



(86) Date de dépôt PCT/PCT Filing Date: 2001/04/06  
 (87) Date publication PCT/PCT Publication Date: 2001/10/18  
 (45) Date de délivrance/Issue Date: 2011/01/25  
 (85) Entrée phase nationale/National Entry: 2002/08/14  
 (86) N° demande PCT/PCT Application No.: GB 2001/001610  
 (87) N° publication PCT/PCT Publication No.: 2001/076719  
 (30) Priorité/Priority: 2000/04/06 (US09/544,572)

(51) Cl.Int./Int.Cl. *B01D 33/00* (2006.01),  
*B01D 33/03* (2006.01), *B01D 33/41* (2006.01),  
*B07B 1/46* (2006.01)

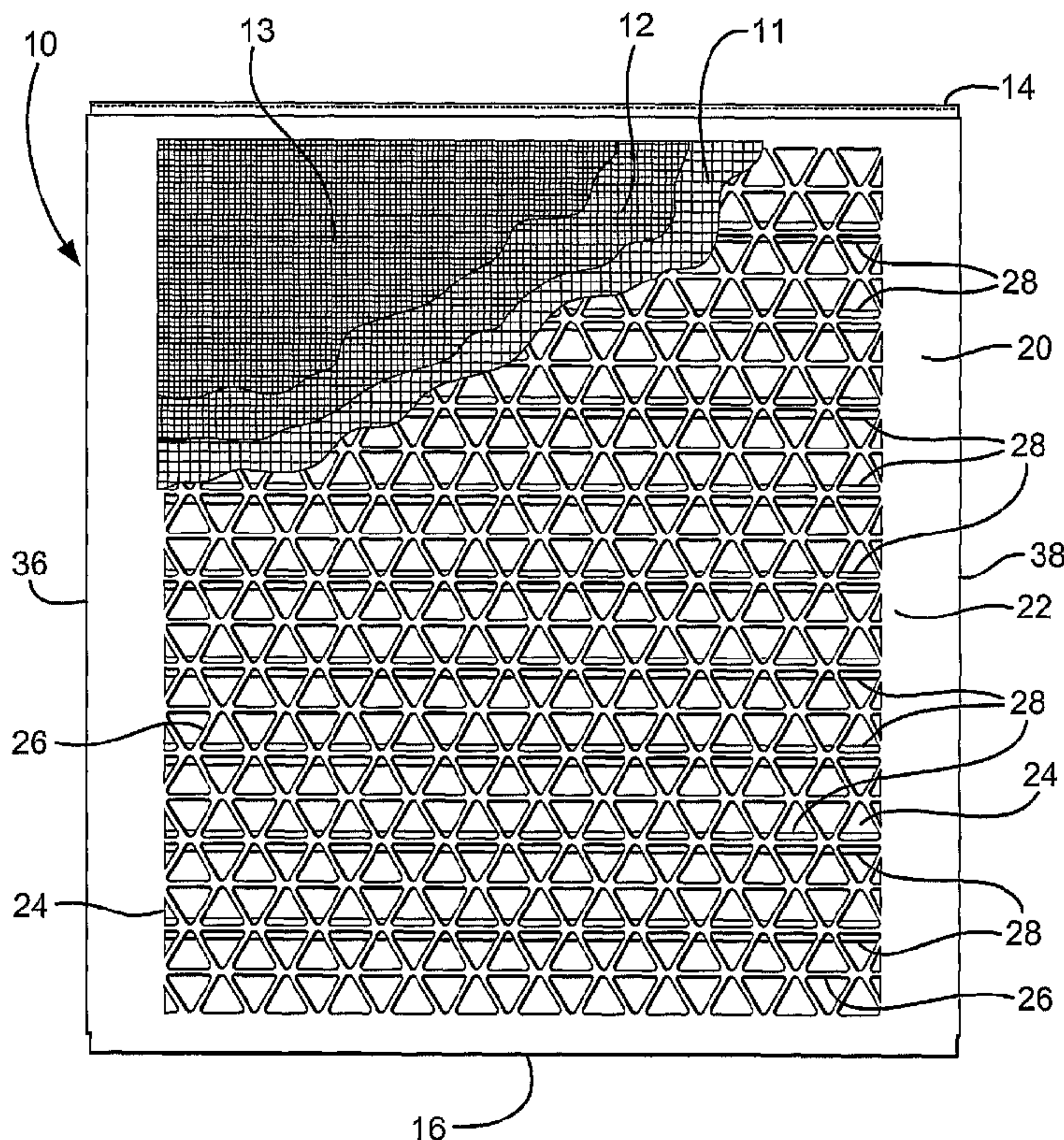
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(54) Titre : ENSEMBLE DE CRIBLAGE, STRUCTURE DE SUPPORT, PROCEDE DE REALISATION, ET SEPARATEUR A VIBRATIONS

(54) Title: A SCREEN ASSEMBLY, A SUPPORT STRUCTURE, A METHOD OF MAKING SAME AND A VIBRATORY SHAKER



(57) Abrégé/Abstract:

A support structure for a screen assembly for a vibratory separator, the support structure comprising a body member (20; F; 70) with portion (20; F; 71) having at least one opening therethrough (24; 41; 42; 43; 44; 45; 46; 47; 76), and integral side portions (36,38) foldable to form a pair of spaced-apart integral side members. A screen assembly comprising a support structure of the

(57) **Abrégé(suite)/Abstract(continued):**

invention, and further comprising at least one sheet of screening material (11, 12, 13; 80) over said at least one opening (24). A vibratory separator comprising at least one support screen or screen assembly of the invention. A method of making a screen support and a screen assembly of the invention, comprising the steps of forming a blank and folding said blank to form a pair of spaced-apart integral side members.

## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau(43) International Publication Date  
18 October 2001 (18.10.2001)

PCT

(10) International Publication Number  
WO 01/76719 A3(51) International Patent Classification<sup>7</sup>: B01D 33/00,  
33/03, 33/41, B07B 1/46

(21) International Application Number: PCT/GB01/01610

(22) International Filing Date: 6 April 2001 (06.04.2001)

(25) Filing Language: English

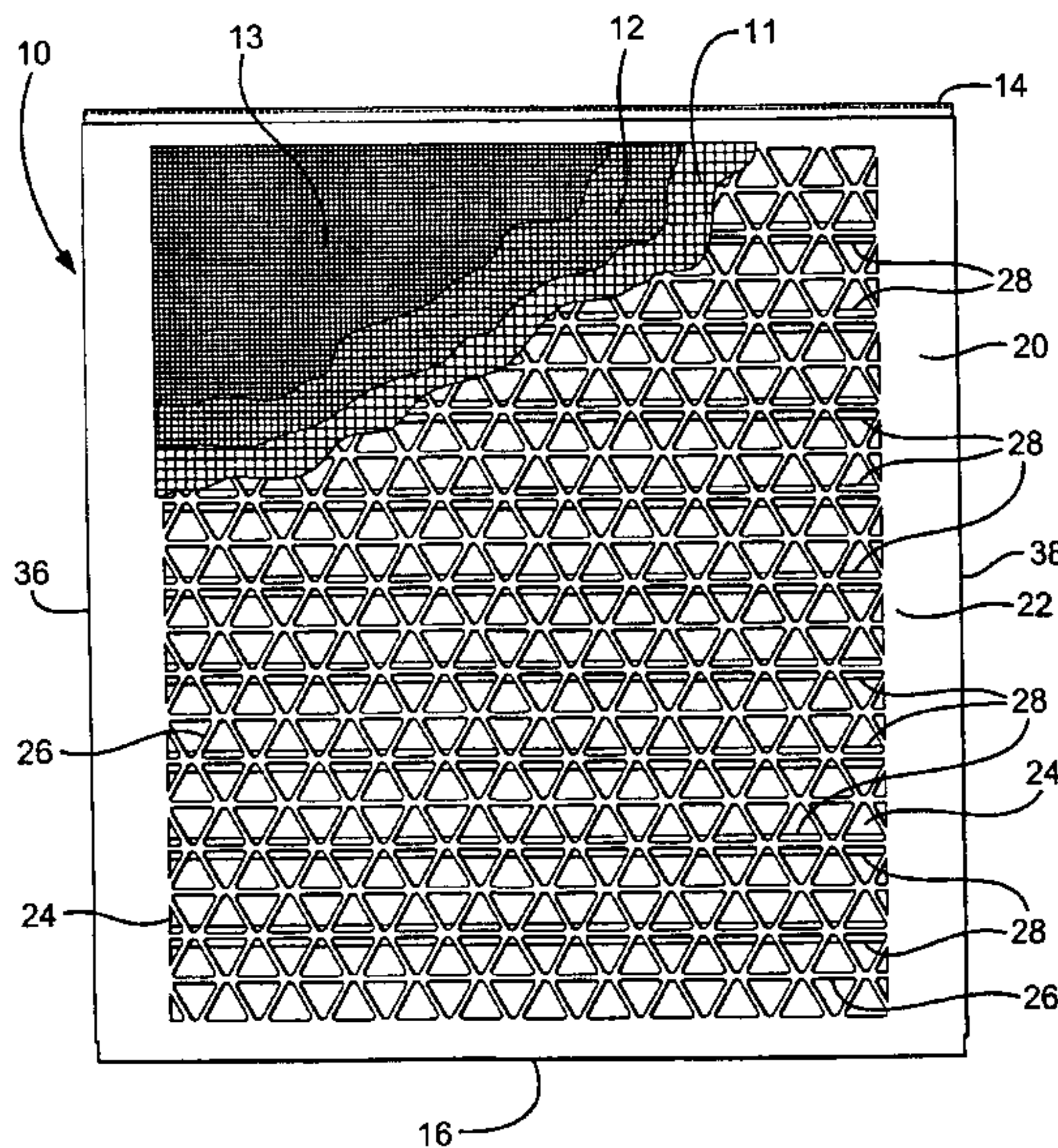
(26) Publication Language: English

(30) Priority Data:  
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AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,  
DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR,  
HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,  
LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,  
NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,  
TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.(84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian  
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: A SCREEN ASSEMBLY, A SUPPORT STRUCTURE, A METHOD OF MAKING SAME AND A VIBRATORY  
SHAKER

(57) Abstract: A support structure for a screen assembly for a vibratory separator, the support structure comprising a body member (20; F; 70) with portion (20; F; 71) having at least one opening therethrough (24; 41; 42; 43; 44; 45; 46; 47; 76), and integral side portions (36,38) foldable to form a pair of spaced-apart integral side members. A screen assembly comprising a support structure of the invention, and further comprising at least one sheet of screening material (11, 12, 13; 80) over said at least one opening (24). A vibratory separator comprising at least one support screen or screen assembly of the invention. A method of making a screen support and a screen assembly of the invention, comprising the steps of forming a blank and folding said blank to form a pair of spaced-apart integral side members.



WO 01/76719 A3

**WO 01/76719 A3**



patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**(88) Date of publication of the international search report:**  
28 March 2002

**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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A SCREEN ASSEMBLY, A SUPPORT STRUCTURE, A METHOD OF  
MAKING SAME AND A VIBRATORY SHAKER

The present invention relates to a screen assembly,  
to a support structure, and to a method of making same.  
5 The invention also relates to a vibratory shaker.

