US011732475B1

(12) **United States Patent**
Teitelbaum

(10) **Patent No.: US 11,732,475 B1**
(45) **Date of Patent: Aug. 22, 2023**

(54) **COMPOSITE OPEN WEB BEAM-JOIST AND METHOD OF MANUFACTURE**

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(72) Inventor: **Ernest Teitelbaum**, Brooklyn, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/078,246**

(22) Filed: **Dec. 9, 2022**

Related U.S. Application Data

(62) Division of application No. 17/702,932, filed on Mar. 24, 2022, now Pat. No. 11,536,030.

(51) **Int. Cl.**

E04C 3/08	(2006.01)
E04C 3/04	(2006.01)
B21D 47/01	(2006.01)
B23P 15/00	(2006.01)

(52) **U.S. Cl.**
CPC ***E04C 3/08*** (2013.01); ***B21D 47/01*** (2013.01); ***B23P 15/00*** (2013.01); *B23P 2700/11* (2013.01); *E04C 2003/0413* (2013.01); *E04C 2003/0434* (2013.01); *E04C 2003/0452* (2013.01); *Y10T 29/49625* (2015.01); *Y10T 29/49634* (2015.01)

(58) **Field of Classification Search**
CPC E04C 3/08; E04C 2003/0413; E04C 2003/0434; E04C 2003/0452; B21D 47/01; B23P 15/00; B23P 2700/11; Y10T 29/49625; Y10T 29/49634
See application file for complete search history.

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Assistant Examiner — Darrell C Ford
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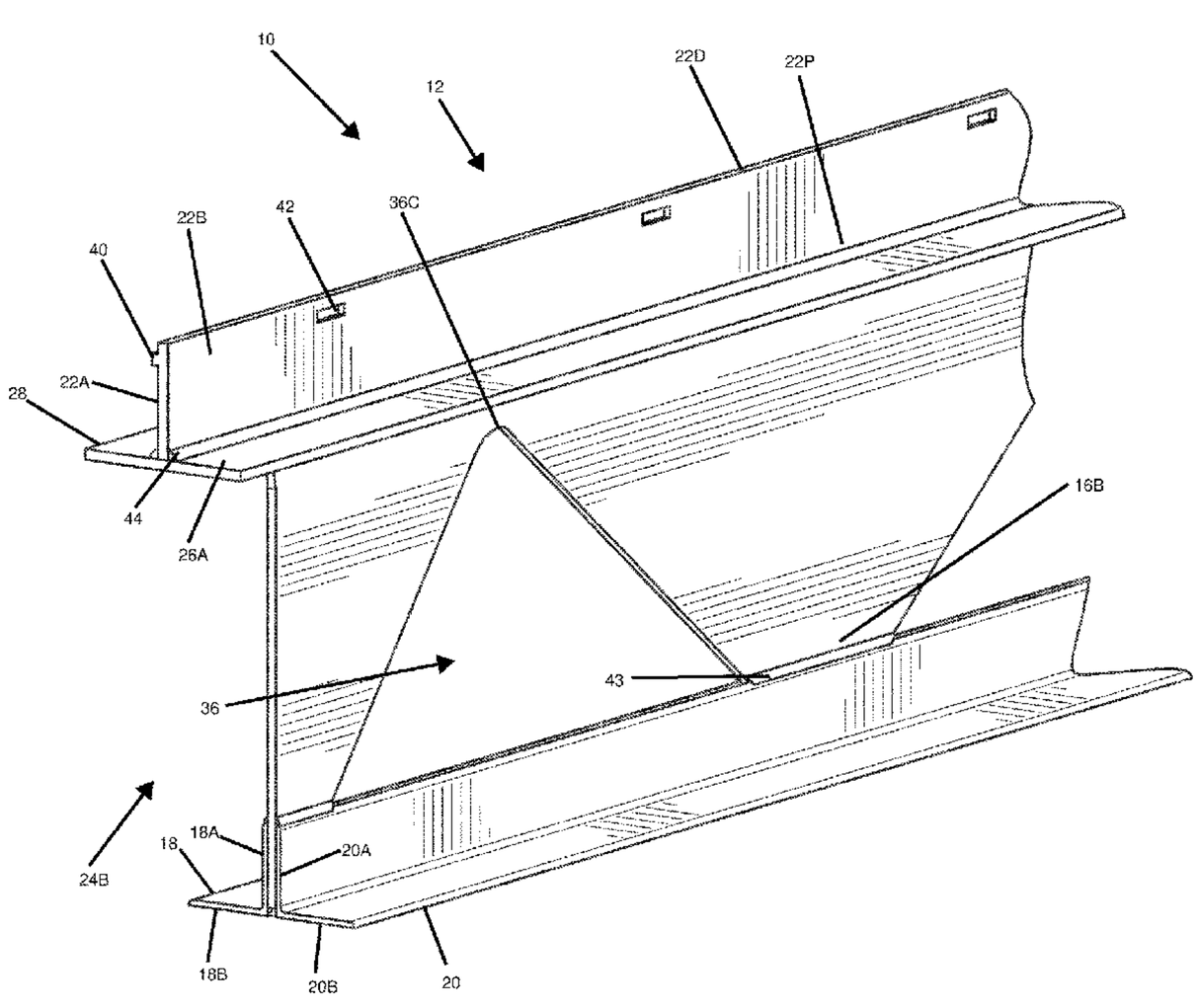
(57) **ABSTRACT**

A composite open web beam joist includes a cambered beam joist portion including a top end, a bottom end, a first side, a second side, and an open web layout extending from end to end. The open web layout includes triangular web sections and openings between each of the triangular web sections. Each triangular web section includes a peak. A first chord angle beam is attached to the first side of the cambered beam-joist portion at the peaks of the triangular web sections. A second chord angle beam is attached to the second side of the cambered beam-joist at the peaks of the triangular web sections. A plate is vertically attached to a center of the top end of the cambered beam-joist. The plate extended longitudinally along the center of the top end of the cambered beam joist portion. The plate includes a distal end having a flange and a recess.

7 Claims, 23 Drawing Sheets



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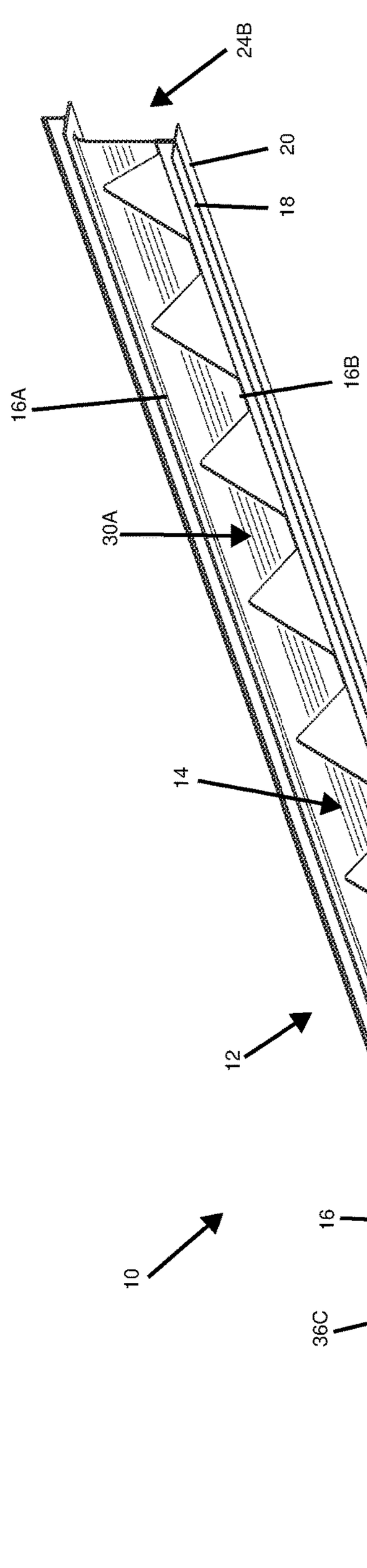
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26B
24A

FIG. 1A

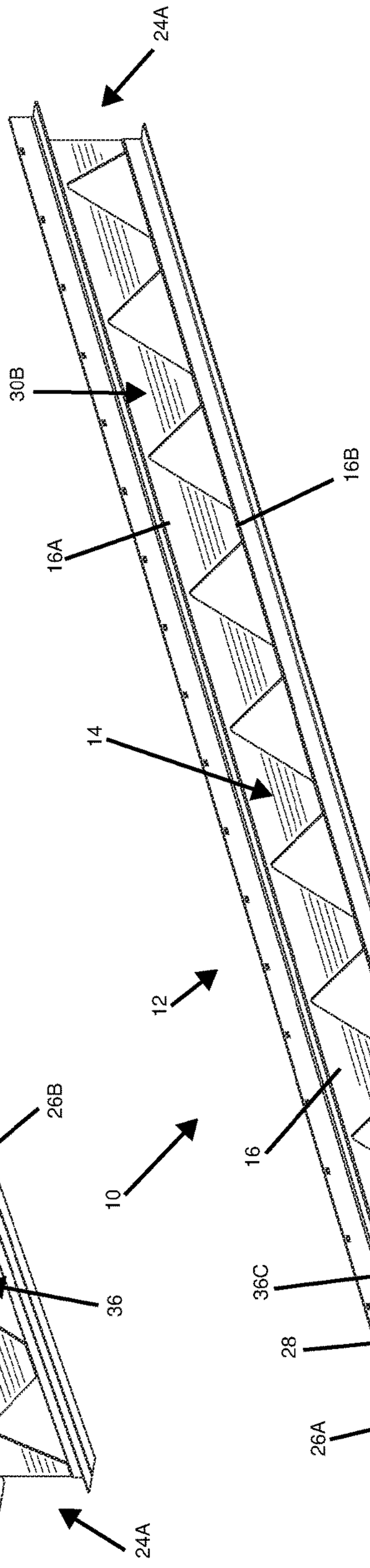
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FIG. 1B

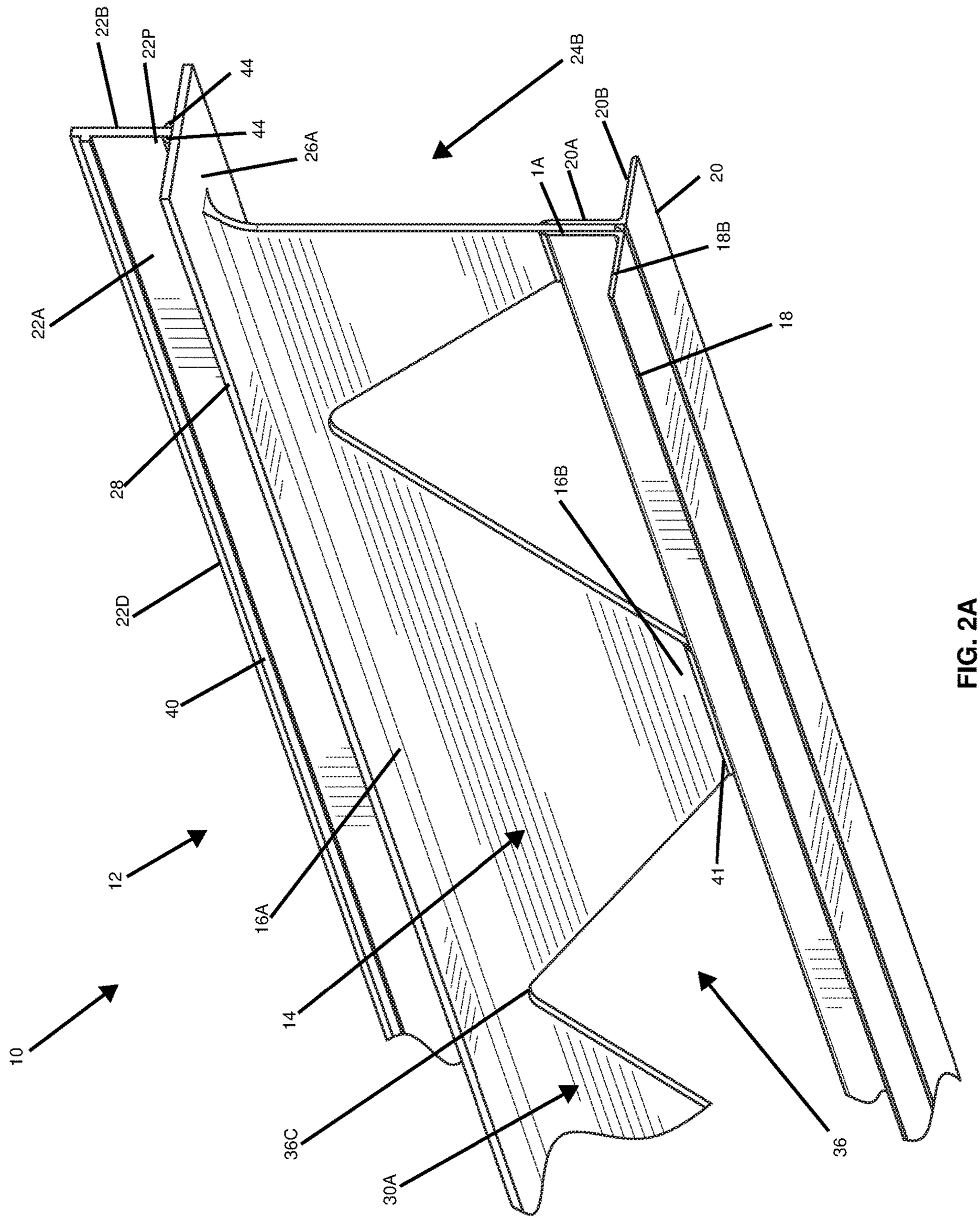
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FIG. 2A

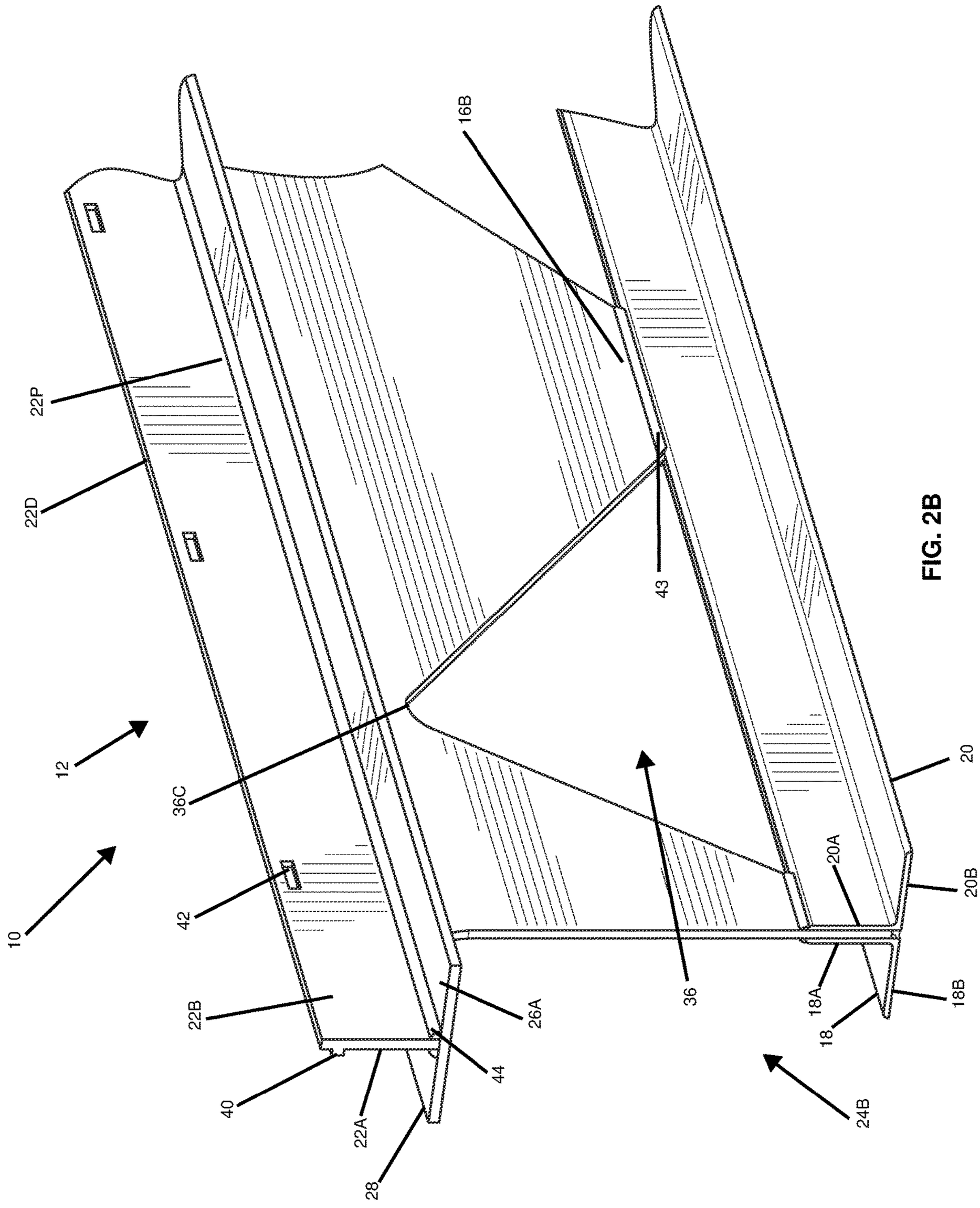
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FIG. 2B

