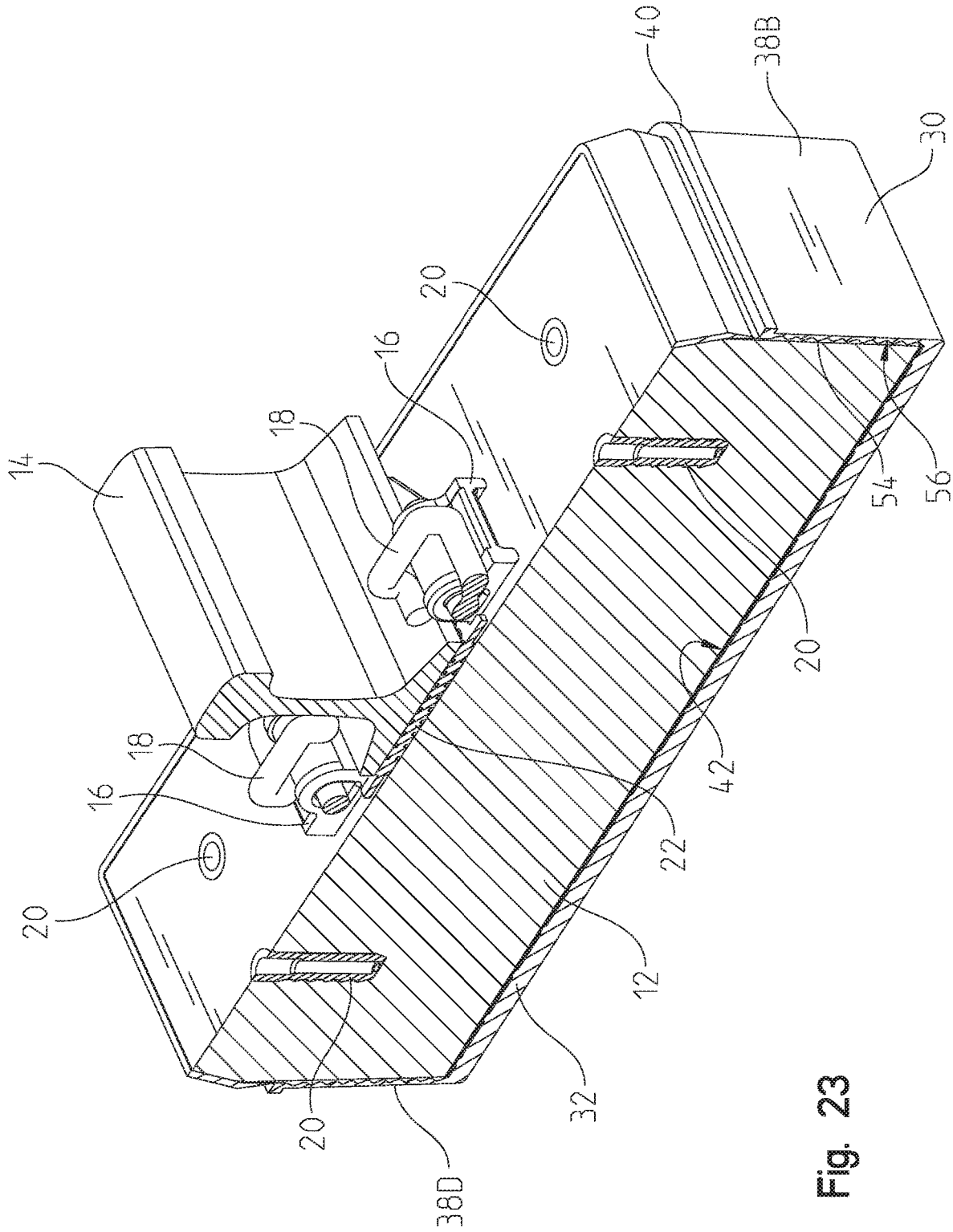

Fig. 23

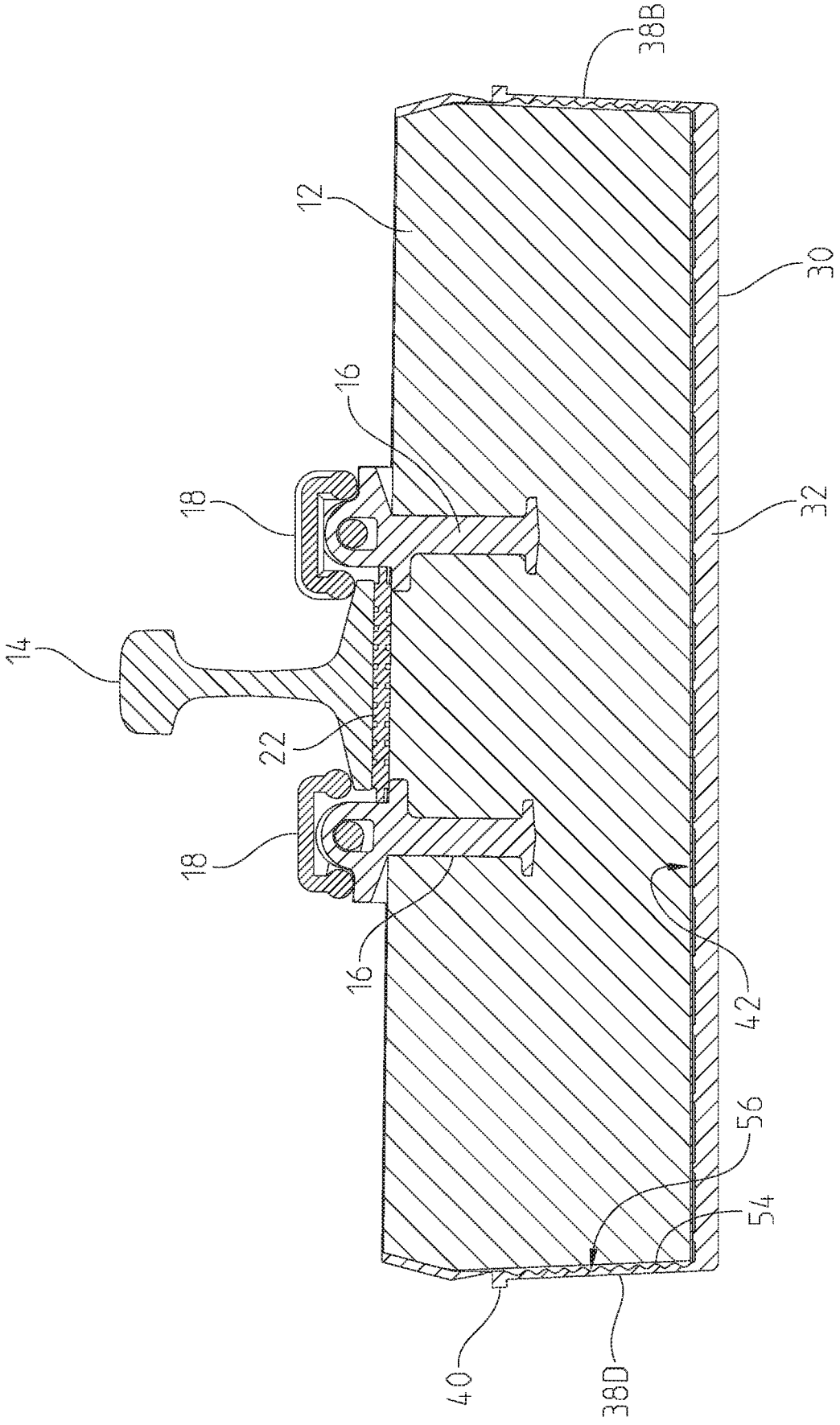

Fig. 24

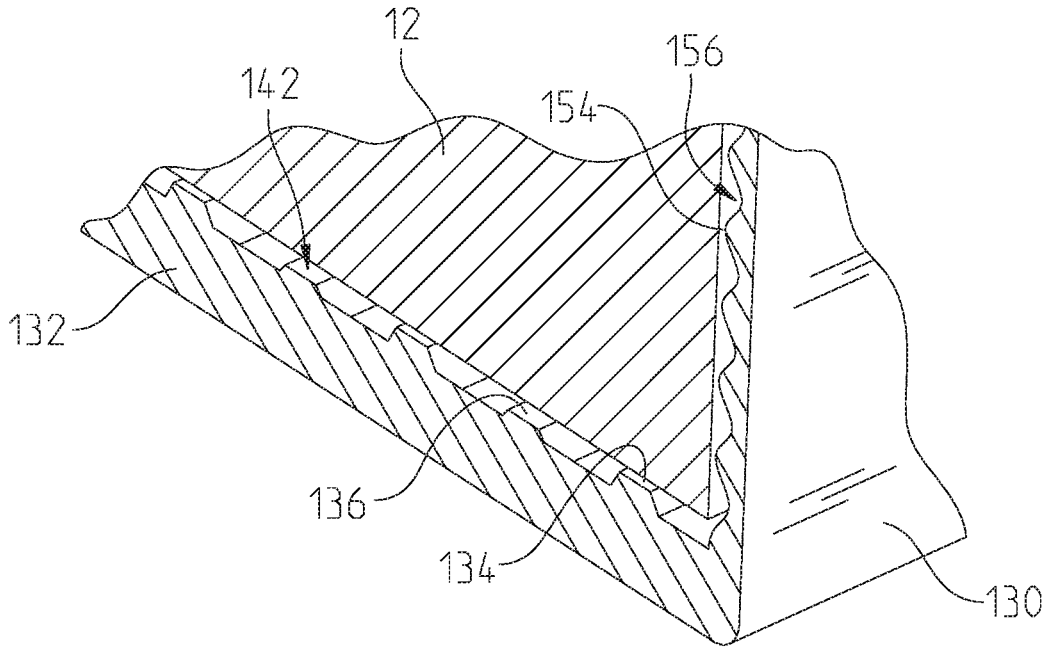

Fig. 25

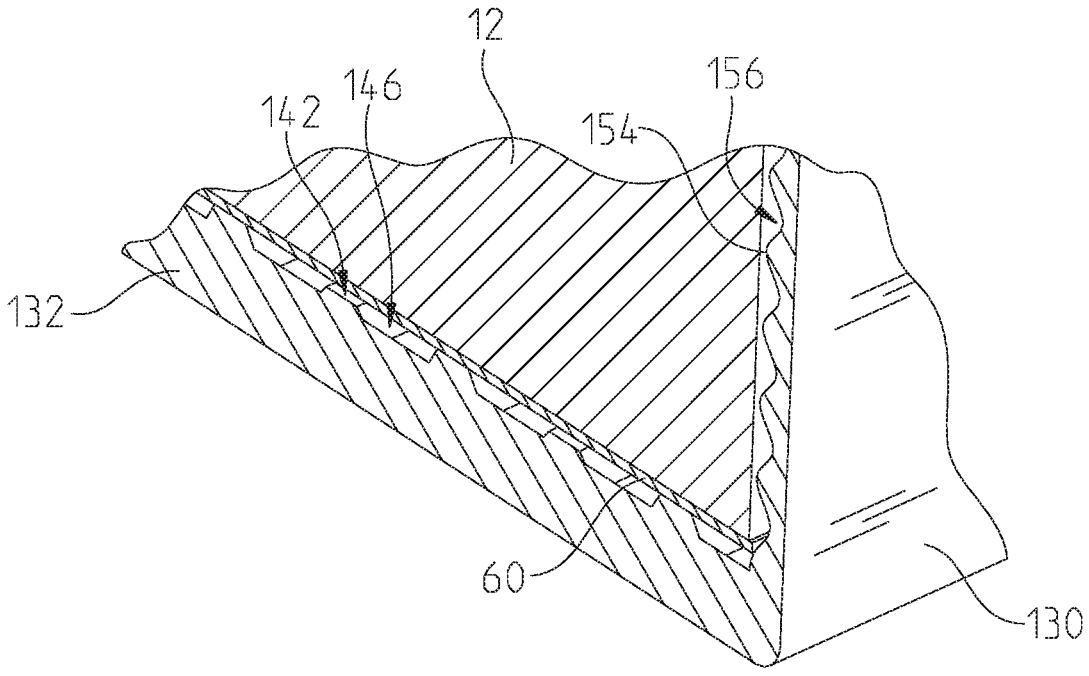

Fig. 26

VIBRATION DAMPENING RAILWAY TIE BOOT

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under Title 35, U.S.C. § 119(e) of U.S. Provisional Patent Application Ser. No. 62/669,761, entitled VIBRATION DAMPENING RAILWAY TIE BOOT and filed on May 10, 2018, the entire disclosure of which is hereby expressly incorporated by reference herein.

BACKGROUND

1. Field of the Disclosure

[0002] The present disclosure relates to railway ties which are typically made of concrete and embedded within grade material for supporting railway tracks. In particular, the present disclosure relates to a resilient boot for surrounding the railway tie to dampening vibrations from passing trains, and to a method of constructing such railway ties.

2. Description of the Related Art

[0003] Railway ties of the type used in many modern railway systems include a tie block made of concrete or other rigid material which includes embedded rail clip mounts or other mounting structures for connecting and securing railway tracks. The tie blocks are embedded in surrounding grade material such as aggregate or concrete, for example, which forms the railway bed. A resilient boot, typically made of rubber or other elastomeric material, substantially surrounds the tie block and is embedded in the surrounding railway bed. A separate resilient pad, typically made of foam or rubber, is disposed between the bottom wall of the boot and the bottom surface of the tie block. The boot and pad dampen vibrations from passing trains to prolong the service life of the tracks and the mounting hardware by which the tracks are secured to the tie blocks.