Screen assemblies are generally used in shale  
shakers. A typical use for a shale shaker is separating  
solids from liquids in the drilling of a wellbore for oil  
and gas. During drilling of a wellbore, a liquid known as  
10 mud is circulated in the well. Circulation involves  
introducing mud into the well and pumping the mud down a  
pipe such as a drill string. The mud picks up cuttings  
and other particles from the bottom of the wellbore and  
are returned to the top of the well via an annulus formed  
15 by the drill pipe and the wellbore. Particle and rock  
laden mud exits the well and is reconditioned ready to be  
reused. Part of the conditioning process involves  
filtering the mud in a vibratory shaker, such as a shale  
shaker. The shale shaker generally comprises a bucket, a  
20 pretensioned screen for screening the particle laden mud  
and a motor for vibrating the bucket and screen. A  
typical example of a shale shaker is disclosed in PCT  
Publication No. WO 96/33792, owned by the applicant for  
the present application. It will be appreciated that the  
25 screen needs to be replaced frequently due to heavy wear.  
It has been found that screens can be pretensioned and  
mounted on a supporting structure to form a screen  
assembly. The screen assembly may be placed in and  
removed from the shale shaker quickly, thereby reducing  
30 downtime of the shale shaker. Such a screen assembly is  
disclosed in EP-A-0 169 698. The screen assemblies are  
generally expensive to manufacture, are heavy and are  
prone to failure in use.

According to the present invention there is provided  
35 a support structure for a screen assembly for a vibratory

separator, the support structure comprising a body member  
made of a single integral sheet-like material, said body  
member having a first portion and a second portion, said  
first portion having a plurality of rib supports bent or  
5 folded out from spaced apart openings, slots or cuts of  
said first portion, the second portion having at least  
one opening therethrough and bent or folded over onto the  
first portion so that the underside of the second portion  
contacts top surfaces of the rib supports.

10 The invention also provides a screen assembly  
comprising a support structure of the invention, and  
further comprising at least one sheet of screening  
material over said at least one opening.

The invention further relates to a vibratory  
15 separator comprising at least one support screen or  
screen assembly of the invention.

The invention further provides a method of making a  
screen support and a screen assembly of the invention,  
comprising the steps of forming a blank and folding said  
20 blank to form a pair of spaced-apart integral side  
members.

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For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

5 Figure 1A is a top plan view of a screen assembly in accordance with the present invention, with parts cut away;

Figure 1B is a top plan view of a structural part of the screen assembly of Figure 1A;

10 Figure 1C is a side elevation of the structural part of the screen assembly shown in Figure 1B;

Figure 1D is a cross-sectional view along line 1D-1D of Figure 1B;

15 Figure 1E is a top plan view of a blank used in the manufacture of the structural part of the screen assembly of Figure 1B;

Figure 1F is a top plan view of a blank used in the manufacture of part of the screen assembly of Figure 1A;

20 Figure 1G is a side elevation of two screen assemblies of the type shown in Figure 1A, arranged end-to-end, indicating the same reference numerals for like parts;

Figure 2 is a perspective view of a shale shaker in accordance with the present invention incorporating a screen assembly according to the present invention;

25 Figures 3A to 3G are each a top plan view of an alternative blank used in the formation of a structural part of a screen assembly in accordance with the present invention;

30 Figures 4A to 4J are each a top plan view of a frame in accordance with the present invention, each showing a different pattern of openings therein.

35 Figure 5A is a top plan view of a blank used in the formation of another embodiment of a structural part of the present invention, the structural part having first and second portions;

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Figure 5B is a top plan view of the blank of Figure 5A with slots cut in the first portion of the blank to facilitate the formation of support ribs;

5 Figure 5C is a top plan view of the blank of Figure 5B with a pattern of openings formed in the second portion;

Figure 5D is a side elevation of the blank of Figure 5C with support ribs projecting from the first portion of the blank;

10 Figure 5E is a perspective view of the blank of Figure 5D with the second portion (the pattern of openings not shown for clarity) folded with respect to the first portion with the support ribs;

15 Figure 5F is a side elevation with the second portion folded over onto the first portion, with side portions folded towards the first portion;

Figure 5G is a top plan view of the structural part of Figure 5F;

20 Figure 5H is a cross-sectional view along line 5H-5H of Figure 5G;

Figure 5I is a side elevation of a screen assembly of the present invention, including the structural part as shown in Figure 5A to 5H;

25 Figure 5J is a cross-sectional view along line 5J-5J of Figure 5K;

Figure 5K is a top plan view of the screen assembly as shown in Figure 5I; and

Figure 6 is a side cross-sectional view of a screen assembly in accordance with the present invention.

30 Referring to Figure 1A, there is shown a screen assembly generally identified by the reference numeral 10 in accordance with the present invention. The screen assembly 10 comprises a support structure 20, made from a single piece of material and identified herein and in  
35 trading as UNIBODY. The support structure is made from a

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sheet of metal such as steel or aluminium but may be made from any other suitable material, including a plastics material. The screen assembly 10 has, optionally, three layers 11, 12, 13 of screening material bonded to a top surface 22 of the support structure 20. Preferably, the layers 11, 12, 13 are also bonded together over substantially their entire surface area with, for example a hotmelt glue.