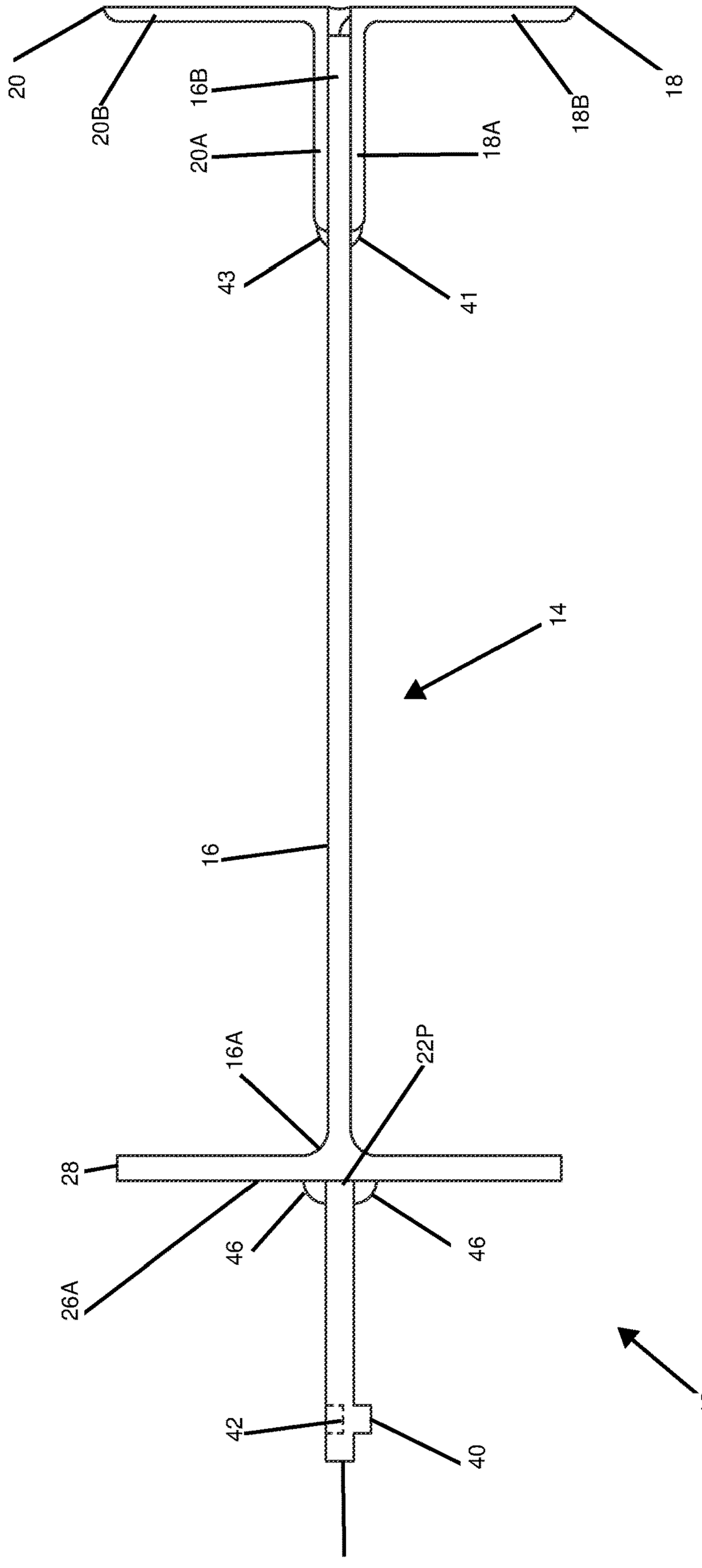
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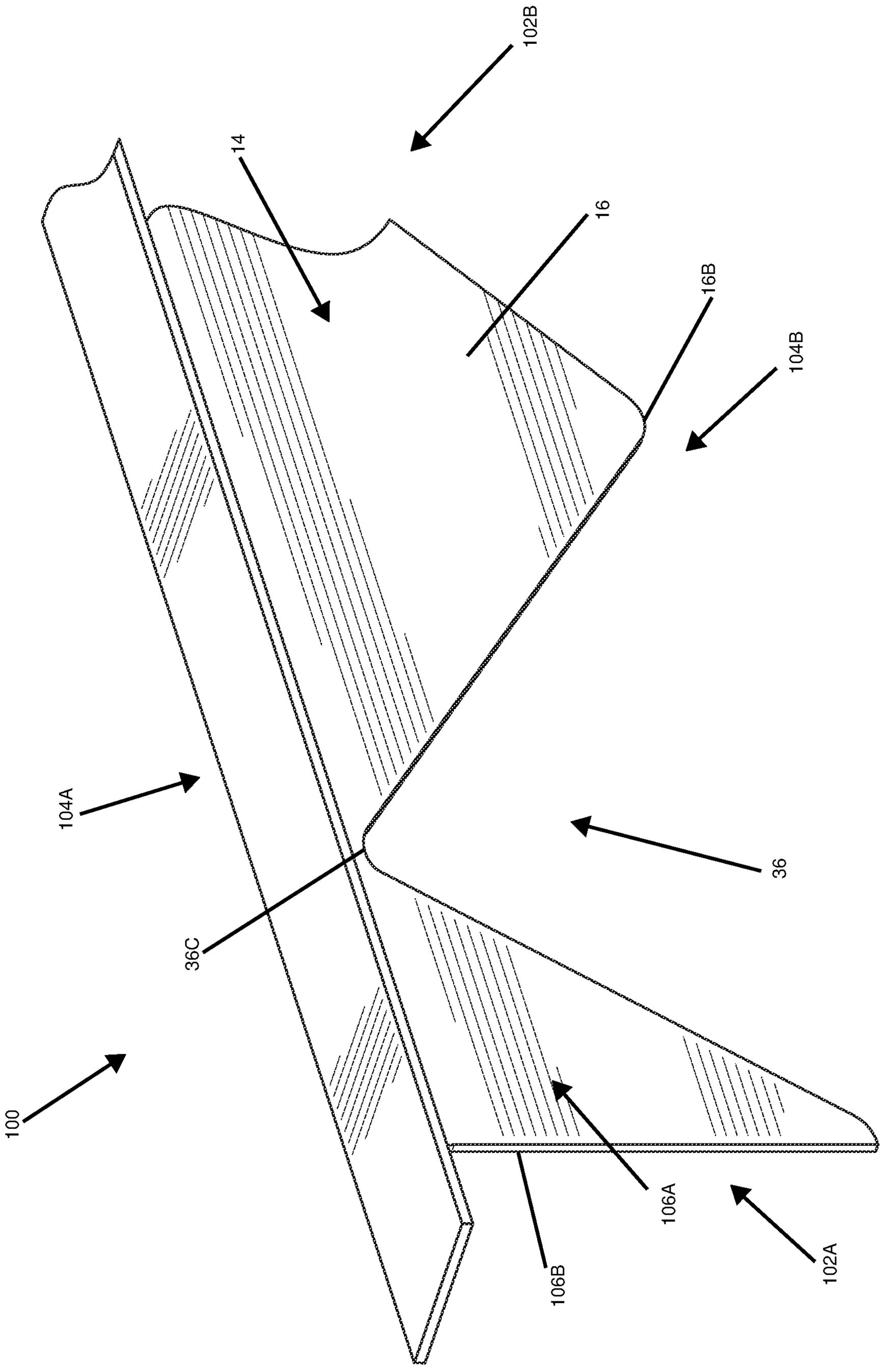
Fig. 3



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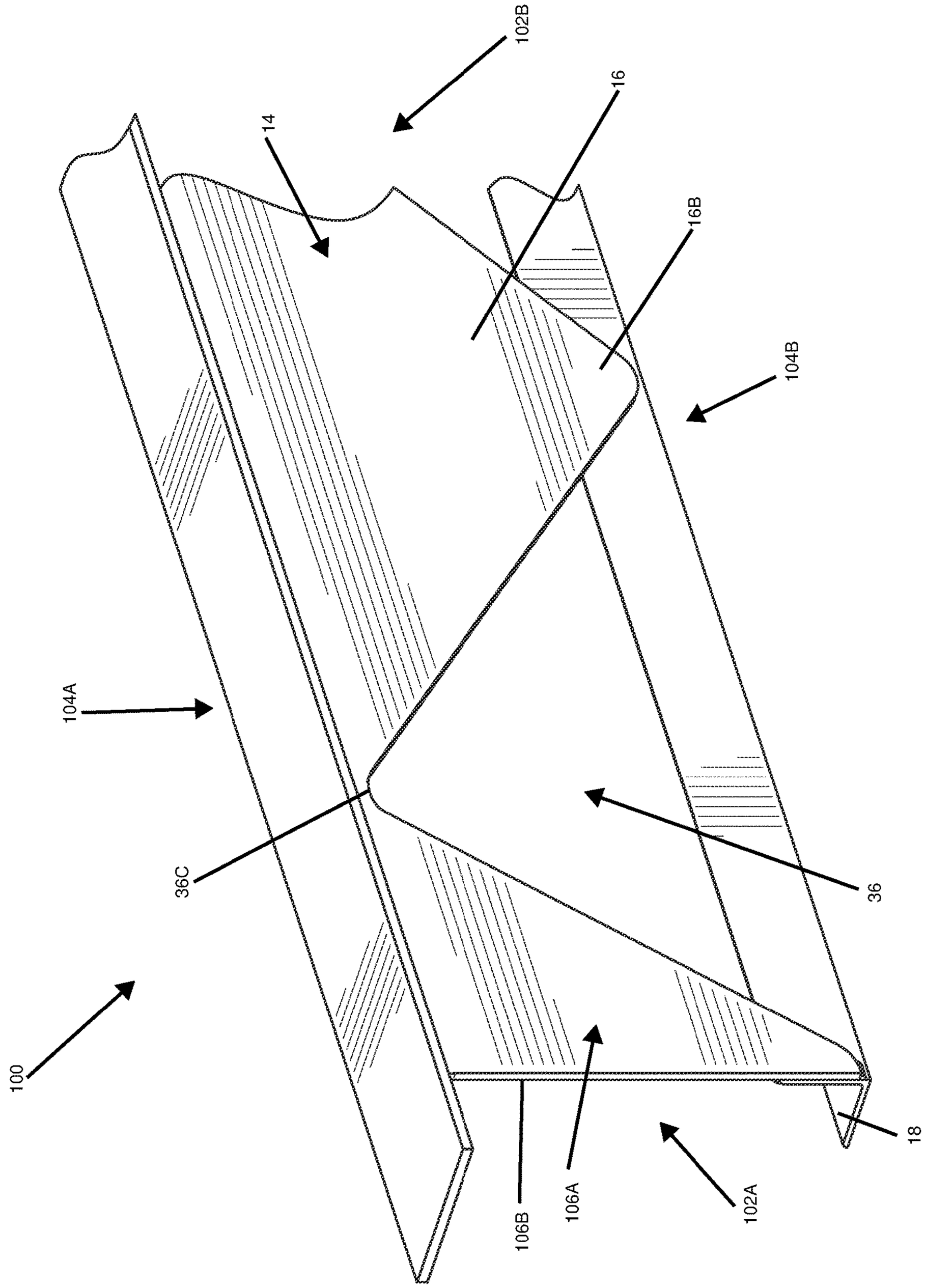

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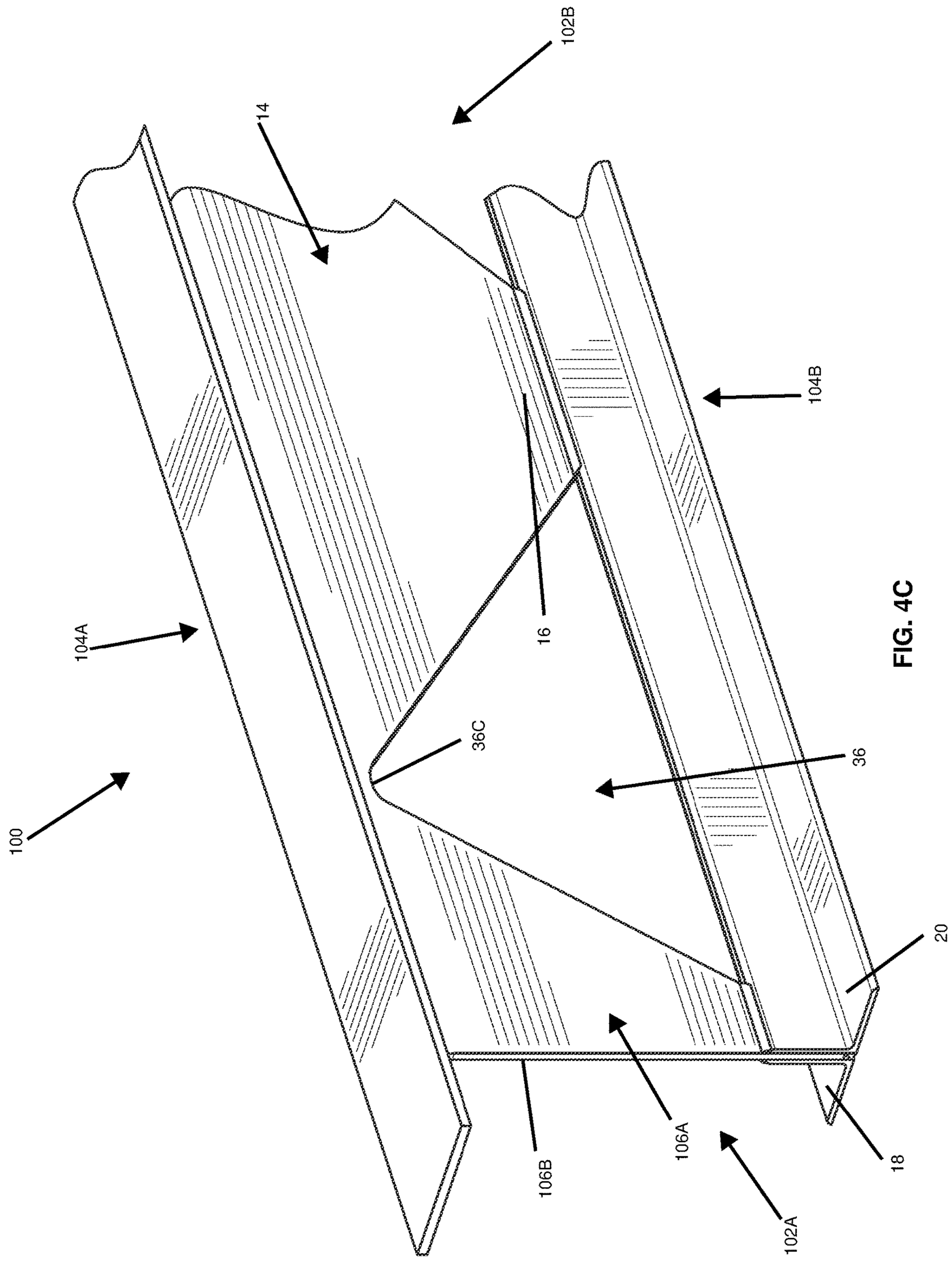

FIG. 4C

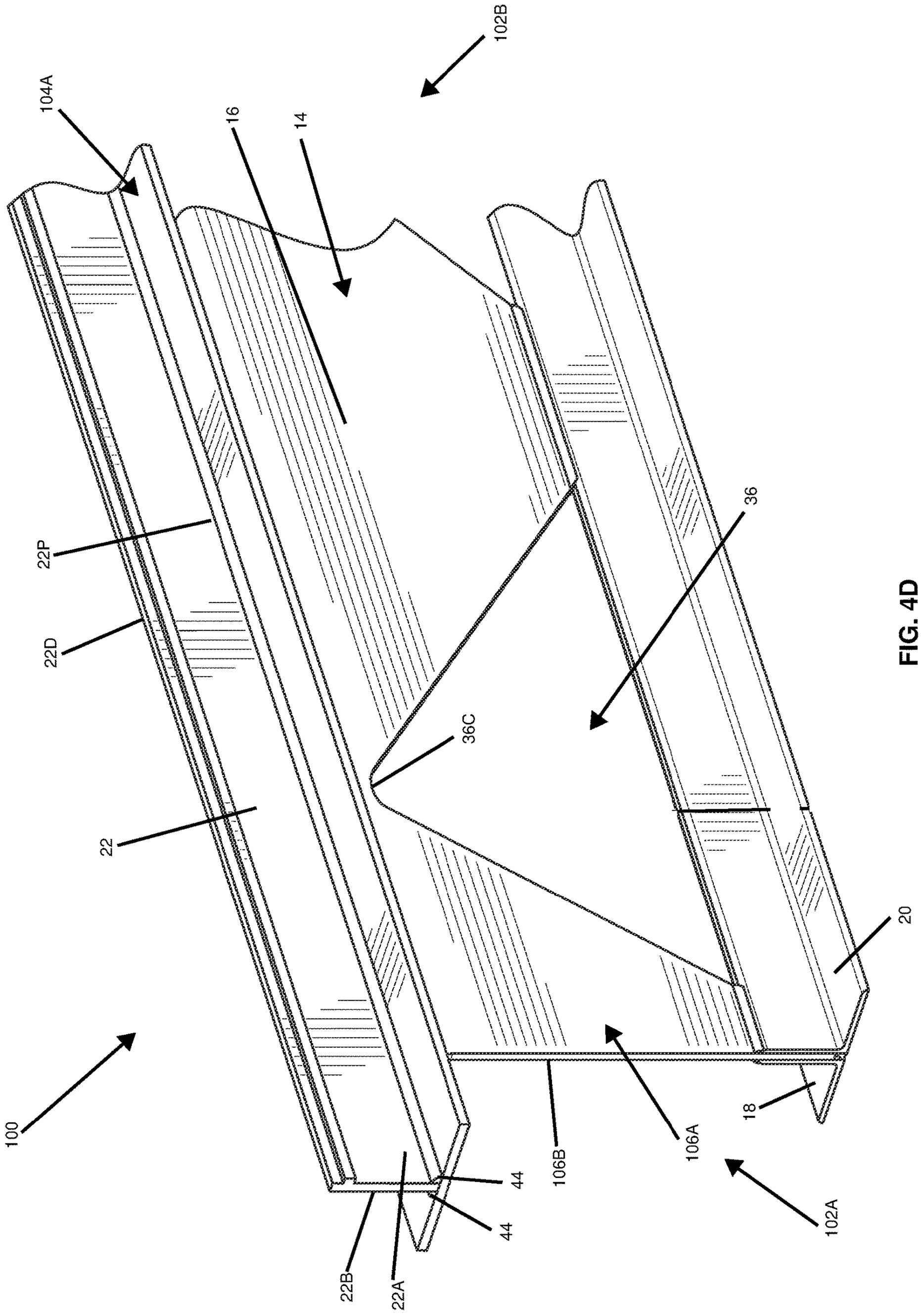
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FIG. 4D