[0004] In one known process for manufacturing railway ties, the concrete tie block is poured using a mold with track mounting structures, such as rail clip mounts and plastic anchors, embedded within the upper portion of the concrete for later securement of rails. After the concrete has cured, the tie block is inserted within a surrounding resilient boot, with the upper edge of the boot disposed at a vertical distance beneath the upper surface of the tie block.

[0005] For aid in embedding the tie block within a surrounding railway bed, a band of resilient material is then installed around the upper portion of the tie block above the upper edge of the boot, such that substantially the entire vertical sidewalls of the tie block are covered. The tie block and boot are then embedded in surrounding railway bed material to a depth at which the railway bed material is disposed near the top of the boot and at the junction between the boot and the resilient band, such that the upper surface of the tie block sits proud of the surrounding railway bed material. In this manner, the resilient band provides a visual locator for the desired depth that the tie block should be embedded in the railway bed. In a final step, the resilient band is cut away from the tie block and surrounding railway bed and removed.

[0006] What are needed are improvements in the vibrational dampening effect of the railway tie boots and a simplified process for constructing and installing railway ties.

SUMMARY

[0007] The present disclosure provides a vibration dampening boot for railway tie blocks and a method of manufacturing railway tie block assemblies. The boot includes a bottom wall with resilient tie block contact structures disposed at different heights for initial tie block support and variable vibration dampening. The upper portion of the boot terminates in a removable wall connected to the side walls of the boot by a relatively thin tear strip to enable direct pouring of cast material, such as concrete or epoxy, into the boot for casting the tie block, with the wall removable after installation of the tie block assembly into a railway bed. In this manner, the boot may be used with pre-cast tie blocks as well as accommodate direct casting of the tie blocks within the boot to form a tie block assembly.

[0008] In one form thereof, the present invention provides a railway tie block boot, including a bottom wall made of a resiliently deformable material, a plurality of side walls extending upwardly from the bottom wall and terminating in an upper lip extending around a periphery defined by the side walls, such that the bottom wall and the plurality of side walls cooperate to form a generally rectangular box-like structure with an open upper end, and a removable wall extending upwardly from the upper lip and extending around the periphery of the side walls, the removable wall tapering inwardly from the upper lip toward the open upper end.