A plurality of triangular openings 24 are provided through the support structure 20. The pattern is disclosed in our co-pending European Publication No. EP-A-1,002,588, which discloses a panel for a screen, said panel comprising a plurality of groups of perforations, each group comprising six generally equally triangular apertures arranged with their apices facing a central portion, wherein the apices of two opposing ones of said triangular apertures are spaced apart further than the apices of opposed ones of the remaining triangular apertures. The triangular openings 24 are defined by a plurality of support members 26. Optionally, a plurality of spaced-apart substantially parallel ribs 28 connected to the support structure 20, which in one aspect are welded to a support structure 20. In this particular embodiment the ribs 28 are positioned along a substantial majority of their length directly beneath one of the support members 26 that extends across a major portion of the support structure 20; but it is within the scope of this invention to use no such ribs or to position them anywhere on the underside of the support structure 20. The support structure 20 has spaced-apart sides 36, 38. As shown in Figure 1C, the screen assembly 10 has an end 14 and a "ledge" end 16. The ledge end has an upper ledge portion 17 that rests on a shoulder 15 of an end 14 of an adjacent screen. Thus one screen end 16 seals against another screen end 14 when such screens are used

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end-to-end, as shown in Figure 1G. In one particular embodiment, (not shown) four screens are used on a shaker, such a shaker is shown in Figure 2, in two end-to-end pairs with the pairs side by side. Each pair is positioned in "C" channels. One of the screens is moved into the "C" channel supports ledge end 16 first. Then the ledge end 16 of the second screen is moved into the "C" channels so that it sealingly abuts the end 14 of the first screen. The other pair is similarly installed.

As shown in Figure 1E, the support structure 20 is, initially, a single integral piece of material in which the pattern of openings 24 is formed, e.g. by any suitable cutting tool, punch, laser, or plasma beam or arc. Alternatively, the area shown provided with the openings 24 in Figure 1E may be removed such that a large opening is left, so that all that is formed according to the present invention is a four-sided structure to which is applied one, two, three or more layers of screening sheet(s) and/or screening material; including but not limited to a perforated sheet or plate and/or any desired number of layers of screening material, bonded or unbonded.

Portions 31, 32, 33, and 34 are folded to form, respectively, the end, 14, end 16 and sides 36, 38. It is within the scope of this invention to fold the various portions of the support structure 20 with any suitable press brake, pliers, or bending device with or without applying heat to the structure. Figure 1F shows a rib 28 which has not yet been bent or folded into a U or V shape, as shown in Figure 1D. Ends 29 may be introduced into corresponding holes or slots (not shown) in the sides 36, 38 to facilitate securement of the ribs.

It is within the scope of this invention for the screen assembly 10 to have none, one, two, three or more layers of screening material, i.e., screen, mesh, and/or cloth

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made, e.g., of stainless steel wire and/or plastic. Any such layer or combination of layers may be bonded together (glued, welded, and/or sintered) in any known manner and/or bonded to the support structure 20 in any known manner. Any such layer or layers of screening material may be substantially flat or may be undulating (with a series of alternating ridges and valleys) as is well known in the art.

Figure 2 shows a shale shaker S according to the present invention with a screen assembly 8 according to the present invention which may be any screen assembly disclosed herein according to the present invention. Any suitable known shaker or vibratory separator may employ one or more screens according to the present invention including but not limited to shakers as disclosed in U.S. Patents 5,392,925 and 5,641,070 and in the references cited in each patent.

Edges on both sides of a support structure according to the present invention can form hook strips. In such an embodiment with hook strips a hook end (like the hook end 14), Figure 1C) and/or a ledge end (like the ledge end 16, Figure 1C) may be deleted.

Figures 3A to 3G are top views of alternative embodiments for the support structure F, each with a series of different-shaped openings 41, 42, 43, 44, 45, 46, 47 therethrough, respectively. Instead of placing sheets or layers of screening material over the openings, it is within the scope of this invention to emplace a plug or module with screening material in some or all of the openings of any screen assembly disclosed herein according to the present invention. In certain aspects, the plugs or modules are as disclosed in our U.S. Patents 5,988,397 or 5,490,598.

Also, as shown in the embodiment of Figure 3E, it is within the scope of this invention to provide one or more

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areas or strips T without openings.

Figures 4A to 4J replicate the panels disclosed in Figures 7 to 16 of our co-pending PCT Publication No. WO 00/41822, and are reproduced here to illustrate certain possible opening/support member patterns for a support structure according to the present invention. Of course if any such opening/support pattern is used in a support structure according to the present invention the ends and sides of the panels as disclosed in Figures 7 to 16 of the cited application may be deleted.

In certain embodiments of a screen assembly with a support structure according to the present invention as described above has no separate pieces added to form parts, e.g. sides, hook strips, hook end, ledge end, etc. and is, therefore, relatively less expensive to make. By reducing or eliminating seams and connection areas, a relatively more substantial screen assembly is possible.

Figures 5A to 5E illustrate stages in the manufacture of a support structure 70 in accordance with the present invention. The support structure 70 is initially a blank that is cut, pressed or machined to the shape shown in Figure 5A that includes a first portion 72 in which will be made a series of rib supports and a second portion 71 in which will be made a pattern of openings. As shown in Figure 5B a series of slots 74 with right angle ends are made by, for example, cutting, drilling, punching, or machining in any suitable manner, in the first portion 72.

As shown in Figure 5C a pattern of openings 76 is made (cut, drilled, punched, or machined in any suitable manner) in the second portion 71. These openings and their pattern may be any suitable shape opening in any desired pattern, including, but not limited to, any opening shape and pattern disclosed herein. The openings 76 may be of such a size that no additional screening

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material is placed over them; or, alternatively, any screening material disclosed herein, bonded or unbonded, may be placed over the openings 76.