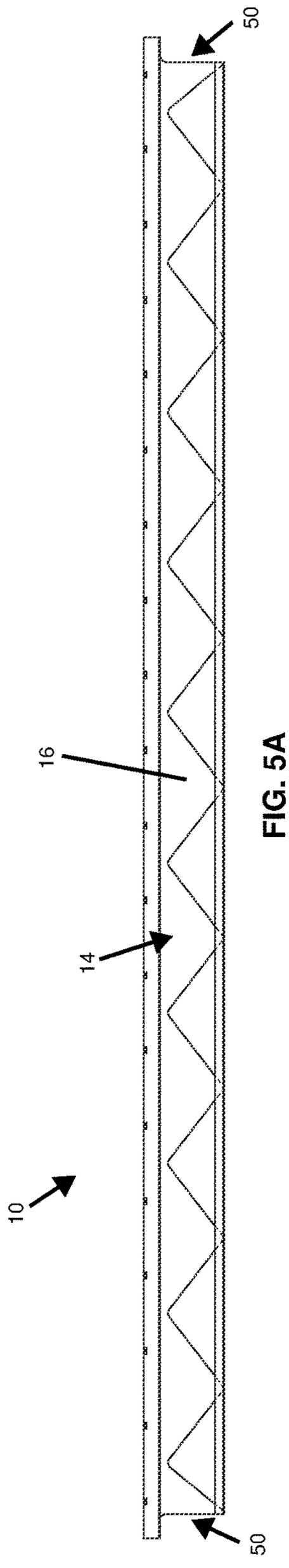


FIG. 5A

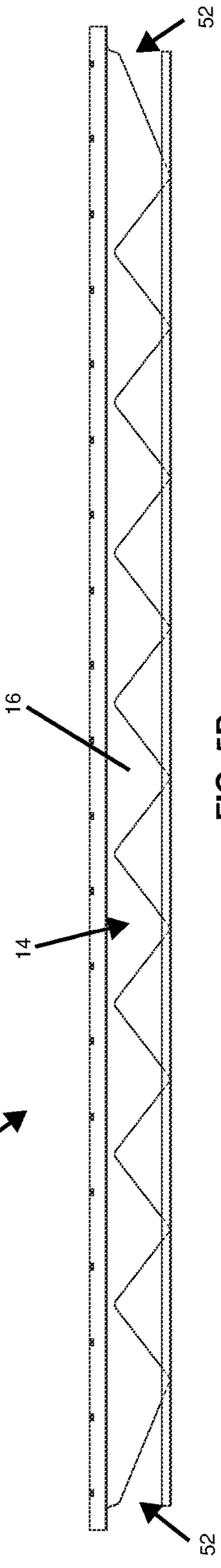
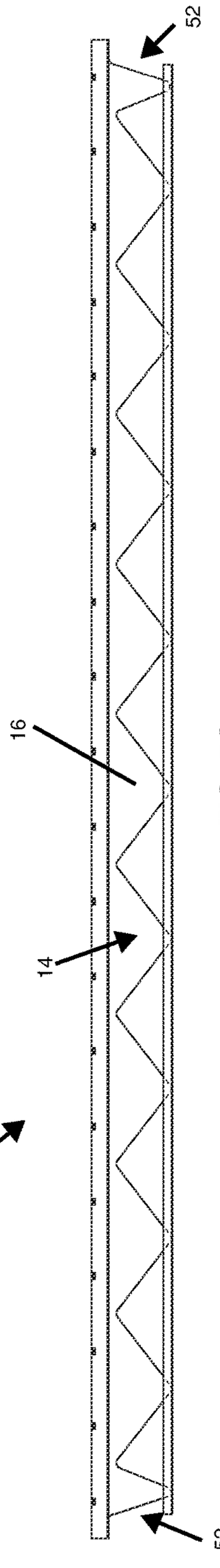


FIG. 5B



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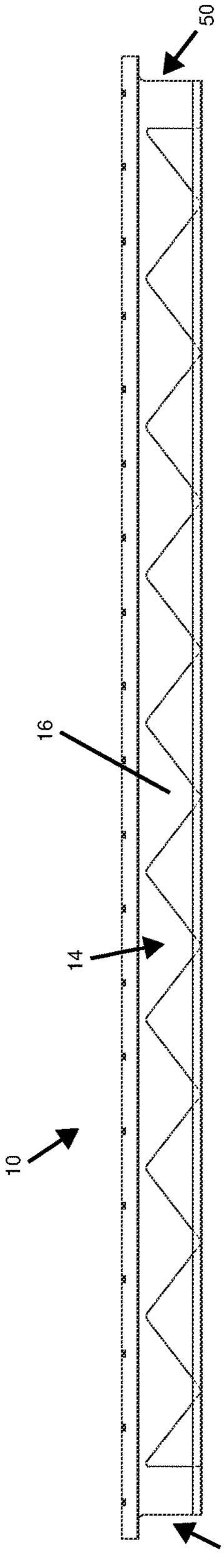


FIG. 5D

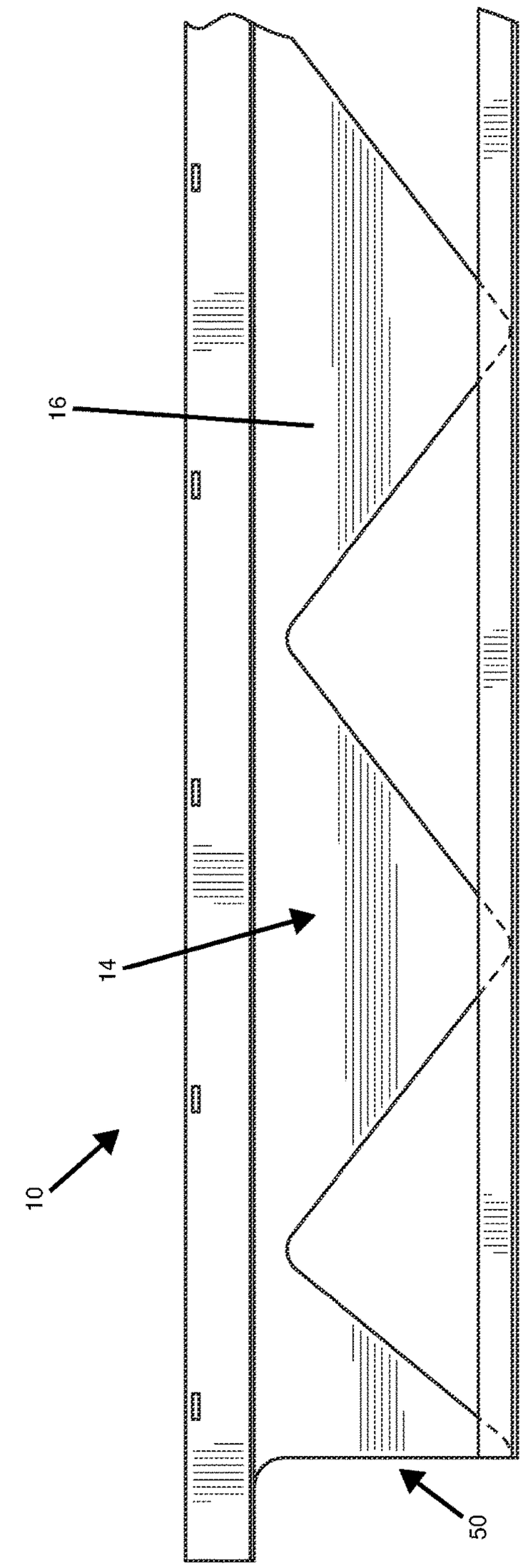
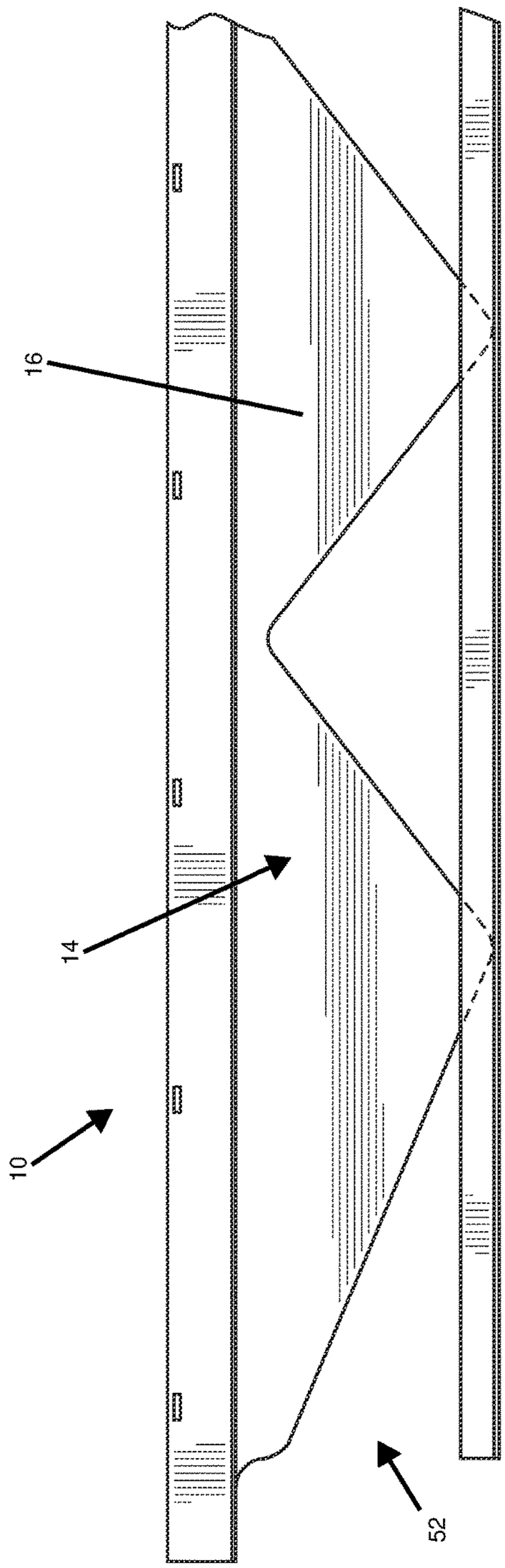


FIG. 6A



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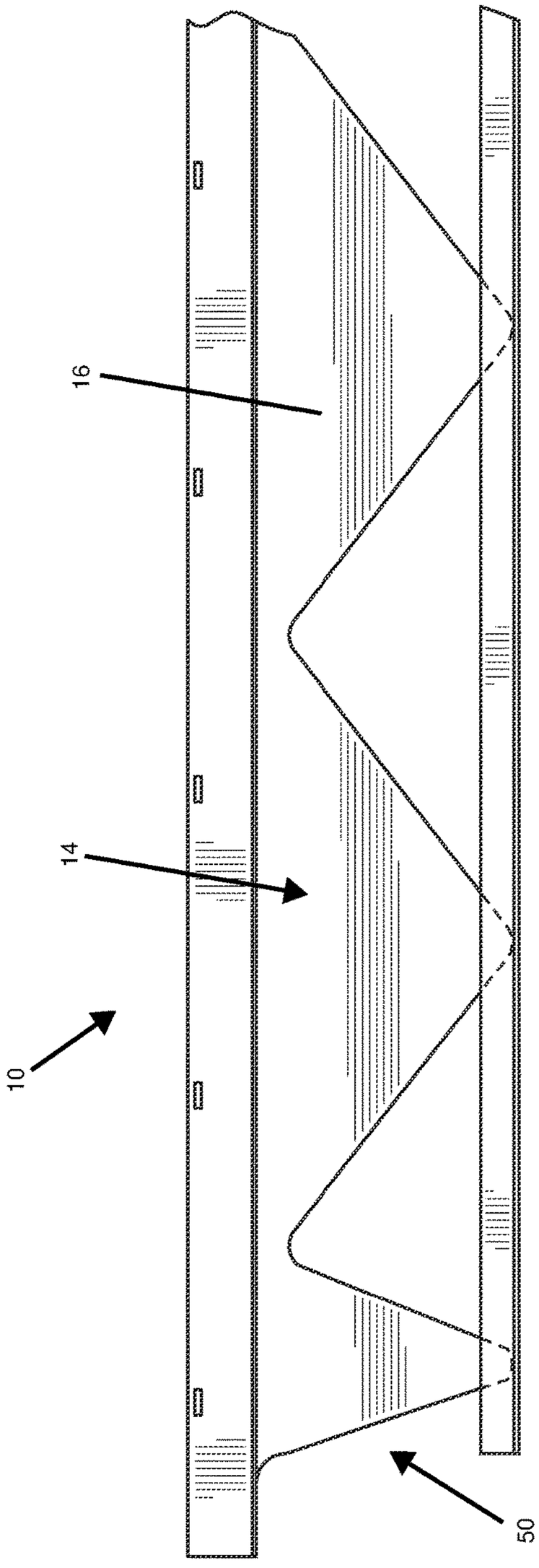

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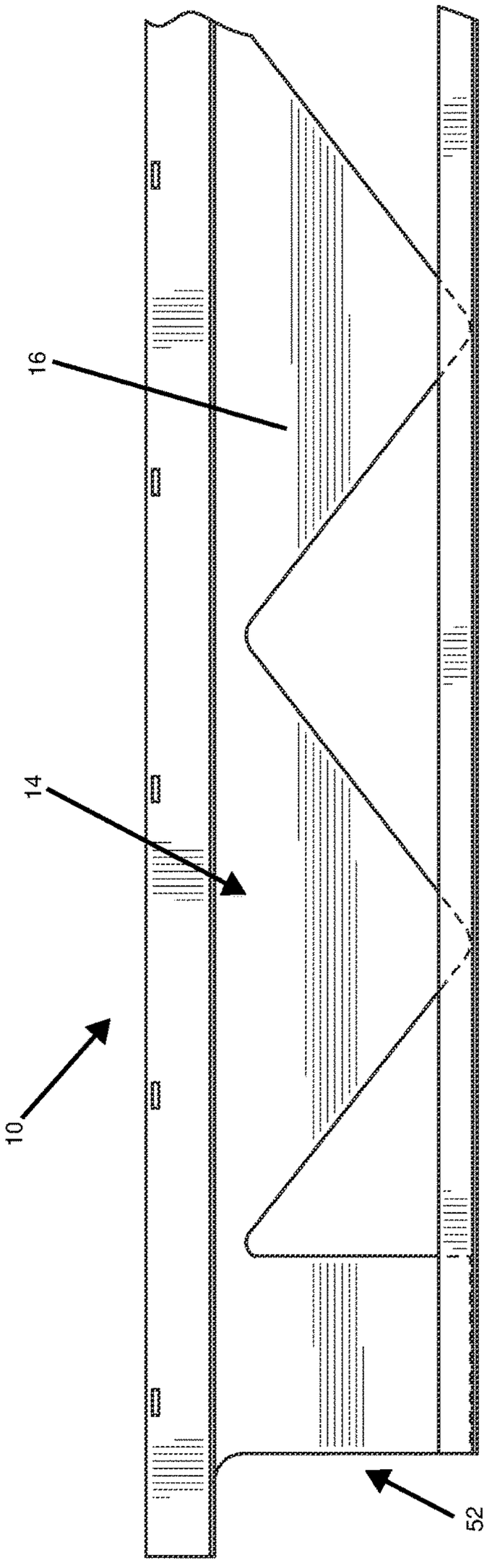

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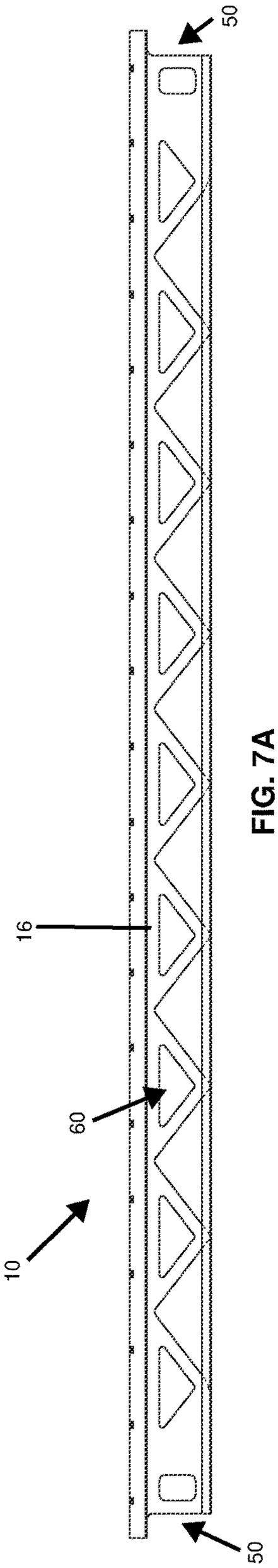
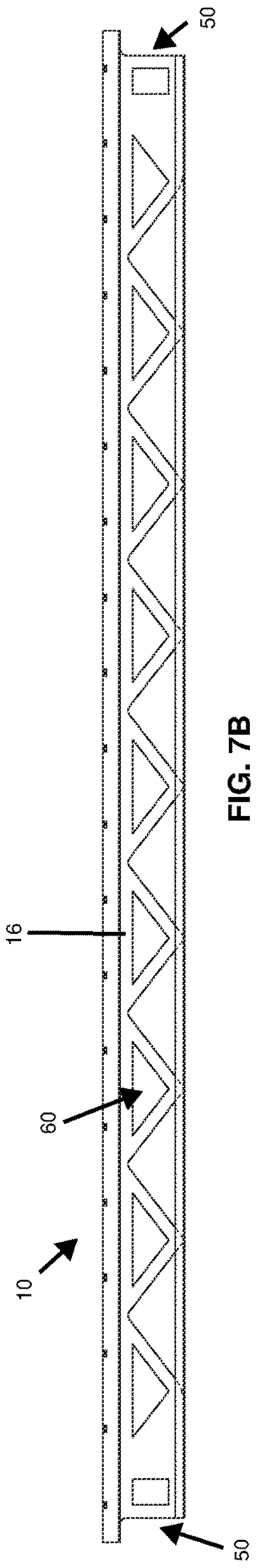