[0009] In another form thereof, the present invention provides a railway tie block boot, including a bottom wall sized and configured to support a railway tie block, the bottom wall having a ribbed structure formed on an upwardly-facing surface thereof and defining a plurality of lands and valleys, and a plurality of side walls extending from the bottom wall and terminating in an upper lip spaced from the bottom wall and extending around the side walls.

[0010] In yet another form thereof, the present invention provides a method of assembling a tie block to a tie block boot, the tie block boot having a bottom wall, a plurality of side walls extending upwardly from the bottom wall and terminating in an upper lip extending around a periphery defined by the side walls, and a removable wall extending upwardly from the upper lip. The method includes folding the removable wall down around the side wall, seating the tie block into the tie block boot such that the tie block is support by the bottom wall and abuts the plurality of side walls, and unfolding the removable wall such that an inwardly-tapered portion of the removable wall is allowed to conform to an adjacent inwardly-tapered portion of the tie block.

[0011] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention as claimed. Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The above-mentioned and other features of the disclosure, and the manner of attaining them, will become

more apparent and will be better understood by reference to the following description of embodiments of the disclosure taken in conjunction with the accompanying drawings, wherein:

[0013] FIG. **1** is an exploded, perspective view of a railway tie assembly including a boot made in accordance with the present disclosure;

[0014] FIG. **2** is a perspective view of the boot shown in FIG. **1**, after removal of a removable wall portion and an associated tear strip;

[0015] FIG. **3** is a top plan view of the boot shown in FIG. **2**;

[0016] FIG. **4** is an enlarged view of a portion of the boot shown FIG. **3**;

[0017] FIG. **5** is a partial perspective, section view of the boot shown in FIG. **2**, taken along the line VI-VI of FIG. **3**;

[0018] FIG. **6** is an elevation, section view of the boot shown in FIG. **2**, taken along the line VI-VI of FIG. **3**;

[0019] FIG. **7** is an enlarged view of a portion of the boot shown in FIG. **6**;

[0020] FIG. **8** is another elevation, section view of the boot shown in FIG. **2**, taken along the line VIII-VIII of FIG. **3**;

[0021] FIG. **9** is an enlarged view of a portion of the boot shown in FIG. **8**;

[0022] FIG. **10** is a perspective view of another boot made in accordance with the present disclosure;

[0023] FIG. **11** is a top plan view of the boot shown in FIG. **10**;

[0024] FIG. **12** is an enlarged view of a portion of the boot shown in FIG. **11**;

[0025] FIG. **13** is a partial perspective, section view of a portion of the boot shown in FIG. **10**, taken along the line XIII-XIII of FIG. **11**;

[0026] FIG. **14** is a perspective, section view of the boot shown in FIG. **10**, taken along the line XIV-XIV of FIG. **11**;

[0027] FIG. **15** is an enlarged view of a portion of the boot shown in FIG. **14**;

[0028] FIG. **16** is a schematic representation of stress concentrations at a bottom wall of the boot shown in FIG. **2**;

[0029] FIG. **17** is a schematic representation of stress concentrations in a bottom wall of the boot of FIG. **10**;

[0030] FIG. **18** is a perspective view of the railway tie assembly shown in FIG. **1**, in a fully assembled configuration;

[0031] FIG. **19** is a perspective, section view of the railway tie assembly shown in FIG. **18**, taken along the line XIX-XIX;

[0032] FIG. **20** is an elevation, section view of the railway tie assembly shown in FIG. **18**, taken along the line XIX-XIX;

[0033] FIG. **21** is a partial perspective, section view of the boot of the railway tie assembly shown in FIG. **18**, taken along the line XIX-XIX;

[0034] FIG. **22** is another perspective view of the railway tie assembly shown in FIG. **18**, shown with the removable wall portion removed via a tear strip;

[0035] FIG. **23** is a perspective, section view of the railway tie assembly shown in FIG. **22**, taken along the line XXIII-XXIII;

[0036] FIG. **24** is an elevation, section view of the railway tie assembly shown in FIG. **22**, taken along the line XXIV-XXIV;

[0037] FIG. **25** is a perspective, section view of a boot made in accordance with the present disclosure having a tie block disposed therein; and

[0038] FIG. **26** is a perspective, section view of a boot made in accordance with the present disclosure, having a cast-in-place tie block disposed therein upon a casting plate.

[0039] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate embodiments of the disclosure and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION

[0040] The present disclosure provides railway tie assembly **10**, shown in FIG. **1**, including boot **30** made of a resiliently deformable material, such as rubber, which is sized to receive tie block **12** (FIG. **18**). As described in further detail below, boot **30** includes bottom wall **32** sized and configured to support tie block **12**. Bottom wall has a network or pattern of ribbed structures formed on its upwardly-facing surface, such that the ribbed structures collectively provide a desired cushioning and resiliency for tie block **12** via the material and geometric arrangement of the ribbed structures. In addition, a plurality of sidewalls **38**, shown as four sidewalls **38**A, **38**B, **38**C and **38**D in FIG. **1**, provide lateral cushioning to absorb, e.g., shear forces applied to the top surface of tie block **12**. Railway tie assemblies **10** may be spaced intermittently along a length of rail **14** to anchor rail **14** to the adjacent rail bed.