As shown in Figure 5D rib supports 78 have been bent or folded out from the first portion 72. The support ribs are bent or folded over at their ends to form a C-shape or flat topped end or hook-shaped end. As shown in Figures 5F to 5G the second portion 71 has been folded or bent over onto the first portion 72 so that an underside of the second portion 71 contacts top surfaces 79 of the rib supports 78. The second portion 71 may be glued, bolted, screwed, or welded to top surfaces 79 of the rib supports 78 [or Velcro™ material may be used to secure the second portion 71 to the ribs 78]. The shaped end to the support rib 78 provides rigidity and provides a flat top to abut the second portion 71, As shown in Figure 5E, in which the second portion 71 has been folded or bent with respect to the first portion 72. The shaped ends to the ribs 78 may line up with support members in the pattern of openings 76 in the second portion 76, as with the support members 26 and ribs 28, as shown in the previous embodiment with reference to Figure 1, which has the advantage that, in use, flow of fluid through the screening area is substantially unimpeded by the support ribs 78. The shaped ends may be as narrow as the support members of the pattern of openings 76 in the second portion 71, or may be slightly larger, which, in use may impede flow slightly.

Figures 5I to 5K show the structure of Figure 5F with screening material 80 thereon. The screening material 80 may be, in at least certain preferred embodiments, any known screen, screens, mesh, and/or meshes in any known combination, bonded or unbonded to each other, bonded or unbonded to the top portion 71, and/or of different weaves or similar weaves. As shown

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in Figures 5H and 5F the ends 73, 75 correspond, respectively, to ends 14 and 16 of the screen of Figure 1A and function similarly to effect the sealing end-to-end abutment of such screens.

5           Figure 6 shows a screen assembly 90 which has a support structure 92 which is substantially flat and with ends 93 folded or bent to form "hook strips" for securing the screen assembly 90 in various shakers and separators that employ such a screen connection apparatus. Such  
10 hook strips may be provided with any support structure disclosed herein, preferably formed integrally with the side portions, such as with the side portions 36, 38 in Figure 1, by providing slightly larger side portions and folding them into a hook, C-shape or channel shape. Such  
15 a support structure may be used instead of various prior art devices which employ, for example, a plate to which channel-shaped members are welded or otherwise secured; for example, but without limitation, the support structure can be used in devices like those of U.S.  
20 Patents 5,720,881 and 4,575,421 (and those of the references cited in these two patents) instead of the plate/channel-shaped member combinations disclosed in these patents. Screening material 94 (as any described herein with respect to layer(s), mesh(es), bonding etc.)  
25 has an undulating shape as viewed in Figure 6. It is shown with lower parts touching and fixed to a top surface of the support structure 92, but it may be spaced-apart from this surface. It is within the scope of this invention to employ undulating screening material  
30 on any support structure and with any screen assembly disclosed herein. Optionally, the screening material 94 may be substantially flat. The support structure 92 may be, as viewed from above, like any support structure disclosed herein. In another aspect, the screening  
35 material 94 is a portion like the first portion 71

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(Figure 5A) and is folded over to a position as shown in Figure 6, rather than affixed as a separate piece. Alternatively, what is shown as the screening material 94 in Figure 6 may be a support structure for additional  
5 screening material placed thereon.

CLAIMS:

1. A support structure for a screen assembly for a vibratory separator, the support structure comprising a  
5 body member made of a single integral sheet-like material, said body member having a first portion and a second portion, said first portion having a plurality of rib supports bent or folded out from spaced apart openings, slots or cuts of said first portion, the second  
10 portion having at least one opening therethrough and bent or folded over onto the first portion so that the underside of the second portion contacts top surfaces of the rib supports.
- 15 2. A support structure as claimed in claim 1, wherein the second portion has integral side portions folded to form a pair of spaced-apart integral side members.
- 20 3. A support structure as claimed in claim 1 or 2, wherein said second portion has a plurality of openings therethrough defining a pattern.
- 25 4. A support structure as claimed in claim 1, 2 or 3, wherein the body member further comprises integral end portions folded to form a pair of spaced-apart integral end members.
- 30 5. A support structure as claimed in Claim 4, wherein one of the pair of spaced-apart end portions is configured with a shoulder support portion for sealingly abutting a screen ledge end of an adjacent screen.
- 35 6. A support structure as claimed in Claim 5, wherein one of the pair of spaced-apart end portions is configured with a ledge portion for sealingly abutting a

shoulder portion of an end of an adjacent screen.

5 7. A support structure as claimed in any one of Claims 2 to 6, wherein the side portions include sub-portions which are folded to form a hook strip on each of two opposed sides of the support structure.

10 8. A support structure as claimed in any one of Claims 1 to 7, wherein said rib supports have ends which are folded into a flat top or C-shape.

15 9. A support structure as claimed in any one of Claims 1 to 8, further comprising a plurality of ribs connected to and beneath the portion of the integral body member with the plurality of spaced-apart screening openings.

20 10. A support structure as claimed in Claim 9, wherein the plurality of ribs are substantially parallel to each other.

25 11. A support structure as claimed in any one of Claims 1 to 10, wherein said support structure is integral with a filtering means.

30 12. A screen assembly comprising a support structure as claimed in any one of claims 1 to 11, and further comprising at least one sheet of screening material over said at least one opening.

13. A screen assembly as claimed in claim 12, wherein said screening material is an undulating screen.

35 14. A screen assembly as claimed in Claim 12 or 13, further comprising at least another layer of screening material overlaying said at least one sheet of screening

material.

15 15. A screen assembly as claimed in Claim 12, 13 or  
14, wherein said at least one sheet of screening material  
is bonded to the support structure, preferably with a hot  
melt glue.