FIG. 7A



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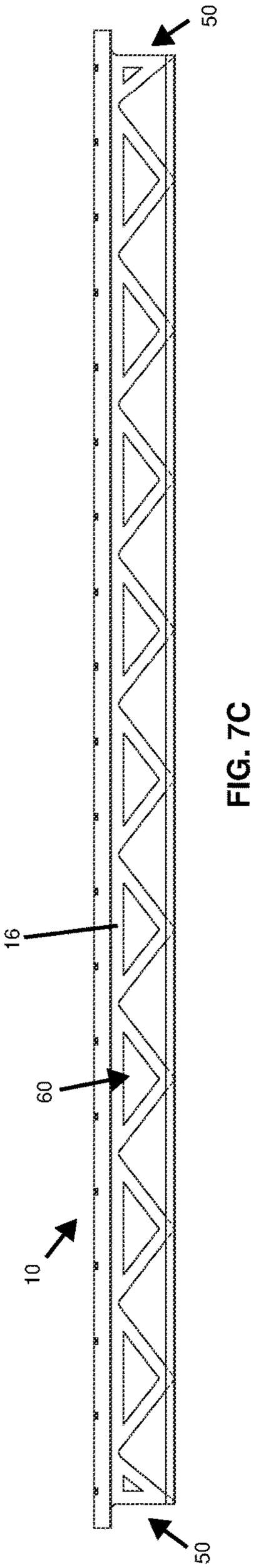

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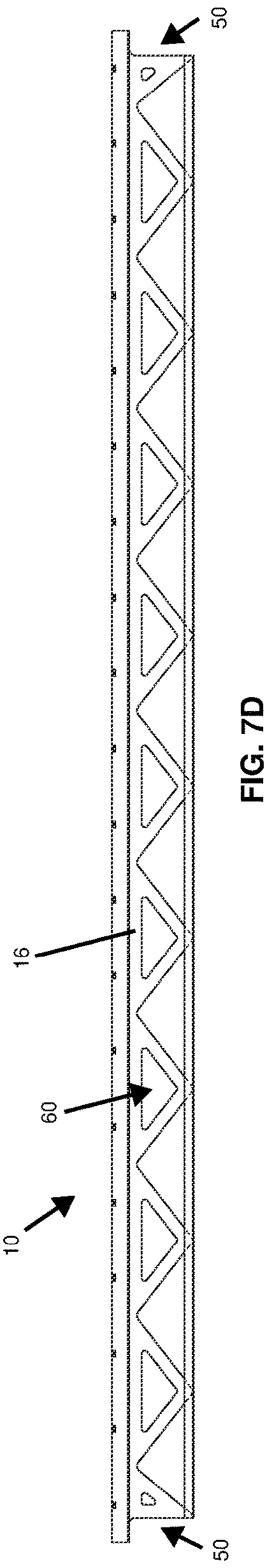

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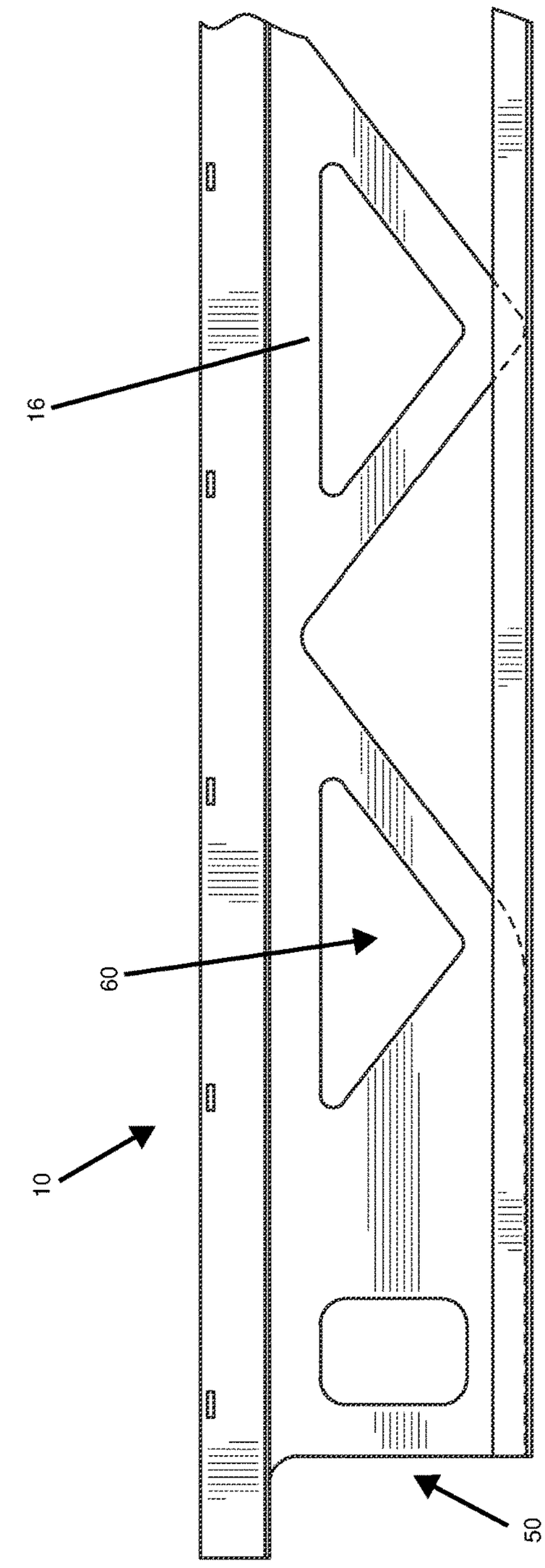
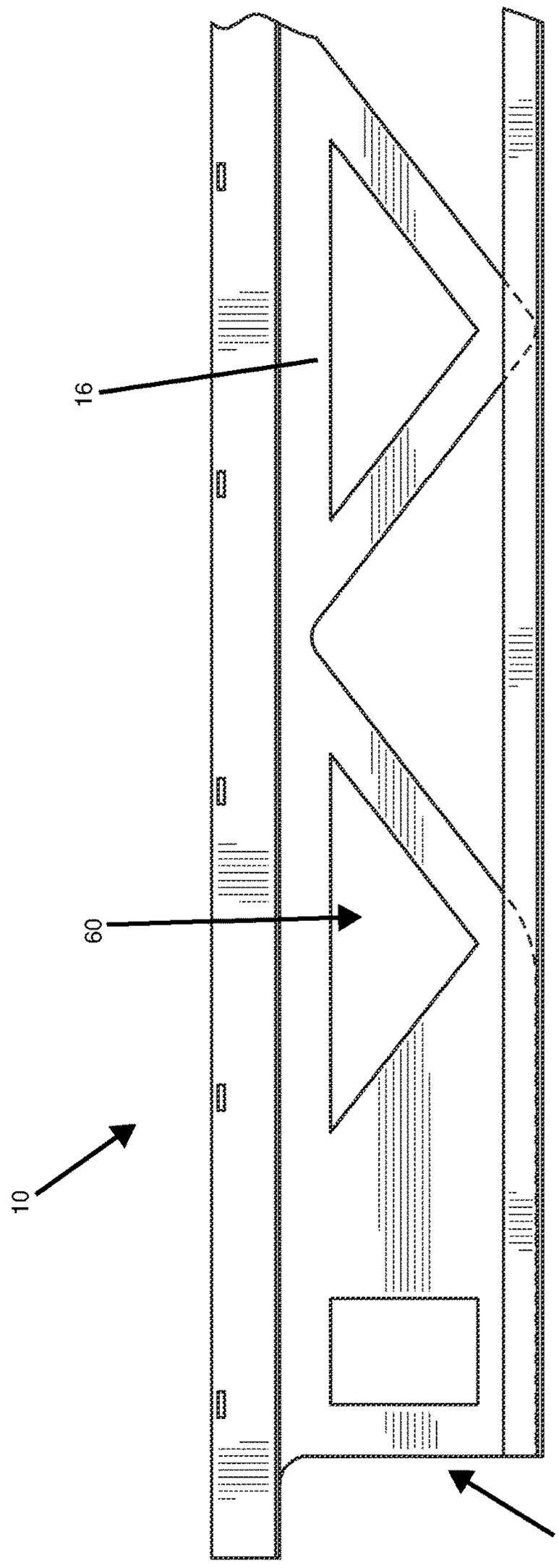


FIG. 8A



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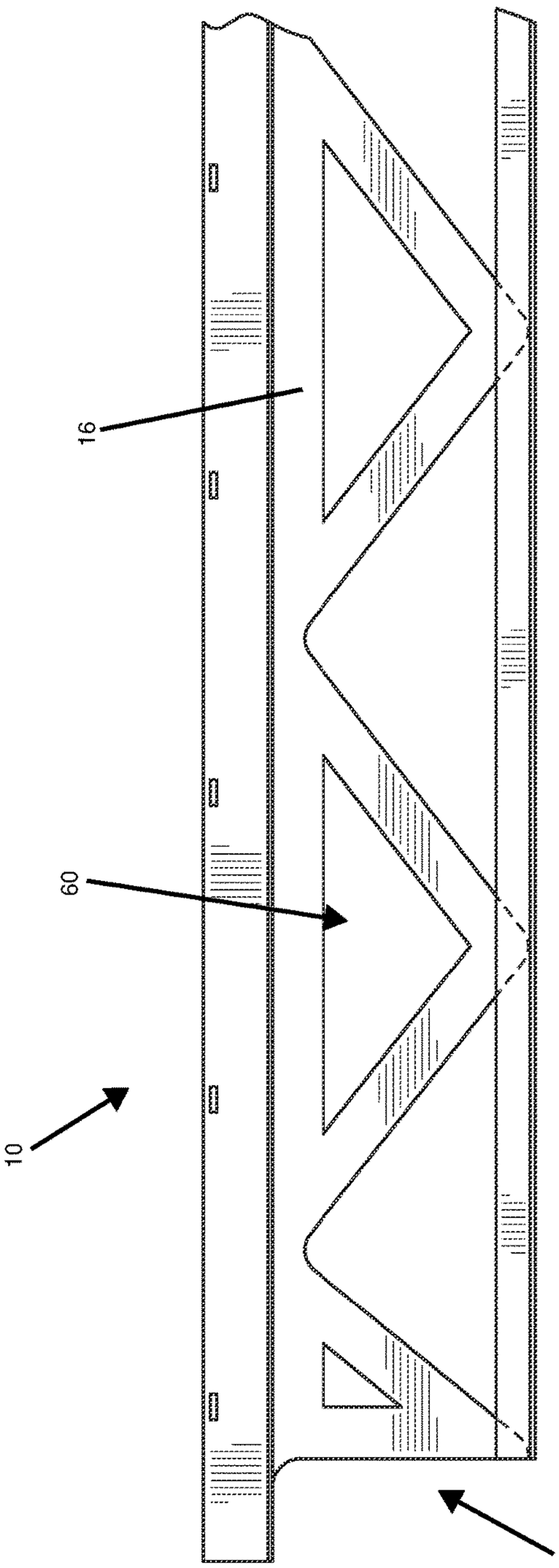

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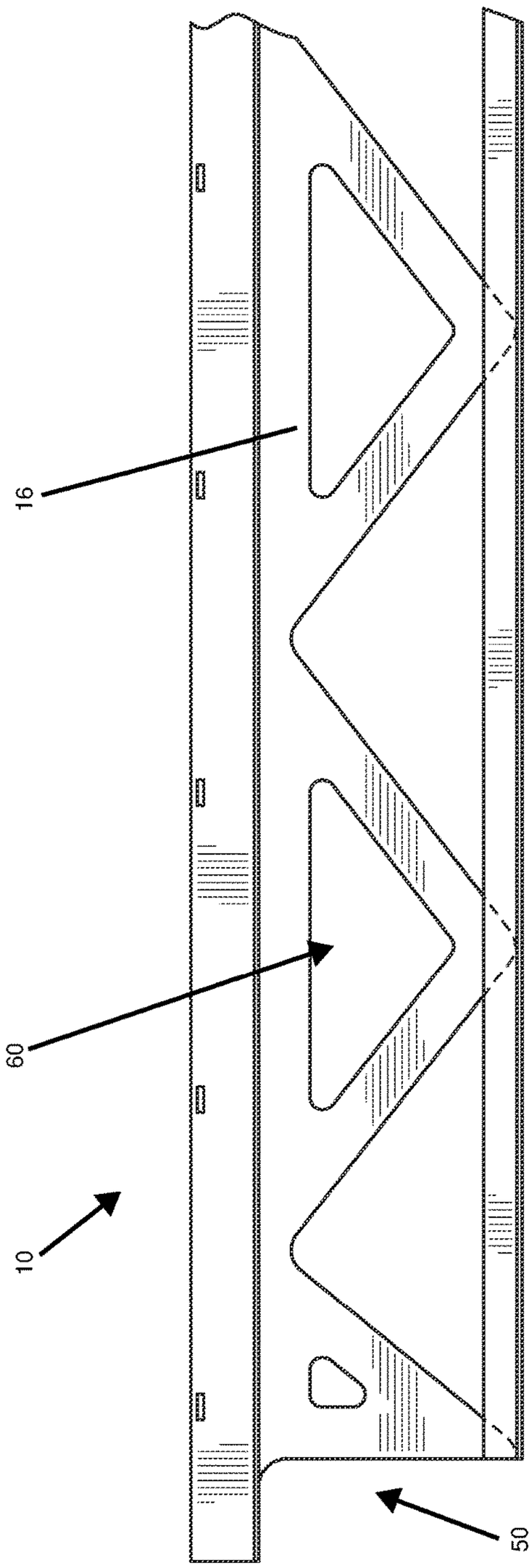

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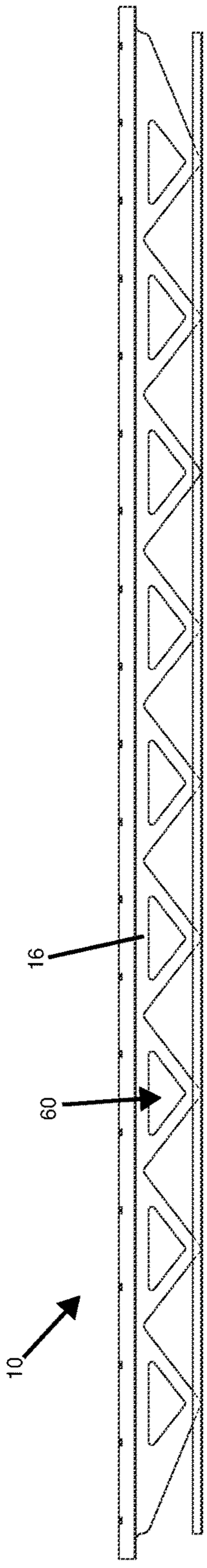
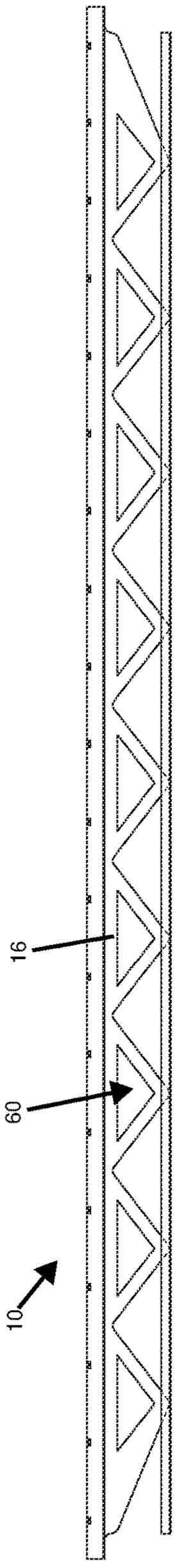


FIG. 9A



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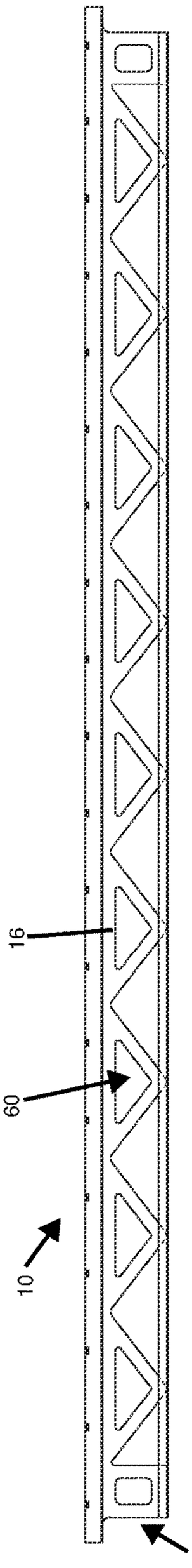