[0041] In the illustrated embodiment, tie block **12** is a cast structure which may be formed, e.g., of concrete or an epoxy polymer material such as CASTINITE available from Precision Polymer Casting, LLC of Perry, Ohio. Such polymer materials may, in some cases, be molded directly within boot **30**, as described below, thereby saving the step of installing tie block **12** into boot **30**. Tie block **12** may include a plurality of cast-in anchors **20**, such as four anchors **20** as illustrated, which may have eyelets (not shown) attached thereto for lifting and spatial manipulation of tie block **12**. Rail clip retainers **16** are also cast in to tie block **12**, and form an anchor point sized to receive rail clips **18**. Rail clips **18** can be attached to rail clip retainers and thereby engaged with a lower flange of rail **14** to affix rail **14** to tie block **12**. Rail pad **22** may also be disposed between rail **14** and tie block **12**.

[0042] Turning now to FIGS. **2-9**, a first embodiment of boot **30** is illustrated. Bottom wall **32** and side walls **38** (which includes side walls **38**A, **38**B, **38**C, and **38**D) cooperate to form a generally rectangular box-like structure with an open upper end as best seen in FIG. **2**. As illustrated in FIGS. **6** and **8**, side walls **38** may splay slightly outwardly toward the open upper end in order to facilitate insertion of tie block **12**.

[0043] The overall dimensions of boot **30** may vary according to the intended railway application. In one exemplary embodiment, boot **30** may be about 31.5 inches long, 11.8 inches wide, and 5.9 inches deep, with a total interior depth (i.e., the distance between the upper surface of lip **40** and the upper surface of ribbed structures **42**) of about 5.3 inches. These dimensions comport with an application in rail beds for light rail applications, as further described below. Other dimensions may be used for other applications, such as freight or heavy rail applications.

[0044] As best seen in FIG. **5**, bottom wall **32** includes a pattern of ribbed structures **42** which form a grid-like network of lands **44** and recesses or valleys **46**. Lands **44** and valleys **46** are regularly spaced and arranged to provide a consistent reaction force across the area of the lower surface of tie block **12** as rail **14** is subjected to downward and lateral forces, such as by a train passing along rail **14**. The particular configuration and spatial arrangement of lands **44** and valleys **46** may be designed in view of the mechanical properties of the resilient material used to form boot **30** to provide a suitable reaction force profile as required or desired for a particular application, such as light rail trains or freight trains, for example.

[0045] For purposes of the present discussion of lands and valleys, the nomenclature of waves may be employed, with lands **44** and valleys **46** cooperating to form a trapezoid wave form in cross section, as shown in FIG. **6** (taken along the length of boot **30**) and FIG. **8** (taken along the width of boot **30**). This mesh of overlapping trapezoidal wave-shaped structures combines to form the network of ribbed structures **42** formed throughout the upwardly facing surface of bottom wall **32** (FIG. **3**). The regularly alternating lands **44** and valleys **46** of each trapezoidal wave defines frequency F and an overall height (i.e., amplitude) DH. In addition angle α may be defined between the upward and downward slopping portions of each land **44**. In the illustrated embodiment, frequency F, height DH and angle α are unchanged throughout the field of ribbed structure **42**, that is, ribbed structure **42** defines a common waveform at all locations within the field. However, it is contemplated that these waveform variables may be adjusted within the field of ribbed structures **42** as required or desired for a particular application.

[0046] In an exemplary embodiment, boot **30** is made of a monolithic structure consisting of a single piece of material, such as natural or synthetic rubber having a durometer as little as 45, 55 or 65 and as large as 70, 75 or 80 on the shore A scale, or may have any durometer within any range defined by any of the foregoing values. Exemplary rubber materials for use in forming boot **30** include ethylene propylene, styrene-butadiene (also known as Buna-S), synthetic or natural isoprene, nitrile rubber (also known as Buna-N), isobutyl isoprene, and chloroprene neoprene.

[0047] With this type of material and in the context of railway tie assembly **10** utilized in a light rail application, frequency F may be between 0.65 inches and 1.0 inches, such as 0.90 inches, and height DH may be between 0.2 and 0.3 inches, such as 0.24 inches. In addition, the lateral extent DL of each upper surface of lands **44** may be between 0.30 and 0.45 inches, such as 0.38 inches, while the width DV of each valley **46** may be between 0.2 and 0.3 inches, such as 0.25 inches. Angle α defined by the upward and downward slopes flanking each land **44** may be between 50 degrees and 70 degrees, such as about 60 degrees, resulting in an overall base width DF of each land **44** being between 0.60 and 0.70 inches, such as about 0.65 inches. This set of parameters for the trapezoid wave form formed by the grid of lands **44** and valleys **46** throughout ribbed structure **42** provides a suitable resilient force profile, in conjunction with the aforementioned materials and durometers, which is commensurate with currently accepted cushioning requirements for railway tie assemblies including a resilient pad disposed at the bottom of a boot, as may be found in existing light rail applications. For example, ribbed structure **42** as described herein may provide an effective spring constant designed to be appropriate for railway applications.

[0048] As best seen in, e.g., FIGS. **7** and **9**, boot **30** may also include a set of rounded lands **54** and valleys **56** along the interior surfaces of wall **38**. Unlike the trapezoid waveform defined by lands **44** and valleys **46** formed on the upper surface of bottom wall **32**, lands **54** and valleys **56** form a rounded waveform similar to a sine wave, with each land **54** extending circumferentially around the inner surface of wall **38**. Collectively, lands **54** and valleys **56** provide a cushioning structure similar to ribbed structure **42**, except for lands **54** and valleys **56** absorb lateral rather than downward forces placed upon tie block **12**. For example, shear forces applied to the top surface of tie block **12** (e.g., from a train passing overhead on a curve, or accelerating) will urge tie block **12** in a lateral (forward-backward and/or side-to-side) direction, tending to compress lands **54**.