10 16. A vibratory separator comprising at least one  
screen assembly as claimed in any one of Claims 12 to 15.

17. A method of making a screen support as claimed  
in any one of claims 1 to 11, the method comprising the  
steps of:

15 providing a blank of sheet-like material that is  
cut, pressed or machined such that it includes a first  
portion and a second portion;

making a series of spaced apart openings, slots or  
cuts in said first portion;

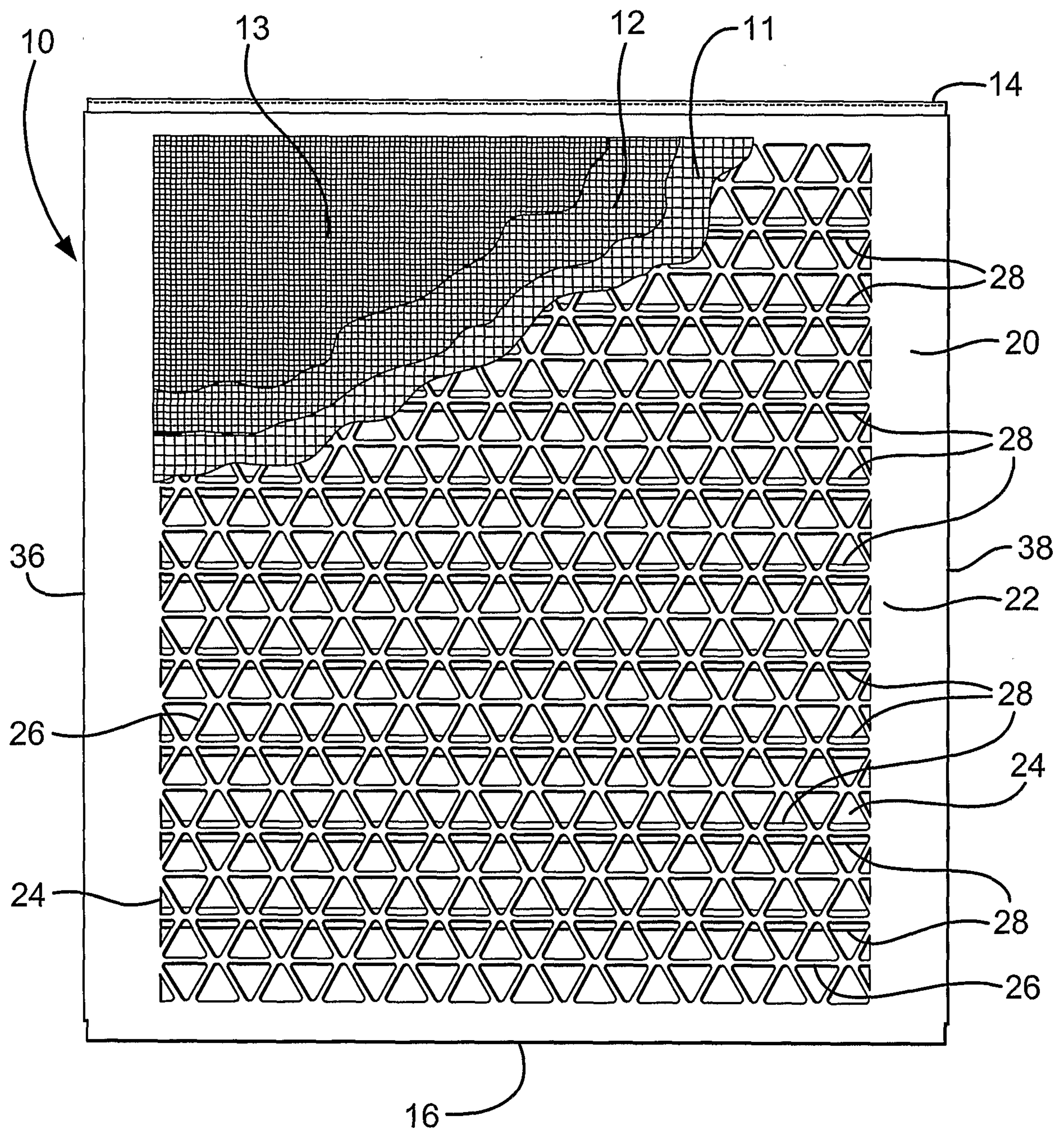
making at least one opening in said second portion;

20 bending or folding out support ribs from said  
openings slots or cuts of said first portion;