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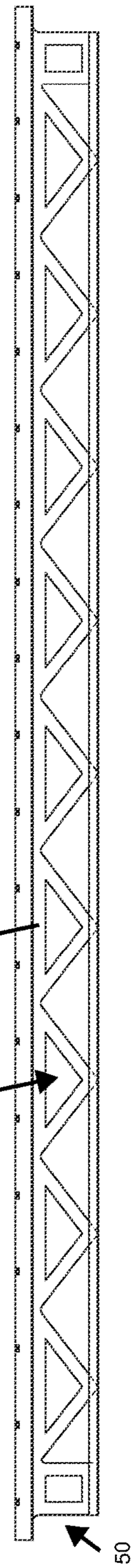


FIG. 9D

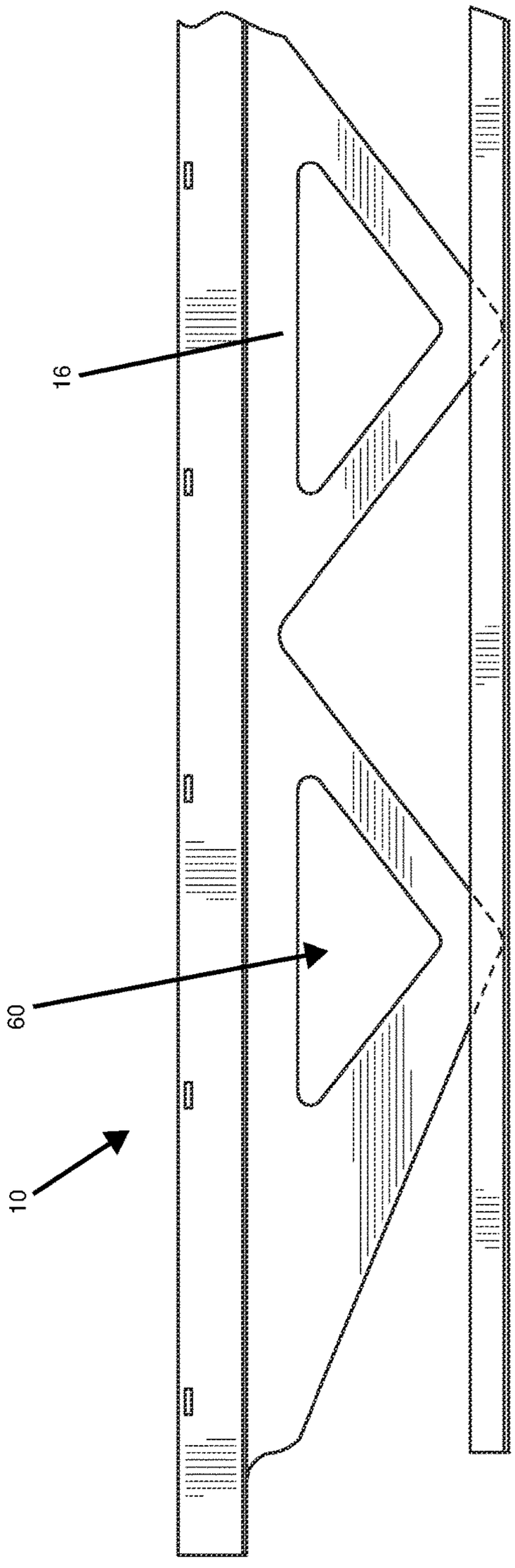
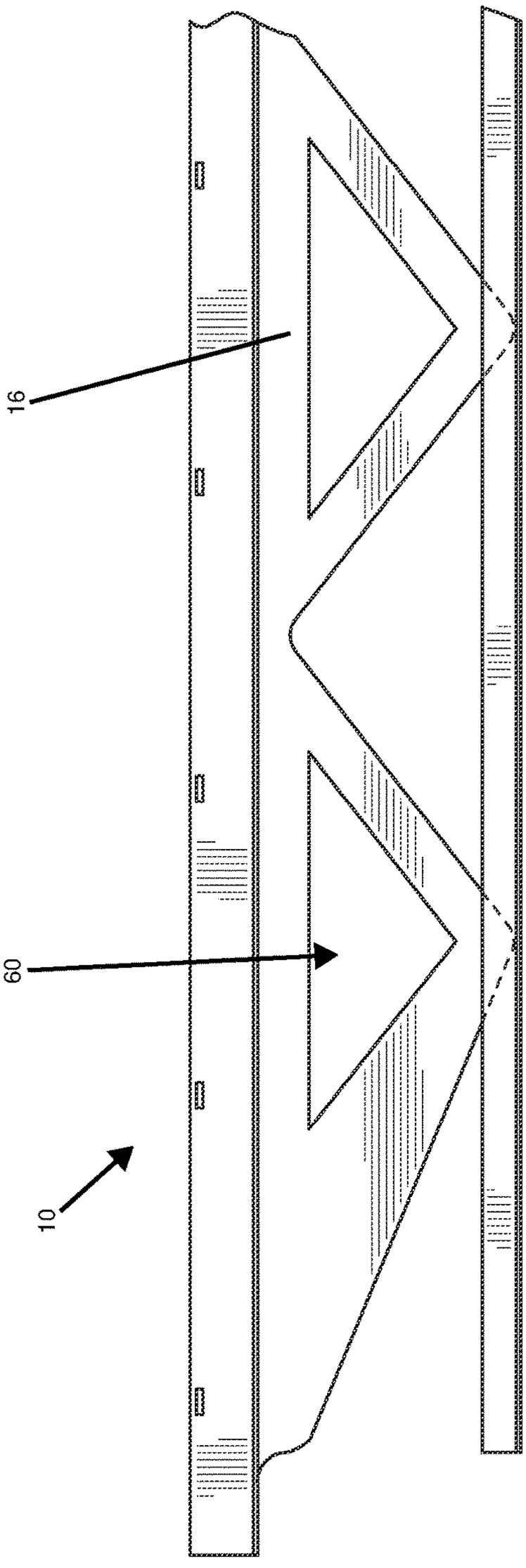


FIG. 10A



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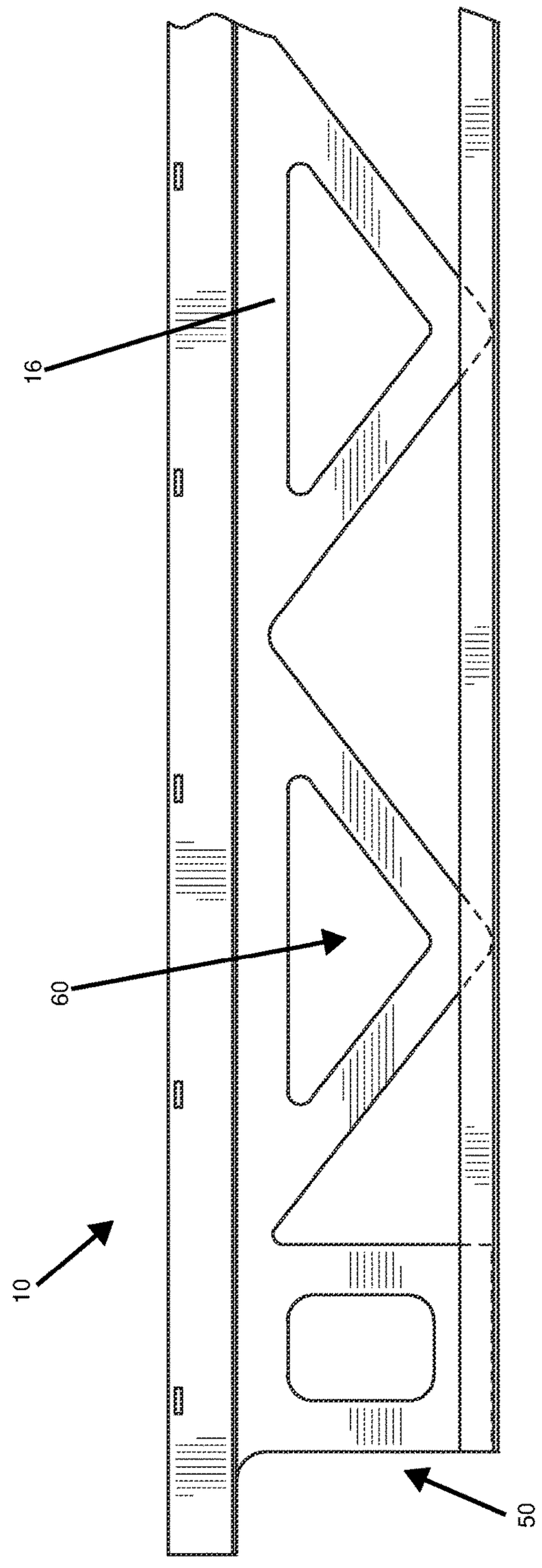

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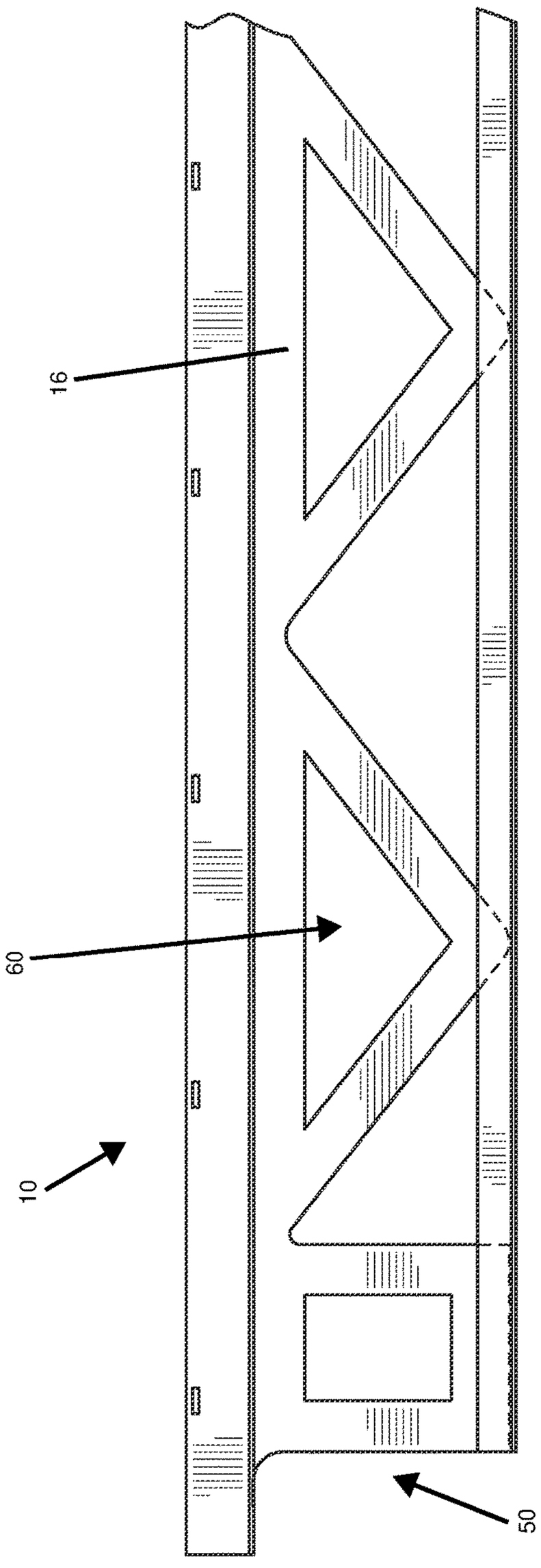

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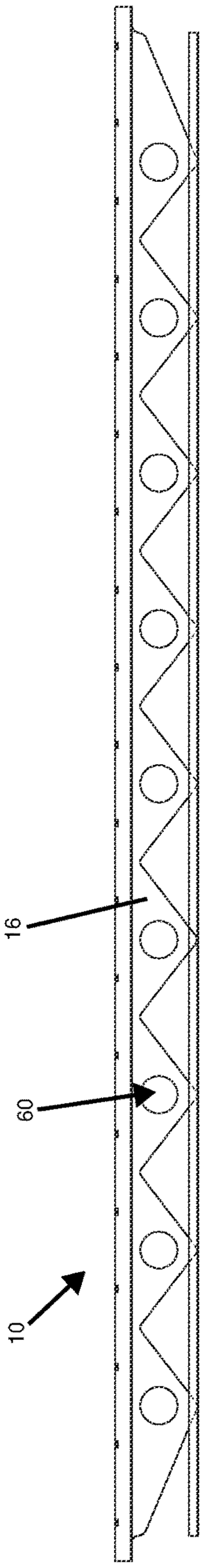
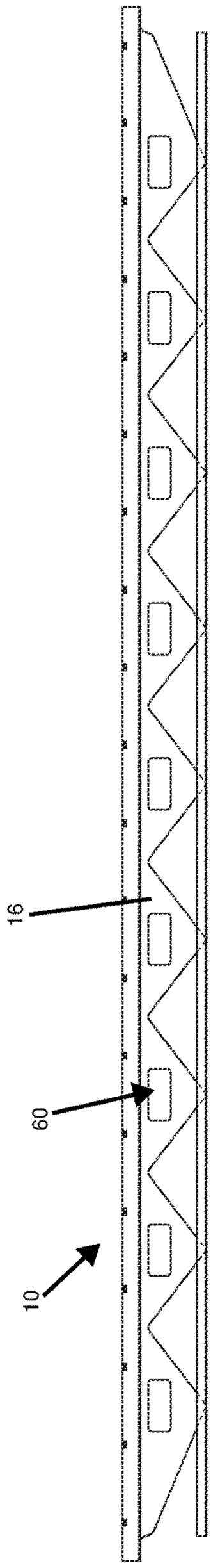


FIG. 11A



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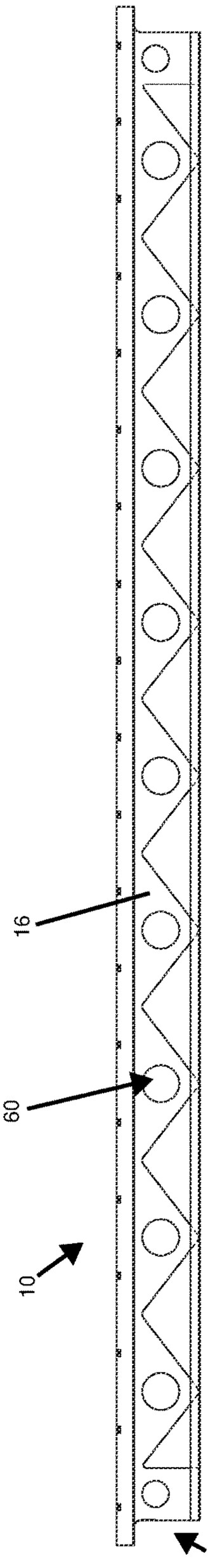

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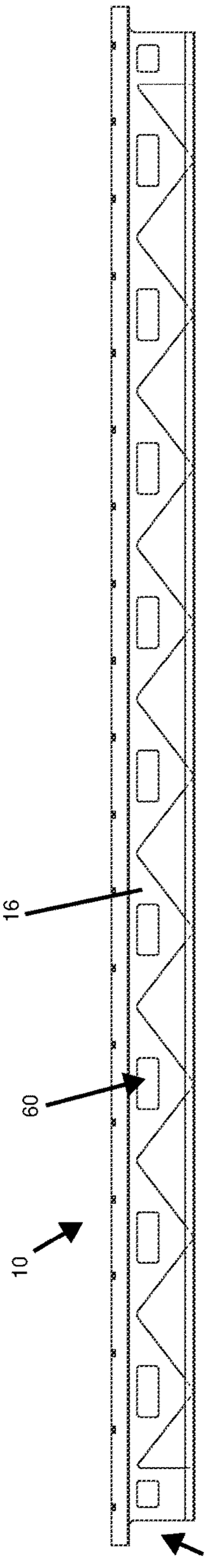