[0049] The material and structure of lands **54** may be tailored to provide a desired reaction force to such external lateral forces. In an exemplary embodiment designed for light-rail applications, lands **54** and valleys **56** may have a frequency of about one land per inch, and an amplitude of about 0.050 inches.

[0050] Referring to FIGS. **5-9**, ribbed structure **42** forms a single planar upper support surface for contact with the lower surface of tie block **12**, in which the support surface consists of all the interconnected lands **44**. As best shown in FIG. **16**, when loaded with the weight of tie block **12** and any downward forces applied thereto, these coplanar lands **44** create a uniform set of stress fields **51** distributed across bottom wall **32** in each of lands **44**. Stress fields **51** result from deformation of the material of ribbed structure **42** under the weight of tie block **12** and any vertical loads which are placed thereupon, such as when a train passes over railway tie assembly **10** and places loads upon rail **14**.

[0051] In an alternative embodiment, two sets of lands set at differing heights may be provided such that a relatively soft initial resiliency gives way to a firmer subsequent resiliency as loads increase sufficiently to deform the upper set of lands enough to bring tie block **12** into contact with the lower set of lands. FIGS. **10-15** show boot **130**, which is designed with such functionality as described in further detail below.

[0052] Boot **130** is substantially similar to boot **30** described above, with reference numerals of boot **130** analogous to the reference numerals used in boot **30**, except with **100** added thereto. Structures of boot **130** correspond to similar structures denoted by corresponding reference numerals of boot **30**, except as otherwise noted herein. Moreover, references to either boot **30** or boot **130** herein may be taken as a reference to both boots, except where differences between boots **30** and **130** are made explicit. Therefore, all features ascribed to boot **30** may also be ascribed to boot **130** except as otherwise noted herein, and vice versa.

[0053] As best shown in FIG. **13**, boot **130** includes a first set of lands **144** defining upper tie block contact structure **134**, while a second set of lands **144'** is recessed relative to lands **144** to form lower tie block contact structure **136**. As illustrated, lands **144** and **144'** alternate in both the length and width directions of ribbed structures **142**, such that an even field of force transfer is provided across the entire lower surface of tie block **12** upon installation, as further detailed below.

[0054] In the illustrated embodiment, lands **144** have the same spatial, size and material configuration as lands **44**, except frequency F' (FIG. **15**) has twice the nominal value of frequency F in order to account for the lower level land **144'** disposed between each neighboring pair of lands **144**. Lands **144'** also define frequency F', and share a common base width DF and land width DL with lands **144**.

[0055] However, height DH' of lands **144'** is reduced in order to create the desired height differential between the upper and lower tie block contact structures **134**, **136**. In order to accommodate this reduced height while maintaining the other spatial variables the same as noted above, lower lands **144'** define an angle β between the sloped surfaces flanking lands **144'** that is larger than the analogous angle α derived from lands **144**. In an illustrated embodiment, angle β between 65 degrees and 85 degrees, such as about 76 degrees. In an embodiment particularly suitable for integration in to a light rail system, the difference between height DH of lands **144** and the reduced height DH' of lands **144'** may be between 0.04 and 0.08 inches, such as 0.06 inches. Because the vertical deformation of upper tie block contact structure **134** needed to initially engage lower tie block contact structure **136** is equal to the difference between DH and DH', this height differential can be used to set the amount of force needed for the ribbed structure **142** to transition from a first, relatively lower spring constant influenced only by lands **144**, to a second relatively larger spring constant influenced by both lands **144** and lands **144'**.

[0056] For the above described durometer rages and the illustrated and described spatial configuration and structural sizes of lands **144**, lands **144'** and valleys **146**, the illustrated configuration of ribbed structure **142** may result in a first spring constant set by upper tie block contact structure **134** that is commensurate with industry-accepted values for a particular application, such as railways applications. Once sufficient pressure is applied to upper contact structure **134**, lands **144** of upper tie block contact structure **134** will deform sufficiently to allow the lower surface of tie block **12** to come into contact with lands **144'** of lower tie block contact structure **136**. At this point, a second spring constant of ribbed structure **142** is set by both upper and lower tie block contact structures **134**, **136**, and may be commensurate with industry-accepted values for extreme or limit loading conditions for a particular application, such as railway applications.

[0057] Turning to FIG. **17**, a deformed configuration of upper and lower tie block contact structures **134** and **136** of bottom wall **132** is illustrated, resulting, e.g., from a downward force provided upon tie block **12**. As illustrated, lands **144** experience a material stress S**2** which is substantially larger than a material stress S**3** experienced in lands **144'**, due to the additional deformation of lands **144** which has already occurred upon initial deformation of lands **144'**.

[0058] Turning now to FIG. **18**, an illustration of railway tie assembly **10** in a fully assembled, ready-to-deploy configuration is shown. When ready to deploy, rail **14** will of course not yet be attached to tie block via rail clips **18** as shown; these are illustrated for purpose of context.