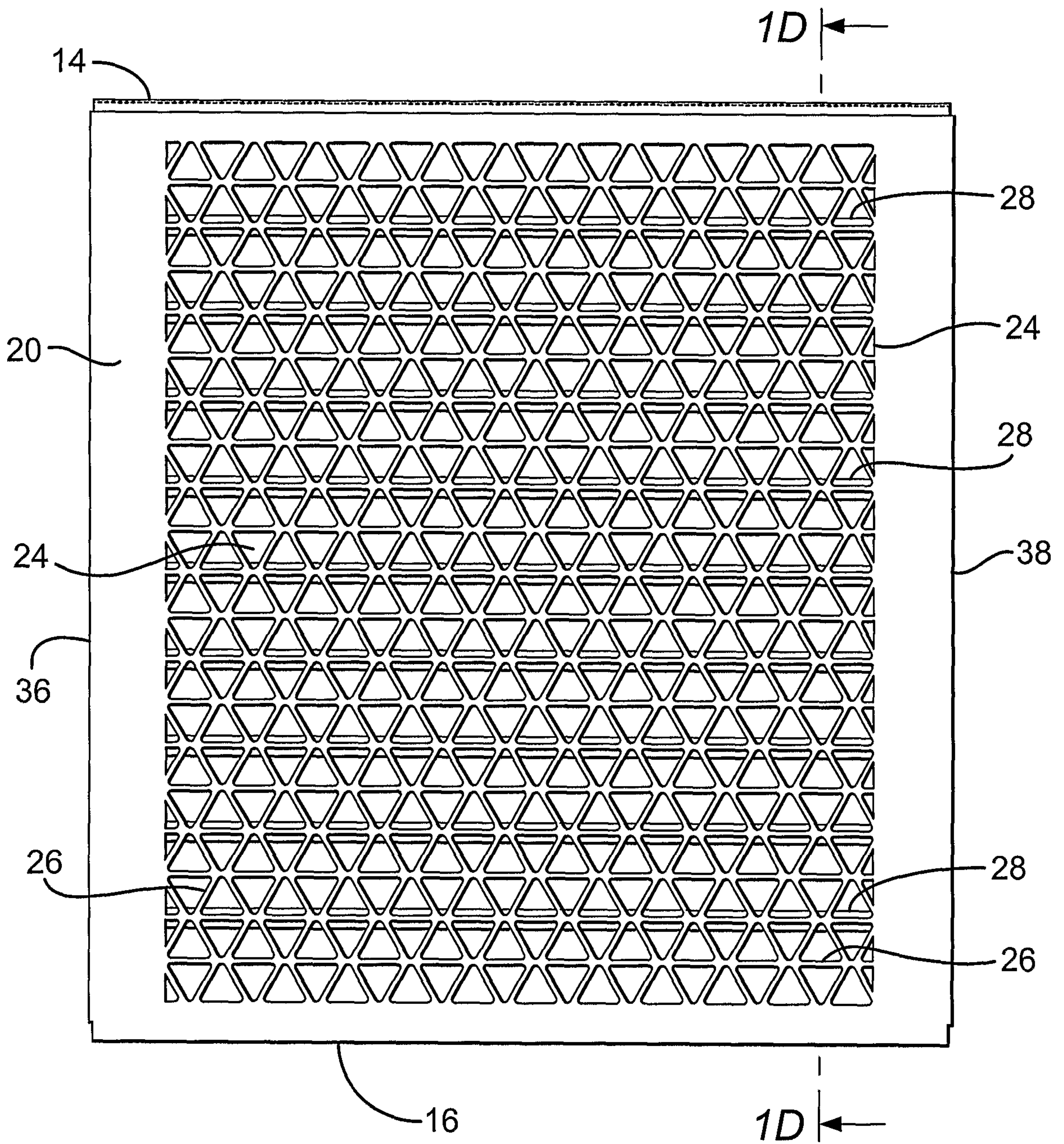
folding or bending said second portion over said  
first portion so that an underside of the second portion  
contacts top surfaces of the rib supports.

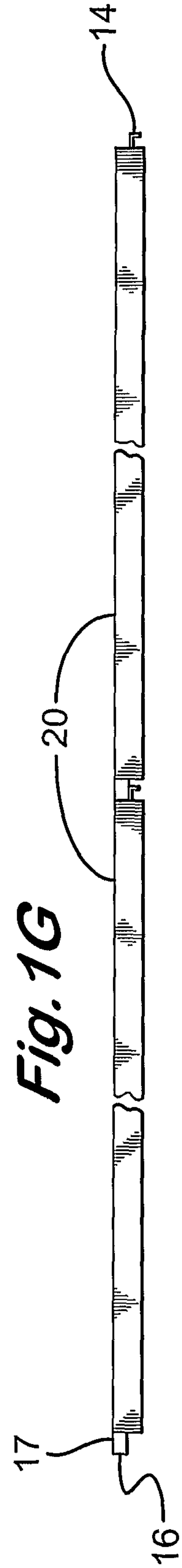
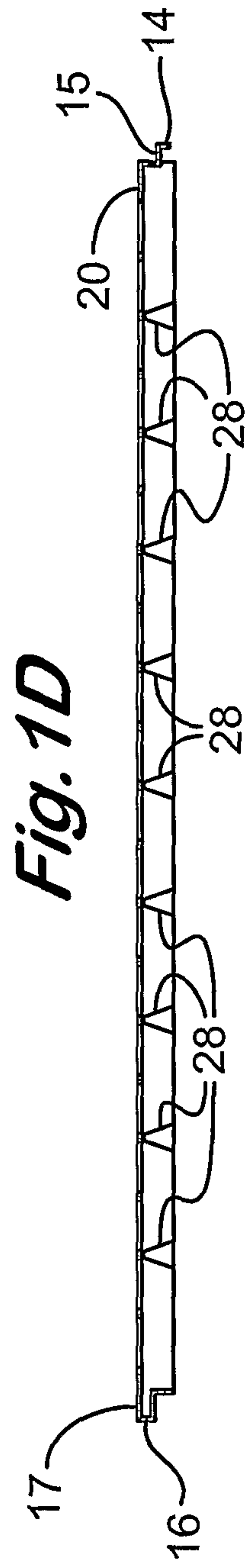
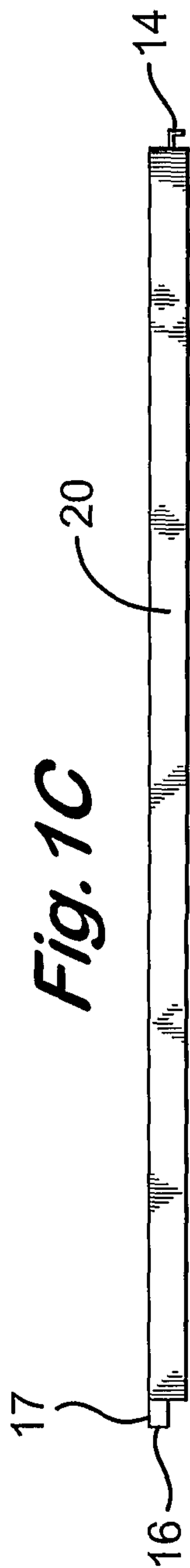
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**Fig. 1A**