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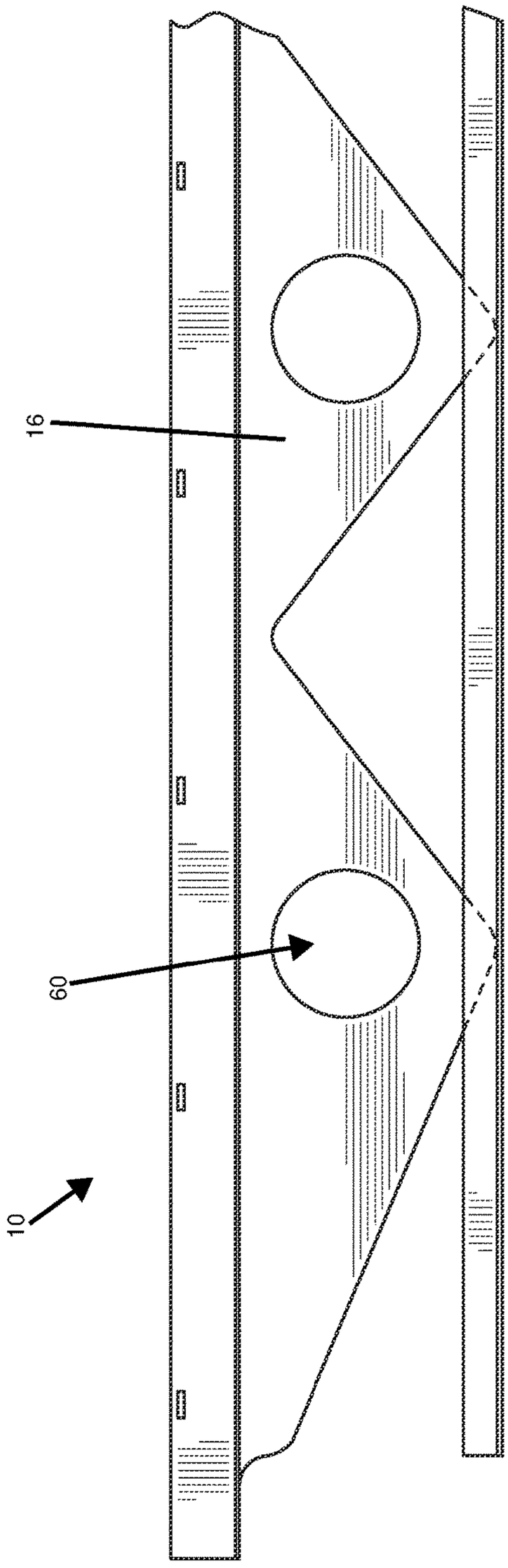
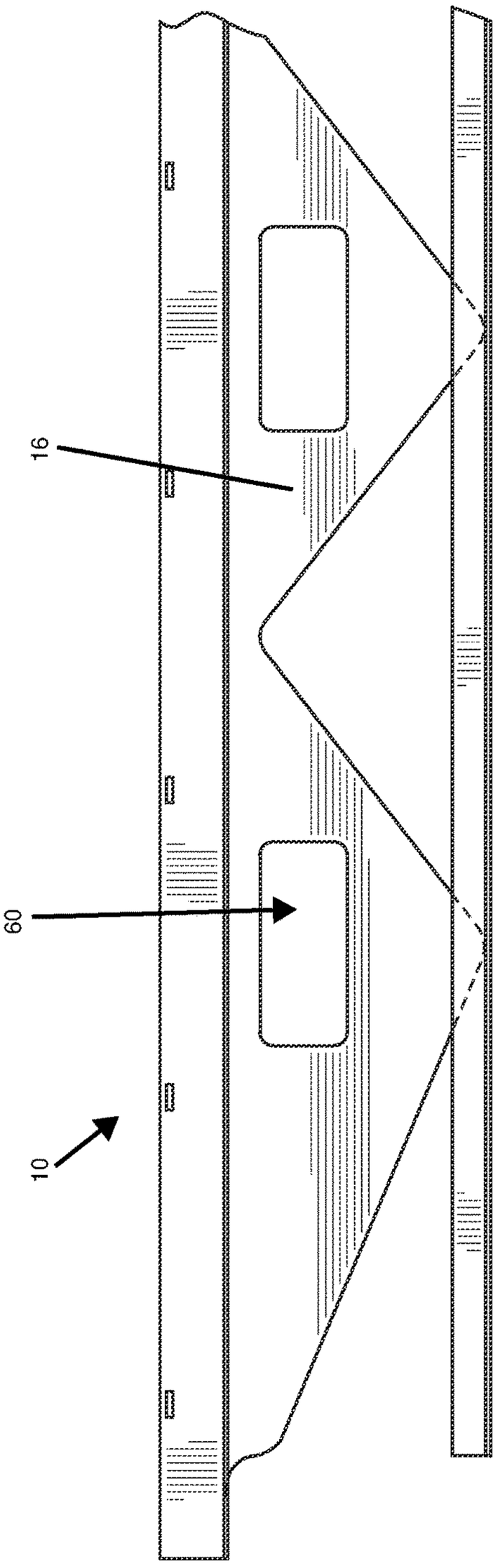


FIG. 12A



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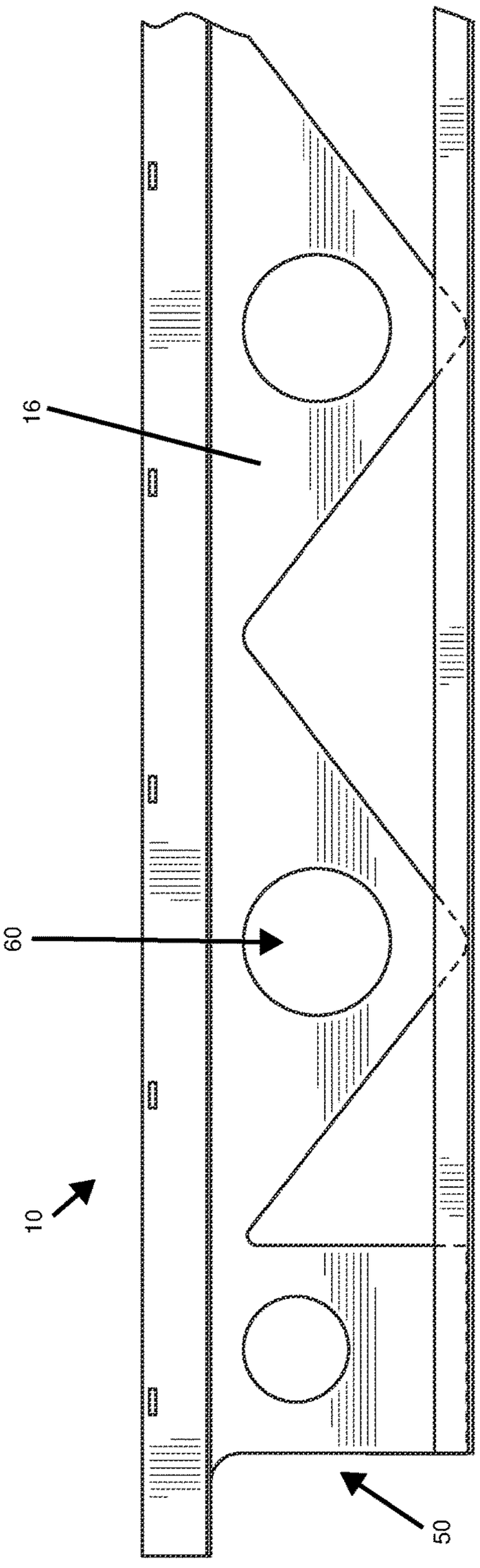