[0059] As best seen in FIGS. **19** and **20**, tie block is fully seated within boot **30**, with removable wall portion **50** attached to lip **40** via tear strip **52** (FIG. **21**). When a user is ready to deploy railway tie assembly **10**, eyelets or other threaded attachment devices may be fixed to anchors **20** to facilitate handling of assembly **10**. As assembly **10** is lifted off the ground, boot **30** remains retained in position around tie block **12** by a combination of friction at side walls **38**, and by removable wall **50**. In particular, removable wall **50** extends upwardly and tapers inwardly from lip **40** toward the open upper end of boot **30**, and tie block **12** has a corresponding tapered upper portion. This inward taper acts to restrain downward movement of boot **30** under its own weight when assembly **10** is lifted.

[0060] Assembly **10** is placed into a desired position within a prepared railway bed, including the creation of an appropriate canter (e.g., a 40:1 slope) in the upper surface of tie block **12**. In the case of a polymer tie block **12**, the appropriate canter may be set by molding tie block **12** within boot **30** as noted herein. Aggregate or other material is filled in around boot **30**. In a typical installation, such aggregate is not intended to completely submerge tie block **12**, but rather, a portion of tie block **12** should extend upwardly out of the aggregate. To this end, lip **40** is positioned at the proper location for aggregate fill depth, and may serve as a visual marker for proper fill depth upon deployment of assembly **10**. Particularly where concrete is poured around boot **30** to fix assembly **10** in its deployed position, a resilient and tight fit of removable wall **50** against the abutting surfaces of tie block **12** may protect the inner cavity of boot **30** from infiltration of such concrete or other poured materials.

[0061] After boot **30** is buried in an appropriate amount of aggregate and therefore fixed at a desired position and orientation within the railway bed, removable wall **50** is ready for removal in order to leave only the material of tie block **12** exposed above the aggregate. To facilitate easy removal without tools, tear strip **52** is provided at the junction between removable wall portion **50** and lip **40**. As best seen in FIG. **21** (in the context of boot **130**, whose features are interchangeable with boot **30** as noted herein), tear strip **52** is a reduced-thickness area of material with extends around the circumference of boot **30** (or **130**) adjacent lip **40** (or **140**).

[0062] Thickness T of tear strip **52** is sufficiently thick to prevent separation of removable wall portion **50** from the remainder of boot **30** during installation and/or pouring of tie block **12** into the inner cavity of boot **30** (as described below), and during handling of assembly **10**. For example, thickness T is large enough to support the weight of boot **30** as railway tie assembly **10** is lifted and moved into place during deployment. On the other hand, thickness T is thin enough to allow a user to grasp a portion of removable wall **50** and tear it away from tie assembly **10** by hand, and without the use of tools. In other embodiments, removable wall **50** may facilitate removal with a tool such as a knife via tear strip **52**.

[0063] FIGS. **22-24** illustrate railway tie assembly **10** without removable wall portion **50**. As shown, tear strip **52** is designed to separate cleanly and with little or no residual material attached to lip **40**. Once removable wall **50** has been removed, the tapered upper surface of tie block **12** is exposed above lip **40**, such that tie block **12** may sit proud of the railway bed, together with the railway structures mounted to tie block **12** such as rail clips **18**, rail pad **22** and rail **14**. In some applications, removable wall **50** may be left in place and not removed prior to placing railway tie assembly **10** into service.

[0064] Tie block **12** may be pre-cast and then placed within boot **30**. To seat tie block **12**, removable wall **50** may be resiliently deformed or folded down around the adjacent

portion of sidewalls **28** to allow tie block **12** to pass into boot **30**, and tie block **12** may then be advanced downwardly into the cavity of boot **30** until the lower surface of tie block **12** contacts at least the upper tie block contact structure **134** as shown in FIG. **25**. To facilitate passage of tie block **12** into this fully seated position, lands **54** and valleys **56** may be designed to reduce surface-area contact, and therefore friction, between the upright surfaces of tie block **12** and the corresponding inner surfaces of side walls **38**. As noted above, lands **54** and valleys **56** also provide lateral cushioning for tie block **12** once it is fully seated. At this point, removable wall **50** may be unfolded such that the inwardly-tapered portion of removable wall **50** is allowed to conform to the adjacent inwardly-tapered portion of tie block **12**.

[0065] Alternatively, tie block **12** may be cast directly into boot **30**, such that boot **30** serves as a casting mold. For this application, a casting plate **60** (FIG. **26**) may be provided to ensure that the flowable concrete or epoxy polymer material of tie block **12** does not infiltrate valleys **46** (or **146**) before it is set. Casting plate **60** may be a rigid or semi-rigid material suitable to pass forces applied to tie block **12** on to ribbed structures **42** (or **142**) of bottom wall **32** (or **132**) as described in detail above. Similar casting plates may also be provided along the side walls **38** to prevent infiltration of flowable material between lands **154** and into valleys **156**. In one embodiment, tie block **12** may be formed upside down within boot **30** in order to ensure that the proper canter or angle is provided in the top surface of tie block **12**.

[0066] While this disclosure has been described as having exemplary designs, the present disclosure can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the disclosure using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this disclosure pertains and which fall within the limits of the appended claims.