FIG. 12C

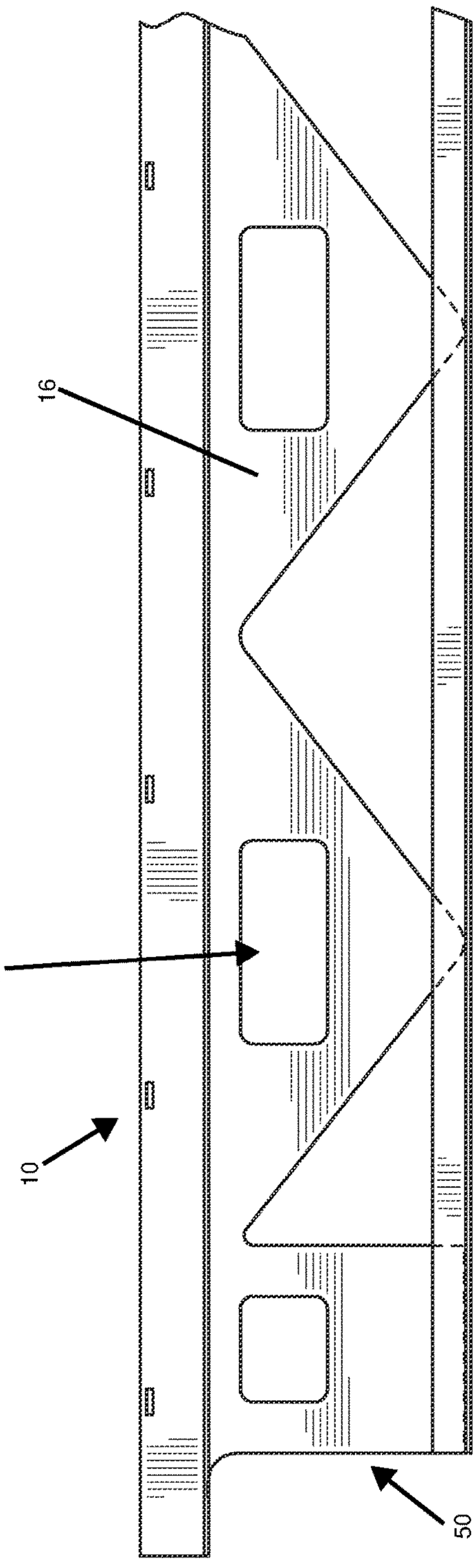

FIG. 12D

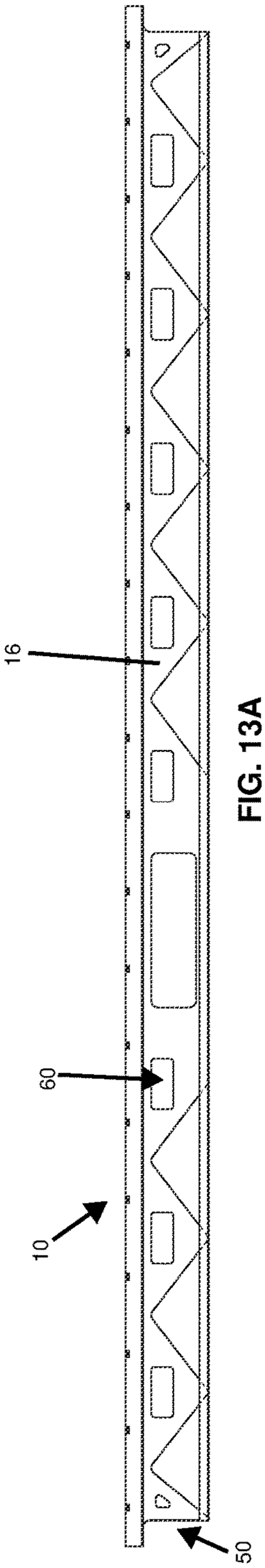

FIG. 13A

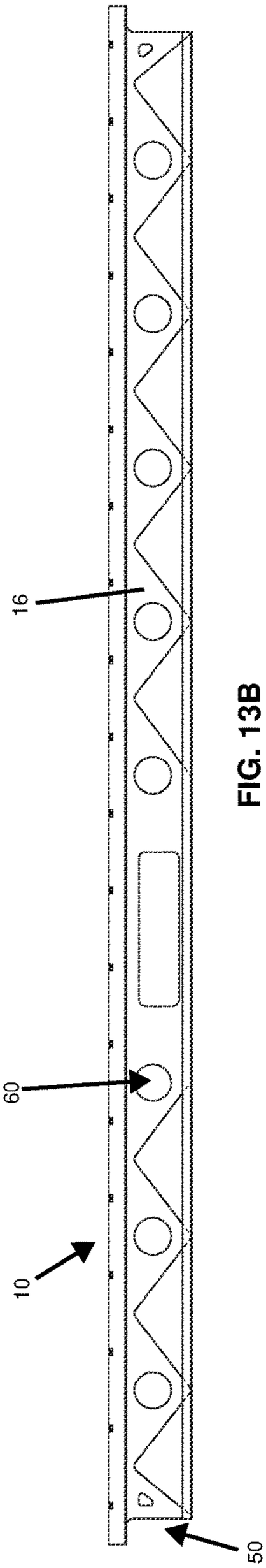

FIG. 13B

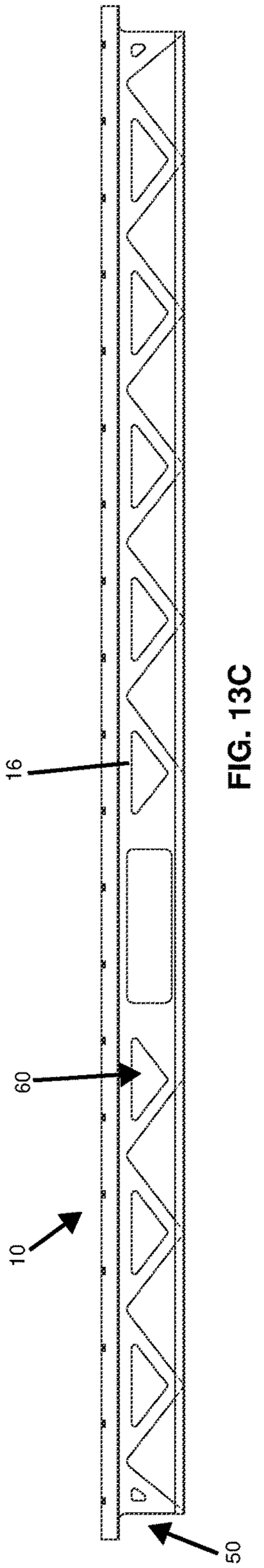

FIG. 13C

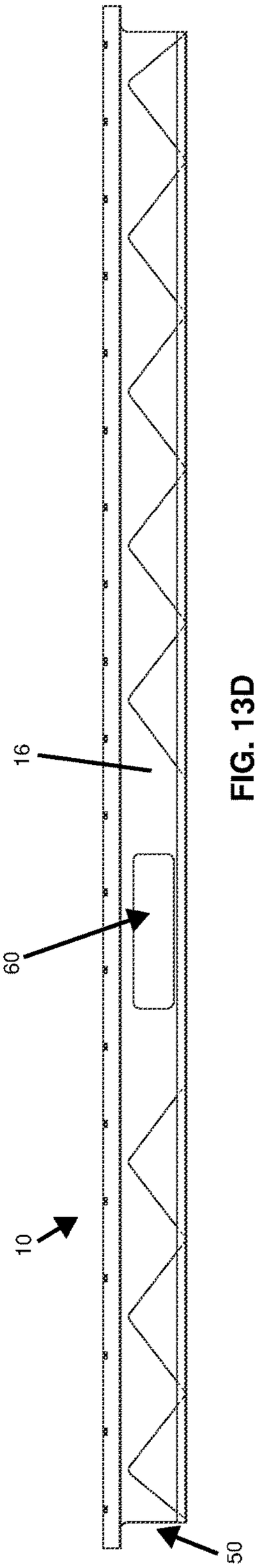

FIG. 13D

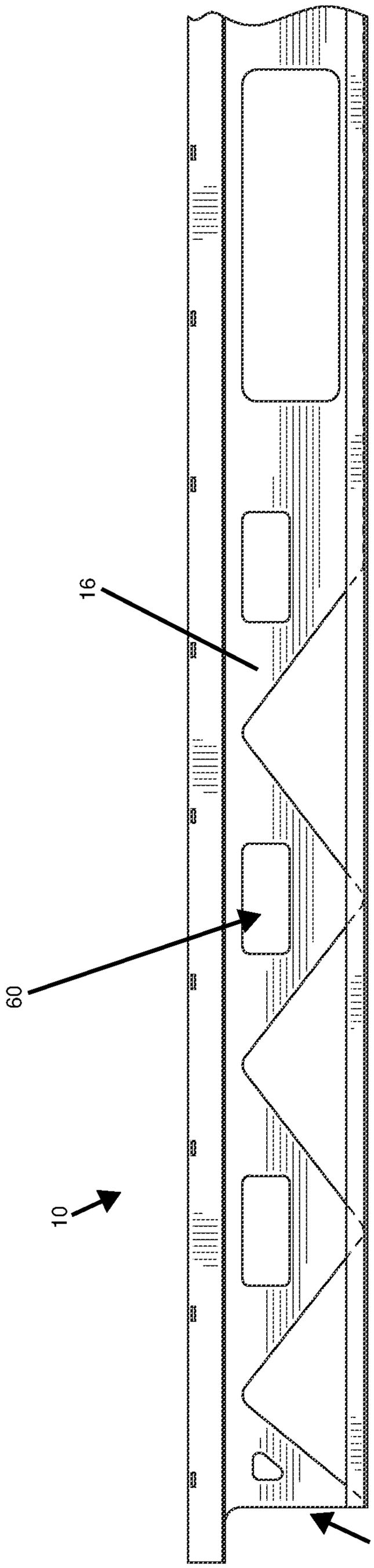

FIG. 14A

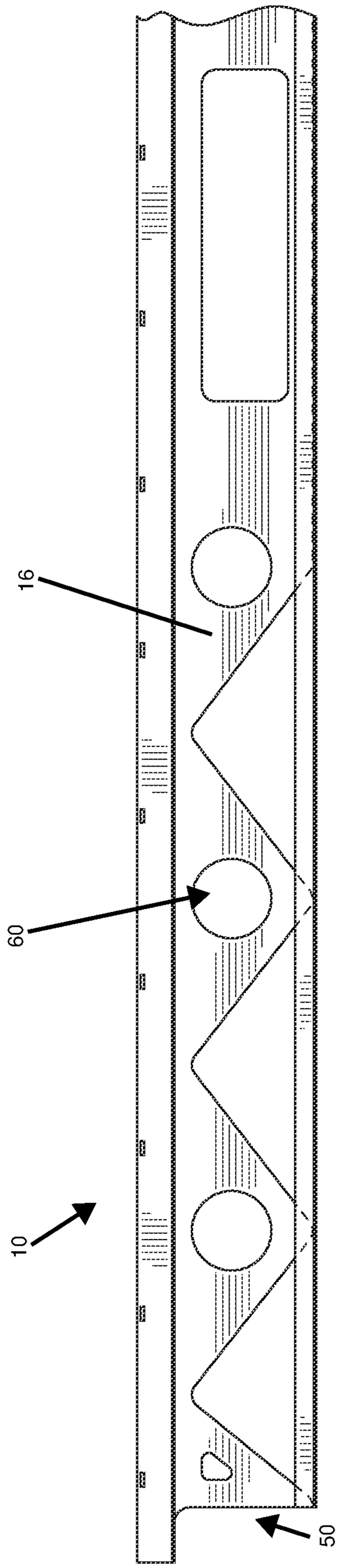

FIG. 14B

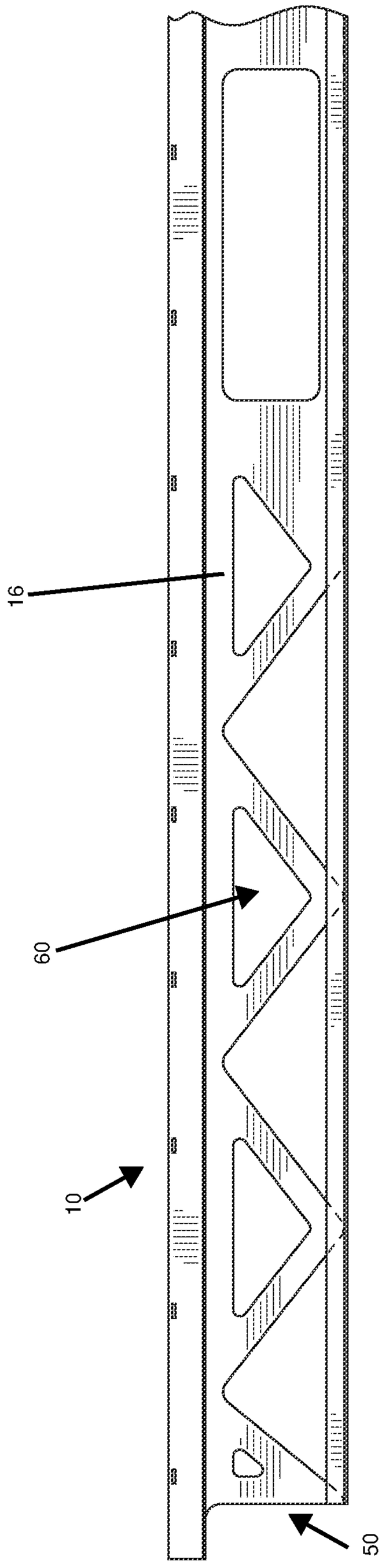

FIG. 14C

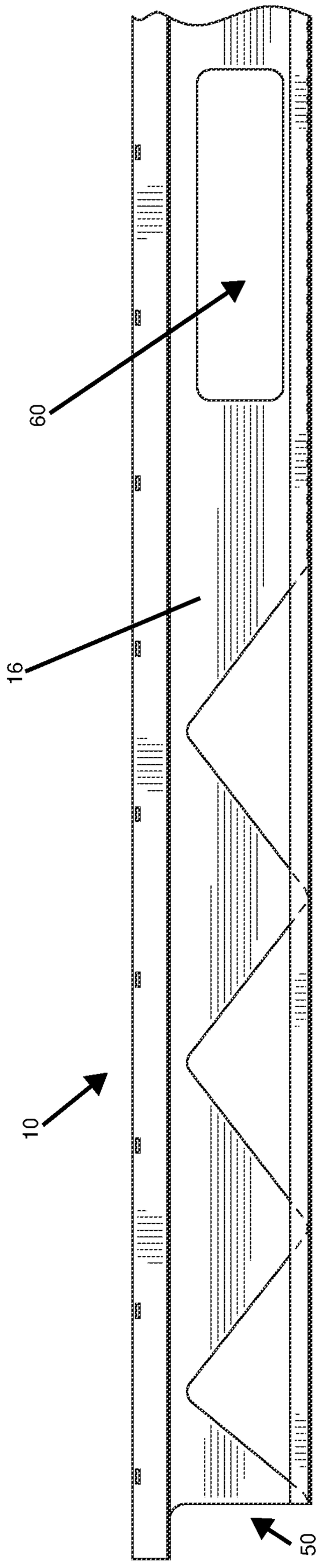

FIG. 14D

COMPOSITE OPEN WEB BEAM-JOIST AND METHOD OF MANUFACTURE

FIELD OF THE DISCLOSED TECHNOLOGY

The disclosed technology relates generally to joists. More specifically, the disclosed technology relates to a composite open web beam joist and a method of making the same.

BACKGROUND OF THE DISCLOSED TECHNOLOGY

Currently most commercial buildings and some apartment complexes are constructed making use of steel supported concrete floors and roofs. Traditional methods employ steel joists, usually being placed parallel to one another, being secured at each of their ends to structural building members such as steel or concrete beams or girders. Each joist end rests on these members, the beams generally running perpendicular to the placement of the joists. The steel joist themselves are usually of the open-web design, each one consisting of a zigzag shaped rod connecting a joist top chord and a bottom chord which run a spaced distance apart and parallel to one another. Both the top and bottom chords are comprised of opposed angle iron members affixed together by means of the apices of the connecting rod. The bearing end of each joist is further comprised of a pair of flange-connected seat angles extending laterally from each opposed angle iron to form a pair of U-shaped channels at each joist bearing end. Corrugated metal decking is then placed on top of the joists, and finally concrete is poured over the corrugated decking and the joist ends and top surface of the beams or girders.

It would therefore be desirable to provide a superior beam-joist structure for use in construction of large buildings and simplified and economical methods of manufacture for this beam-joist structure.

SUMMARY OF DISCLOSED TECHNOLOGY

The disclosed technology provides a composite open web beam joist including a beam-joist including a first end, a second end opposite the first end, a top end having a flange, a bottom end opposite the top end, a first side, a second side opposite the first side, and an open web layout extending between the first end and second end, the open web layout including a plurality of triangular web sections extending between the top end and the bottom end and an opening between the triangular web sections, each triangular web section including a base disposed at the top end and a peak disposed at the bottom end, a first chord angle beam attached to the first side of the cambered beam-joist at the peaks of the triangular web sections, and a second chord angle beam attached to the second side of the cambered beam-joist at the peaks of the triangular web sections.

In embodiments, the composite open web beam joist further includes a vertical plate attached to a center of the top end of the cambered beam-joist, the plate extending longitudinally along the top end of the cambered beam-joist between the first end and the second end of the cambered beam-joist portion, the plate including a first side, a second side opposite the first side, a distal end, and a proximal end opposite the distal end, the first side including a flange at the distal end, the second side including a recess at the distal end.

In some embodiments, the plate is attached to the center of the top end of the cambered beam joist with substantially 12-inch-long continuous welds on the first side of the plate and the second side of the plate at a juncture where the proximal end of the plate meets the top end of the cambered beam joist portion, the 12-inch-long continuous welds disposed at the first end and the second end of the cambered beam-joist portion.

In other embodiments, the plate further includes substantially 2-inch-long continuous welds on the first side of the plate and the second side of the plate at the juncture where the proximal end of the plate meets the top end of the cambered beam joist portion to further weld the plate to the center of the top end of the cambered beam-joist portion, the 2-inch-long continuous welds staggered 12 inches apart on the first side and the second side of the plate.

In some embodiments, the 12-inch-long continuous welds and the 2-inch-long continuous welds comprise a thickness of 3⁄16 inches.

In embodiments, the first chord angle beam is equidistant from a center of all the triangular web sections, the second chord angle beam mirrors the first chord angle beam and is equidistant from a center of all the triangular web sections, and the first chord angle beam and the second chord angle beam are attached to each other in parallel.

In some embodiments, the first chord angle beam is welded to the first side of the cambered beam-joist portion at the peaks of the triangular web sections, the second chord angle beam is welded to the second side of the cambered beam-joist portion at the peaks of the triangular web sections.

In certain embodiments, the beam-joist is cambered along a vertical plane of the beam-joist.

In other embodiments, the openings of the open web layout each include a center that is substantially 24 inches from a center of an adjacent opening.

The disclosed technology also provides a method of manufacturing a composite open web beam joist from a beam having a closed uniform web layout including cutting the beam longitudinally along the closed uniform web layout to form a beam joist portion including a first end, a second end opposite the first end, a top end, a bottom end opposite the top end, a first side, a second side opposite the first side, and an open web layout extending between the first end and the second end, the open web layout including a plurality of triangular web sections extending between the top end and the bottom end and an opening between the triangular web sections, each of the triangular web sections including a base disposed at the top end and a peak disposed at the bottom end, cambering the beam-joist portion to bend the beam-joist portion along a vertical plane thereof to form a cambered beam-joist portion, attaching a first chord angle beam to the first side of the cambered beam joist portion at the peaks of the triangular web sections, attaching a second chord angle beam to the second side of the cambered beam-joist portion at the peaks of the triangular web sections, and attaching a plate vertically to the top end of the cambered beam-joist portion such that the plate extends longitudinally along the top end of the cambered beam-joist portion between the first end and the second end of the cambered beam-joist portion, the plate including a first side, a second side opposite the first side, a distal end, and a proximal end opposite the distal end, the first side including a flange at the distal end, the second side including a recess at the distal end.

In some embodiments, the method further includes attaching the first chord angle beam and the second chord angle beam to each other.

In other embodiments, the method further includes securing the beam on a table prior to cutting the beam to ensure stability of the beam while cutting.

In certain embodiments, the beam is cut such that the openings of the open web layout each include a center that is substantially 24 inches from a center of an adjacent opening.

In embodiments, the first chord angle beam is attached to the first side of the cambered beam-joist portion at the peaks of the triangular web sections such that the first chord angle beam is equidistant from a center of all the triangular web sections and the second chord angle beam is attached to the second side of the cambered beam joist portion at the peaks of the triangular web sections such that the second chord angle beam mirrors the first chord angle beam and is equidistant from a center of all the triangular web sections.

In some embodiments, the first chord angle beam is attached to the first side of the cambered beam-joist portion at the peaks of the triangular web sections via welding and the second chord angle beam is attached to the second side of the cambered beam-joist portion at the peaks of the triangular web sections via a welding.

In embodiments, the plate is vertically attached to a center of the top end of the cambered beam-joist portion via welding.

In some embodiments, the plate is welded by welding substantially 12-inch-long continuous welds on the first side of the plate and the second side of the plate at a juncture where the proximal end of the plate meets the top end of the cambered beam-joist portion.

In certain embodiments, the substantially 12-inch-long continuous welds are made at the first end and the second end of the cambered beam-joist portion.

In some embodiments, the plate is further welded to the center of the top end of the cambered beam-joist portion by welding substantially 2-inch-long continuous welds on the first side of the plate and the second side of the plate at the juncture where the proximal end of the plate meets the top end of the cambered beam-joist portion, and the 2-inch-long continuous welds are staggered 12 inches apart on the first side and the second side of the plate, wherein each of the 12-inch-long continuous welds and the 2-inch-long continuous welds comprise a thickness of 3/16 inches.

"Triangular web sections" or "triangular", in this application is defined as having two oppositely disposed sides which meet at any of a pointed vertex, flat side being acute to each oppositely disposed side, or which meet at an ovoid end."

"Composite" refers to "being made up of various parts, components, or elements. and creates a bond and becomes one." "Web" refers to "the vertical portion of a beam that takes on shear force." "Camber" or "Cambering" refers to "bending or curving sections of metal." "Chords" or "chord angle beams" refers to "the structural reinforcement legs or a framework of a composite beam-joist."

Any device or step to a method described in this disclosure can comprise or consist of that which it is a part of, or the parts which make up the device or step. The term "and/or" is inclusive of the items which it joins linguistically and each item by itself. "Substantially" is defined as "at least 95% of the term being described" and any device or aspect of a device or method described herein can be read as "comprising" or "consisting" thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A shows a front perspective view of the composite open web beam-joist according to one embodiment of the present disclosed technology.

FIG. **1**B shows a rear perspective view of the composite open web beam-joist according to one embodiment of the present disclosed technology.

FIG. **2**A shows front perspective view of a portion of the composite open web beam joist according to one embodiment of the present disclosed technology.

FIG. **2**B shows a rear perspective view of a portion of the composite open web beam-joist according to one embodiment of the present disclosed technology.

FIG. **3** shows a cross-sectional view of the composite open web beam-joist according to one embodiment of the present disclosed technology.

FIG. **4**A shows a close-up view of a portion of the composite open web beam-joist, illustrating the beam-joist portion formed after cutting the beam according to one embodiment of the present disclosed technology.

FIG. **4**B a close-up view of a portion of the composite open web beam-joist, illustrating the cambered beam-joist portion formed after attaching the first chord angle beam to the first side of the cambered beam-joist portion according to one embodiment of the present disclosed technology.

FIG. **4**C a close-up view of a portion of the composite open web beam-joist, illustrating the cambered beam-joist portion formed attaching the second chord angle beam to the second side of the cambered beam-joist portion according to one embodiment of the present disclosed technology.

FIG. **4**D a close-up view of a portion of the composite open web beam-joist, illustrating the composite open web beam-joist formed after attaching the plate vertically to the top end of the cambered beam-joist portion according to one embodiment of the present disclosed technology.

FIG. **5**A shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to one embodiment of the present disclosed technology.

FIG. **5**B shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to another embodiment of the present disclosed technology.

FIG. **5**C shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to yet another embodiment of the present disclosed technology.

FIG. **5**D shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to an alternative embodiment of the present disclosed technology.

FIG. **6**A shows a close-up view of the composite open web beam-joist of FIG. **5**A according to one embodiment of the present disclosed technology.

FIG. **6**B shows a close-up view of the composite open web beam-joist of FIG. **5**B according to one embodiment of the present disclosed technology.

FIG. **6**C shows a close-up view of the composite open web beam-joist of FIG. **5**C according to one embodiment of the present disclosed technology.

FIG. **6**D shows a close-up view of the composite open web beam-joist of FIG. **5**D according to one embodiment of the present disclosed technology.

FIG. **7**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology.

FIG. **7**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology.

FIG. **7**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology.

FIG. **7**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology.

FIG. **8**A shows a close-up view of the composite open web beam-joist of FIG. **7**A according to one embodiment of the present disclosed technology.

FIG. **8**B shows a close-up view of the composite open web beam-joist of FIG. **7**B according to one embodiment of the present disclosed technology.

FIG. **8**C shows a close-up view of the composite open web beam-joist of FIG. **7**C according to one embodiment of the present disclosed technology.

FIG. **8**D shows a close-up view of the composite open web beam-joist of FIG. **7**D according to one embodiment of the present disclosed technology.

FIG. **9**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology.

FIG. **9**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology.

FIG. **9**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology.

FIG. **9**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology.

FIG. **10**A shows a close-up view of the composite open web beam joist of FIG. **9**A according to one embodiment of the present disclosed technology.

FIG. **10**B shows a close-up view of the composite open web beam joist of FIG. **9**B according to one embodiment of the present disclosed technology.

FIG. **10**C shows a close-up view of the composite open web beam-joist of FIG. **9**C according to one embodiment of the present disclosed technology.

FIG. **10**D shows a close-up view of the composite open web beam-joist of FIG. **9**D according to one embodiment of the present disclosed technology.

FIG. **11**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology.

FIG. **11**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology.

FIG. **11**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology.

FIG. **11**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology.

FIG. **12**A shows a close-up view of the composite open web beam joist of FIG. **11**A according to one embodiment of the present disclosed technology.

FIG. **12**B shows a close-up view of the composite open web beam-joist of FIG. **11**B according to one embodiment of the present disclosed technology.

FIG. **12**C shows a close-up view of the composite open web beam-joist of FIG. **11**C according to one embodiment of the present disclosed technology.

FIG. **12**D shows a close-up view of the composite open web beam-joist of FIG. **11**D according to one embodiment of the present disclosed technology.

FIG. **13**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology.

FIG. **13**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology.

FIG. **13**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology.

FIG. **13**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology.

FIG. **14**A shows a close-up view of the composite open web beam joist of FIG. **13**A according to one embodiment of the present disclosed technology.

FIG. **14**B shows a close-up view of the composite open web beam-joist of FIG. **13**B according to one embodiment of the present disclosed technology.

FIG. **14**C shows a close-up view of the composite open web beam-joist of FIG. **13**C according to one embodiment of the present disclosed technology.

FIG. **14**D shows a close-up view of the composite open web beam joist of FIG. **13**D according to one embodiment of the present disclosed technology.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE DISCLOSED TECHNOLOGY

The present disclosed technology provides a composite open web beam-joist as well as a method of manufacturing the open web beam-joist from a beam having a closed uniform web layout. The composite open web beam-joist **10** comprises a cambered beam-joist portion **12** including an open web layout **14** including a plurality of triangular web sections **16**, a first chord angle beam **18** attached the triangular web sections **16**, a second chord angle beam **20** attached to the triangular web sections **16**, and a vertical plate **22** (which herein refers to **22**A, **22**B, **22**C, and **22**D as further described below) attached to a top of the cambered beam-joist **12** opposite the first and second chord angles **18**, **20**. In embodiments, the composite open web beam joist **10** includes a bearing seat having a width of at least 2 ½ inches. In some embodiments, the composite open web beam joist **10** comprises a layer of primer.

Referring to FIGS. **1**A-**3**, simultaneously, FIG. **1**A shows a front perspective view of the composite open web beam-joist according to one embodiment of the present disclosed technology. FIG. **1**B shows a rear perspective view of the composite open web beam-joist according to one embodiment of the present disclosed technology. FIG. **2**A shows front perspective view of a portion of the composite open web beam joist according to one embodiment of the present disclosed technology. FIG. **2**B shows a rear perspective view of a portion of the composite open web beam joist according

to one embodiment of the present disclosed technology. FIG. **3** shows a cross-sectional view of the composite open web beam-joist according to one embodiment of the present disclosed technology. In embodiments of the disclosed technology the web beam joist is formed from two different beam joists which are welded together. In one beam joist, the triangular web is cut therefrom or thereinto and the other beam joist is a linear beam welded thereto.

The cambered beam-joist portion **12** further includes a first end **24**A, a second end **24**B opposite the first end **24**A, a top end **26**A having a flange **28**, a bottom end **26**B opposite the top end **26**A, a first side **30**A, a second side **30**B opposite the first side **30**A. The open web layout **14** extends between the first end **24**A and second end **24**B. Each of the plurality of triangular web sections **16** extends between the top end **26**A and the bottom end **26**B. The open web layout **14** further includes an opening **36** between each of the triangular web sections **16**. Each triangular web section **16** includes a base **16**A disposed at the top end **26**A and a peak **16**B at the bottom end **26**B. The cambered beam joist **12** is made from metal such as steel, iron, aluminum, and the like. The cambered beam-joist portion **12** is cambered along a vertical plane of the beam-joist **12**. In embodiments, the triangular web sections **16** are uniform with respect to each other in terms of area or cross-sectional area. In other embodiments, the triangular web sections **16** are irregular with respect to one another and do not include a consistent area or cross-sectional area. In some embodiments, the openings **36** each include a center **36**C that is substantially 24 inches from the center **36**C of an adjacent opening **36**.

The first chord angle beam **18** includes an L-shaped metal beam having a first portion **18**A and a second portion **18**B. The second chord angle beam **20** also includes an L-shaped metal beam having a first portion **20**A and a second portion **20**B. The first portion **18**A of the first chord angle beam **18** is attached to the first side **30**A of the cambered beam-joist portion **12** at the peaks **16**B of each of the triangular web sections **16**. The first portion **20**A of second chord angle beam **20** is attached to the second side **30**B of the cambered beam-joist portion **12** at the peaks **16**B of each of the triangular web sections **16**.

In embodiments, each attachment point of the first chord angle beam **18** and the second chord angle beam **20** to the triangular web sections **16** is equidistant to a center of the respective triangular web section **16** to which it is attached. In some embodiments, the first chord angle beam **18** and the second chord angle beam **20** are attached to each other in parallel, or mirror each other, such that the second portion **18**B of the first chord angle beam **18** and the second portion **20**B of the second chord angle beam **18** align with each other on the same plane to form a flush bearing seat f. In other embodiments, the first chord angle beam **18** and the second chord angle beam **20** each include an equal length of which is equal to the length of the cambered beam-joist portion **12**.

In embodiments, the first portion **18**A of the first chord angle beam **18** is attached to the first side **30**A of the cambered beam-joist portion **12** with welds **41** fashioned with welding. The first portion **20**A of second chord angle beam **20** is attached to the second side **30**B of the cambered beam-joist portion **12** welds **43** fashioned with welding. The first chord angle beam **18** and the second chord angle beam **20** are attached to each other via welding.

The vertical plate **22** is attached vertically to a center of the top end **26**A of the cambered beam-joist portion **12** such that it protrudes off the top end **26**A of the cambered beam-joist portion **12**. The plate **22** extends longitudinally along the top end **26**A of the cambered beam-joist portion **12** between the first end **24**A and the second end **24**B of the cambered beam-joist portion **12**. The plate **22** is planar and includes a first side **22**A, a second side **22**B opposite the first side **22**A, a distal end **22**D, and a proximal end **22**P opposite the distal end **22**D. {The first side **22**A includes a flange **40** at the distal end **22**D that extends along the length of the plate **22** from end to end. The second side **22**B includes one or more recesses **42** at the distal end **22**D that are spaced at regular intervals along the length of the plate **22**.}

The plate **22** is attached to the center of the top end **26**A of the cambered beam joist portion **12** with substantially 12-inch-long continuous welds **44** on the first side **22**A of the plate **22** and the second side **22**B of the plate **22**B at the juncture where the proximal end **22**P of the plate **22** meets the top end **26**A of the cambered beam-joist portion **12**. The 12-inch-long continuous welds **44** are disposed at the first end **24**A and the second end **24**B of the cambered beam-joist portion **12**.

In embodiments, the plate **22** further includes substantially 2-inch-long continuous welds **46** on the first side **22**A of the plate **22** and the second side **22**B of the plate **22** at the juncture where the proximal end **22**P of the plate **22** meets the top end **26**A of the cambered beam-joist portion **12** to further weld the plate **22** to the center of the top end **26**A of the cambered beam-joist portion **12**. The 2-inch-long continuous welds **46** are staggered 12 inches apart on the first side **22**A and the second side **22**B of the plate **22**. In some embodiments, the 12-inch-long continuous welds **44** and the 2-inch-long continuous welds **46** comprise a thickness of 3⁄16 inches.

Referring now to FIG. **5**A-FIG. **6**D, simultaneously, FIG. **5**A FIG. **5**A shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to one embodiment of the present disclosed technology. FIG. **5**B shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to another embodiment of the present disclosed technology. FIG. **5**C shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to yet another embodiment of the present disclosed technology. FIG. **5**D shows an elevation view of the composite open web beam-joist, illustrating the open web layout according to an alternative embodiment of the present disclosed technology. FIG. **6**A shows a close-up view of the composite open web beam-joist of FIG. **5**A according to one embodiment of the present disclosed technology. FIG. **6**B shows a close-up view of the composite open web beam-joist of FIG. **5**B according to one embodiment of the present disclosed technology. FIG. **6**C shows a close-up view of the composite open web beam-joist of FIG. **5**C according to one embodiment of the present disclosed technology. FIG. **6**D shows a close-up view of the composite open web beam-joist of FIG. **5**D according to one embodiment of the present disclosed technology.

In embodiments, the pattern or cut of the open web layout **14** may vary from composite open web beam joist **10** to composite open-web beam-joist **10** depending on the cut or arrangement of triangular web sections **16**. For example, in certain embodiments, the open web layout **14** may include closed ends **50** as shown in FIGS. **5**A and **5**D, although the thickness of the closed ends **50** may differ from web layout to web layout. In other embodiments, the open web layout **14** may include open ends **52** as shown in FIGS. **5**B and **5**C, although the size of the openings of the open ends **52** may be different from web layout to web layout.

Referring now to FIG. **7**A—FIG. **14**D, simultaneously, FIG. **7**A shows an elevation view of the composite open web

beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology. FIG. **7**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology. FIG. **7**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology. FIG. **7**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology. FIG. **8**A shows a close-up view of the composite open web beam-joist of FIG. **7**A according to one embodiment of the present disclosed technology. FIG. **8**B shows a close-up view of the composite open web beam joist of FIG. **7**B according to one embodiment of the present disclosed technology. FIG. **8**C shows a close-up view of the composite open web beam joist of FIG. **7**C according to one embodiment of the present disclosed technology. FIG. **8**D shows a close-up view of the composite open web beam joist of FIG. **7**D according to one embodiment of the present disclosed technology. FIG. **9**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology. FIG. **9**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology. FIG. **9**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology. FIG. **9**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology. FIG. **10**A shows a close-up view of the composite open web beam-joist of FIG. **9**A according to one embodiment of the present disclosed technology. FIG. **10**B shows a close-up view of the composite open web beam joist of FIG. **9**B according to one embodiment of the present disclosed technology. FIG. **10**C shows a close-up view of the composite open web beam-joist of FIG. **9**C according to one embodiment of the present disclosed technology. FIG. **10**D shows a close-up view of the composite open web beam-joist of FIG. **9**D according to one embodiment of the present disclosed technology. FIG. **11**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology. FIG. **11**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology.

FIG. **11**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology. FIG. **11**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology. FIG. **12**A shows a close-up view of the composite open web beam-joist of FIG. **11**A according to one embodiment of the present disclosed technology. FIG. **12**B shows a close-up view of the composite open web beam joist of FIG. **11**B according to one embodiment of the present disclosed technology. FIG. **12**C shows a close-up view of the composite open web beam joist of FIG. **11**C according to one embodiment of the present disclosed technology. FIG. **12**D shows a close-up view of the composite open web beam-joist of FIG. **11**D according to one embodiment of the present disclosed technology. FIG. **13**A shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to one embodiment of the present disclosed technology.

FIG. **13**B shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to another embodiment of the present disclosed technology. FIG. **13**C shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to yet another embodiment of the present disclosed technology. FIG. **13**D shows an elevation view of the composite open web beam-joist, illustrating the cut-outs within an open web layout according to an alternative embodiment of the present disclosed technology. FIG. **14**A shows a close-up view of the composite open web beam-joist of FIG. **13**A according to one embodiment of the present disclosed technology. FIG. **14**B shows a close-up view of the composite open web beam-joist of FIG. **13**B according to one embodiment of the present disclosed technology. FIG. **14**C shows a close-up view of the composite open web beam joist of FIG. **13**C according to one embodiment of the present disclosed technology. FIG. **14**D shows a close-up view of the composite open web beam joist of FIG. **13**D according to one embodiment of the present disclosed technology.

In embodiments, the closed ends **50** and/or the triangular web sections **16** includes cut-outs **60** for facilitating the installation of plumbing, electrical, and/or HVAC in a building as well as reducing the weight of the composite open web beam joists **10** while not compromising their structural integrity or strength. The cut-outs **60** may be triangular as shown in FIGS. **7**A-**10**D, circular as shown in FIGS. **11**A, **11**C, **12**A, **12**C, **13**B, and **14**B, or rectangular as shown in FIGS. **11**B, **11**D, **12**B, **12**D, **13**A, and **14**A. The cut-outs may further range in size and position within the triangular web sections **16**.

Referring now to FIG. **4**A-**4**D, simultaneously, FIG. **4**A shows a close-up view of a portion of the composite open web beam-joist, illustrating the beam-joist portion formed after cutting the beam according to one embodiment of the present disclosed technology. FIG. **4**B a close-up view of a portion of the composite open web beam-joist, illustrating the cambered beam-joist portion formed after attaching the first chord angle beam to the first side of the cambered beam-joist portion according to one embodiment of the present disclosed technology. FIG. **4**C a close-up view of a portion of the composite open web beam-joist, illustrating the cambered beam-joist portion formed attaching the second chord angle beam to the second side of the cambered beam joist portion according to one embodiment of the present disclosed technology. FIG. **4**D a close-up view of a portion of the composite open web beam-joist, illustrating the composite open web beam-joist formed after attaching the plate vertically to the top end of the cambered beam-joist portion according to one embodiment of the present disclosed technology.

The method of manufacturing the composite open web beam joists comprises securing a metal beam having a closed uniform web layout to a fastening table or guide table to secure the beam in position. Next, the method comprises cutting the metal beam longitudinally along the closed uniform web layout to form a beam joist portion **100** including a first end **102**A, a second end **102**B opposite the first end **102**A, a top end **104**A, a bottom end **104**B opposite

the top end **104**A, a first side **106**A, a second side **106**B opposite the first side **106**A, and the open web layout **14** as shown in FIG. **4**A. The open web layout **14** extends between the first end **102**A and the second end **102**B and includes an undulating shape formed of the plurality of triangular web sections **16** and the openings **36** positioned between each of the triangular web sections **16**. Each of the triangular web sections **16** extends between the top end **104**A and the bottom end **104**B and includes the base **16**A, which is disposed at the top end **104**A, and the peak **16**B, which is disposed at the bottom end **104**B. In embodiments, the metal beam is cut such that the center **36** of one of the openings **36** is substantially 24 inches away from the center **36** of an adjacent opening **36**. The metal beam may comprise an I-beam, a T-bar beam, a wide-flange beam, or the like.

Next, the method comprises cambering the beam joist portion **100** to bend the beam-joist portion **100** along a vertical plane thereof to form a cambered beam-joist portion **100**. In embodiments, the camber can be set to the designation pattern of a 1" camber on **40'**, and ½" on **20'**.

Next, the method comprises attaching the first chord angle beam **18** to the first side of the cambered beam-joist portion **100** at the peaks **16**B of the triangular web sections **16** as shown in FIG. **4**B. In embodiments, the first chord angle beam **18** is attached to the first side **106**A of the cambered beam-joist portion **100** at the peaks **16**B of the triangular web sections **16** such that the first chord angle beam **18** is equidistant from a center of all the triangular web sections **16**. In other words, each attachment point of the first chord angle beam **18** to the peaks **16**B of the triangular web sections **16** is equidistant to a center of the respective triangular web section **16** to which the first chord angle beam **18** is attached. The first chord angle beam **18** is attached to the peaks **16**B of the triangular web sections **16** via welding.

Next, the method comprises attaching the second chord angle beam **20** to the second side of the cambered beam-joist portion **100** at the peaks **16**B of the triangular web sections **16** as shown in FIG. **4**C. In embodiments, the second chord angle beam **20** is attached to the second side **106**B of the cambered beam-joist portion **100** at the peaks **16**B of the triangular web sections **16** such that the first chord angle beam **18** is equidistant from a center of all the triangular web sections **16**. In other words, each attachment point of the second chord angle beam **20** to the peaks **16**B of the triangular web sections **16** is equidistant to a center of the respective triangular web section **16** to which the second chord angle beam **20** is attached. The second chord angle beam **20** is attached to the peaks **16**B of the triangular web sections **16** via welding.

Next, in embodiments, the method comprises attaching the first chord angle beam **18** and the second chord angle beam **20** to each other. In some embodiments, they're attached to each other via welding.

Lastly, the method comprises vertically attaching the vertical plate **22** to a center of the top end **104**A of the cambered beam joist portion such that the plate extends longitudinally along the top end **104**A of the cambered beam-joist portion **100** between the first end **102**A and the second end **102**B of the cambered beam joist portion **100**, as shown in FIG. **4**D. In embodiments, the plate **22** is attached by welding the substantially 12-inch-long continuous welds **44** on the first side **22**A of the plate **22** and the second side **22**B of the plate **22**B at the juncture where the proximal end **22**P of the plate **22** meets the top end **104**A of the cambered beam-joist portion **100**. In some embodiments, the 12-inch-long continuous welds **44** are made at the first end **102**A and the second end **102**B of the cambered beam-joist portion **100**.

In other embodiments, the plate **22** is further welded to the center of the top end of the cambered beam-joist portion by welding substantially 2-inch-long continuous welds on the first side **22**A of the plate **22** and the second side **22**B of the plate **22** at the juncture where the proximal end **22**P of the plate **22** meets the top end **104**A of the cambered beam-joist portion **100**. In some embodiments, the 2-inch-long continuous welds are staggered 12 inches apart on the first side **22**A and the second side **22**B of the plate. The 12-inch-long continuous welds and the 2-inch-long continuous welded to a thickness of at least 3⁄16 inches.

Any device or step to a method described in this disclosure can comprise or consist of that which it is a part of, or the parts which make up the device or step. The term "and/or" is inclusive of the items which it joins linguistically and each item by itself.

For purposes of this disclosure, the term "substantially" is defined as "at least 95% of" the term which it modifies.

Any device or aspect of the technology can "comprise" or "consist of" the item it modifies, whether explicitly written as such or otherwise.

When the term "or" is used, it creates a group which has within either term being connected by the conjunction as well as both terms being connected by the conjunction.

While the disclosed technology has been disclosed with specific reference to the above embodiments, a person having ordinary skill in the art will recognize that changes can be made in form and detail without departing from the spirit and the scope of the disclosed technology. The described embodiments are to be considered in all respects only as illustrative and not restrictive. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope. Combinations of any of the methods and apparatuses described hereinabove are also contemplated and within the scope of the invention.

What is claimed is:

1. A composite open web beam-joist, comprising:

a cambered metal beam-joist portion including a first end, a second end opposite the first end, a top end having a flange comprising a unitary structure, a bottom end opposite the top end, a first side, a second side opposite the first side, and an open web layout extending between the first end and second end, the open web layout including a plurality of metal triangular web sections extending between the top end and the bottom end and an opening between the triangular web sections, each triangular web section comprising a solid metal portion including a base disposed at the top end and an ovoid peak disposed at the bottom end;

a first metal chord angle beam welded to the first side of the cambered beam-joist portion at the peaks of the triangular web sections; and

a second metal chord angle beam welded to the second side of the cambered beam-joist portion at peaks of the triangular web sections;

a vertical flat and planar plate attached to a center of the top end of the cambered beam-joist portion, the flat and planar plate extending longitudinally along the top end of the cambered beam-joist portion between the first end and the second end of the cambered beam-joist portion, the flat and planar plate including a first side, a second side opposite the first side, a distal end, and a proximal end opposite the distal end, the first side including a flange at a point between a central point

thereof and the distal end, the second side including a recess at a point between a central point thereof and the distal end, the point of the recess location being opposite the point at which the flange is situated on the first side.

2. The composite open web beam-joist of claim **1**, wherein the flat and planar plate is attached to the center of the top end of the cambered beam-joist portion with substantially 12-inch-long continuous welds on the first side of the flat and planar plate and the second side of the flat and planar plate at a juncture where the proximal end of the flat and planar plate meets the top end of the cambered beam-joist portion, the substantially 12-inch-long continuous welds disposed at the first end and the second end of the cambered beam-joist portion.

3. The composite open web beam-joist of claim **2**, wherein the flat and planar plate further include substantially 2-inch-long continuous welds on the first side of the flat and planar plate and the second side of the flat and planar plate at the juncture where the proximal end of the flat and planar plate meets the top end of the cambered beam-joist portion to further weld the flat and planar plate to the center of the top end of the cambered beam-joist portion, the substantially 2-inch-long continuous welds staggered 12 inches apart on the first side and the second side of the flat and planar plate.

4. The composite open we beam-joist of claim **3**, wherein the substantially 12-inch-long continuous welds and the substantially 2-inch-long continuous welds comprise a thickness of substantially 3/16 inches.

5. The composite open web beam-joist of claim **1**, wherein:

the first chord angle beam is equidistant from a center of all the triangular web sections;

the second chord angle beam mirrors the first chord angle beam and is equidistant from a center of all the triangular web sections; and

the first chord angle beam and the second chord angle beam are attached to each other in parallel such that a distance there-between is equal to or less than double a thickness of a most planar section of each of the first and second chord angle beams; and

wherein the first chord angle beam and the second chord angle beam are each L-shaped metal beams.

6. The composite open web beam-joist of claim **1**, wherein the beam-joist is cambered along a horizontal plane of the beam-joist.

7. The composite open web beam-joist of claim **1**, wherein the openings of the open web layout each include a center that is 24 inches from a center of an adjacent opening.

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