What is claimed is:

1. A railway tie block boot, comprising:

a bottom wall made of a resiliently deformable material;

a plurality of side walls extending upwardly from the bottom wall and terminating in an upper lip extending around a periphery defined by the side walls, such that the bottom wall and the plurality of side walls cooperate to form a generally rectangular box-like structure with an open upper end; and

a removable wall extending upwardly from the upper lip and extending around the periphery of the side walls, the removable wall tapering inwardly from the upper lip toward the open upper end.

2. The railway tie block boot of claim **1**, wherein the plurality of side walls splay outwardly at the open upper end.

3. The railway tie block boot of claim **1**, wherein the removable wall is connected to the upper lip by a tear portion of reduced thickness relative to the upper lip and the side walls

4. The railway tie block boot of claim **3**, wherein the reduced thickness of the removable wall is thin enough to allow a user to grasp a portion of removable wall and tear the removable wall away from the plurality of side walls by hand, and without the use of tools.

5. The railway tie block boot of claim **1**, wherein the resiliently deformable material is rubber has a durometer between 45 and 80 on the shore A scale.

6. The railway tie block boot of claim **5**, wherein the rectangular box-like structure of the railway tie block boot is about 31.5 inches long, 11.8 inches wide, and 5.9 inches deep, whereby the railway tie block boot is compatible for use in rail beds for light rail applications.

7. The railway tie block boot of claim **1**, in combination with a cast tie block receivable within the railway tie block boot, the cast tie block having a tapered upper portion corresponding to the taper of the removable wall.

8. The railway tie block boot of claim **1**, wherein:

the bottom wall has a first plurality of tie block contact features disposed at a first, upper elevation with respect to the bottom wall and a second plurality of tie block contact features disposed at a second, lower elevation with respect to the bottom wall, with a plurality of recesses defined between the first and second tie block contact features.

9. A railway tie block boot, comprising:

a bottom wall sized and configured to support a railway tie block, the bottom wall having a ribbed structure formed on an upwardly-facing surface thereof and defining a plurality of lands and valleys; and

a plurality of side walls extending from the bottom wall and terminating in an upper lip spaced from the bottom wall and extending around the side walls.

10. The railway tie block boot of claim **9**, further comprising a removable wall extending from the upper lip and extending circumferentially around the side walls, the removable wall connected to the upper lip by a tear portion of reduced thickness relative to the upper lip and the side walls.

11. The railway tie block boot of claim **9**, wherein the plurality of side walls further comprise a second set of lands and valleys, each of the second set of lands extending circumferentially around the plurality of side walls.

12. The railway tie block boot of claim **9**, wherein the lands of the ribbed structure are all substantially coplanar.

13. The railway tie block boot of claim **9**, wherein the lands of the bottom wall comprise a first set of lands disposed at a first, upper elevation with respect to the bottom wall and a second set of lands disposed at a second, lower elevation with respect to the bottom wall.

14. The railway tie block boot of claim **13**, wherein the first set of lands alternate with the second set of lands throughout the ribbed structure, such that respective individual lands of the first set of lands are disposed between a neighboring pair of the second set of lands.

15. The railway tie block boot of claim **9**, wherein the plurality of lands and valleys are regularly spaced and arranged to provide a consistent reaction force when subjected to downward and lateral forces.

16. The railway tie block boot of claim **9**, wherein the plurality of lands and valleys cooperate to form a trapezoid wave form in cross section.

17. The railway tie block boot of claim **16**, wherein the plurality of lands and valleys defines a frequency between 0.65 inches and 1.0 inches and a height between 0.2 and 0.3 inches,

18. The railway tie block boot of claim **17**, wherein:

the plurality of lands each has an upper surface defining a lateral extent between 0.30 and 0.45 inches,

the plurality of valleys each defines a width between 0.2 and 0.3 inches, and an angle defined by the upward and downward slopes flanking each of the plurality of lands is between 50 degrees and 70 degrees.

19. The railway tie block boot of claim **9**, wherein the bottom wall and the plurality of side walls are monolithically formed from a single piece of material.

20. The railway tie block boot of claim **9**, in combination with a cast tie block receivable within the railway tie block boot, the cast tie block formed from one of concrete and an epoxy polymer material cast material.

21. A method of assembling a tie block to a tie block boot, the tie block boot having a bottom wall, a plurality of side walls extending upwardly from the bottom wall and terminating in an upper lip extending around a periphery defined by the side walls, and a removable wall extending upwardly from the upper lip, the method comprising:

folding the removable wall down around the side wall;

seating the tie block into the tie block boot such that the tie block is support by the bottom wall and abuts the plurality of side walls; and

unfolding the removable wall such that an inwardly-tapered portion of the removable wall is allowed to conform to an adjacent inwardly-tapered portion of the tie block.

22. The method of claim **21**, further comprising installing the tie block and tie block boot into a railbed without removing the removable wall.

23. The method of claim **21**, further comprising removing the removable wall by one of cutting and tearing.

24. The method of claim **21**, wherein the step of seating the tie block into the tie block boot comprises lowering a precast tie block into engagement with the bottom wall.

25. The method of claim **24**, wherein the step of lowering a precast tie block into engagement with the bottom wall comprises engaging a set of lands and valleys formed in the plurality of side walls, the land and valleys configured to reduce surface-area contact, and therefore friction, between the upright surfaces of the tie block and the corresponding inner surfaces of the plurality of side walls.

26. The method of claim **21**, wherein the step of seating the tie block into the tie block boot comprises casting the tie block directly into the tie block boot, such that the tie block boot serves as a casting mold.

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