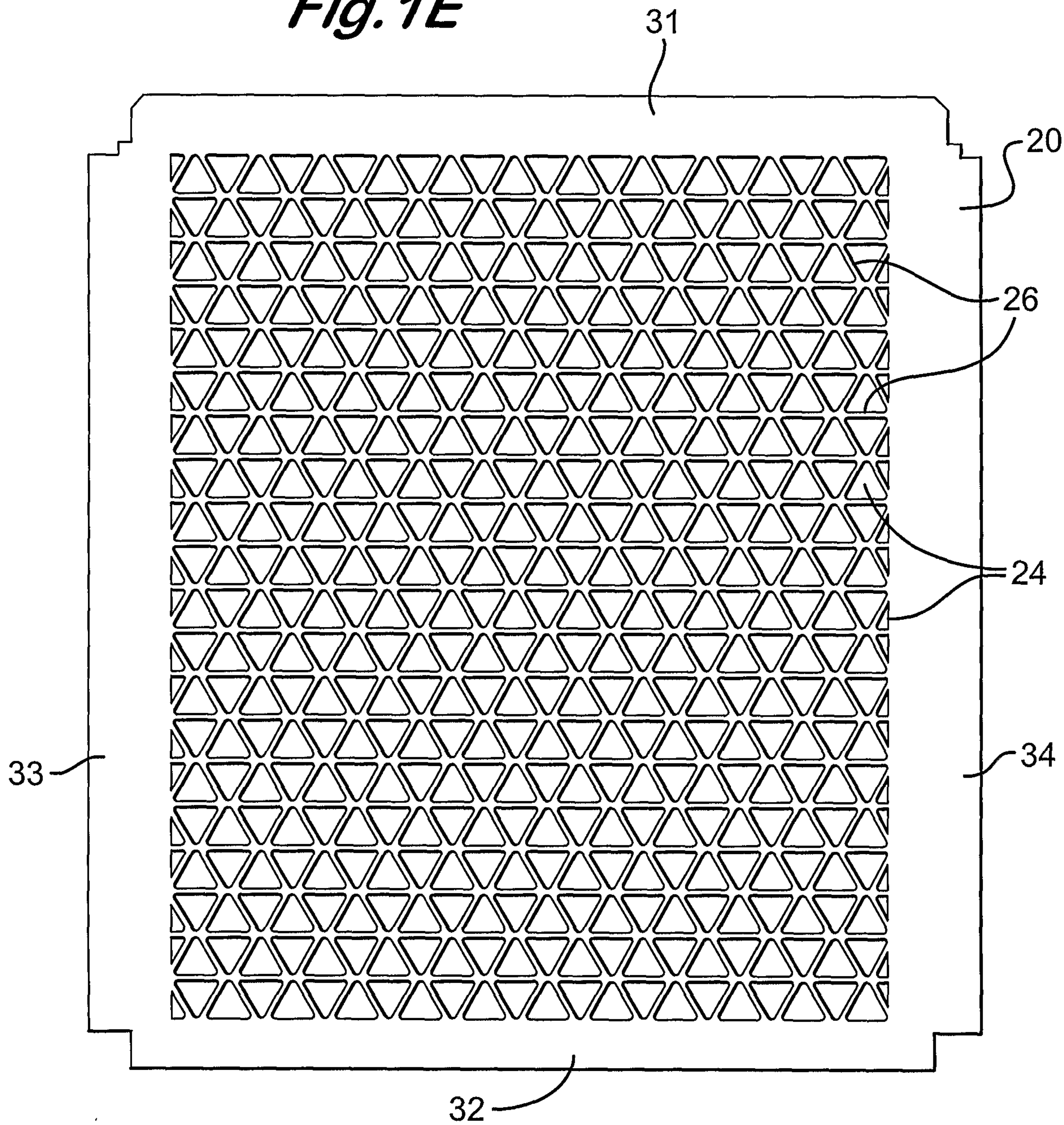
**Fig. 1B**



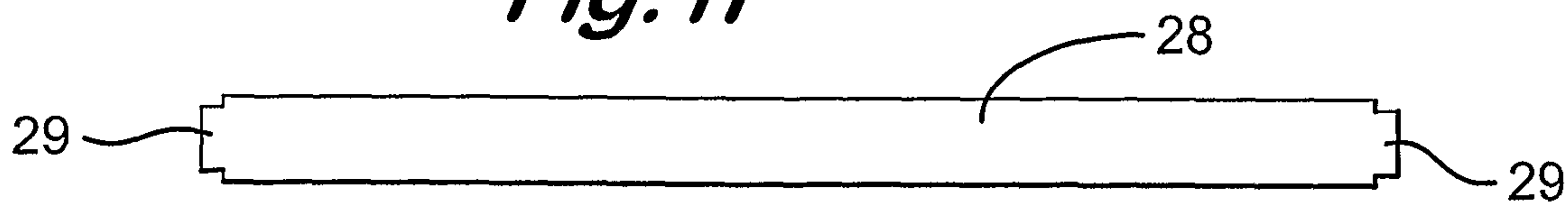


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**Fig. 1E**

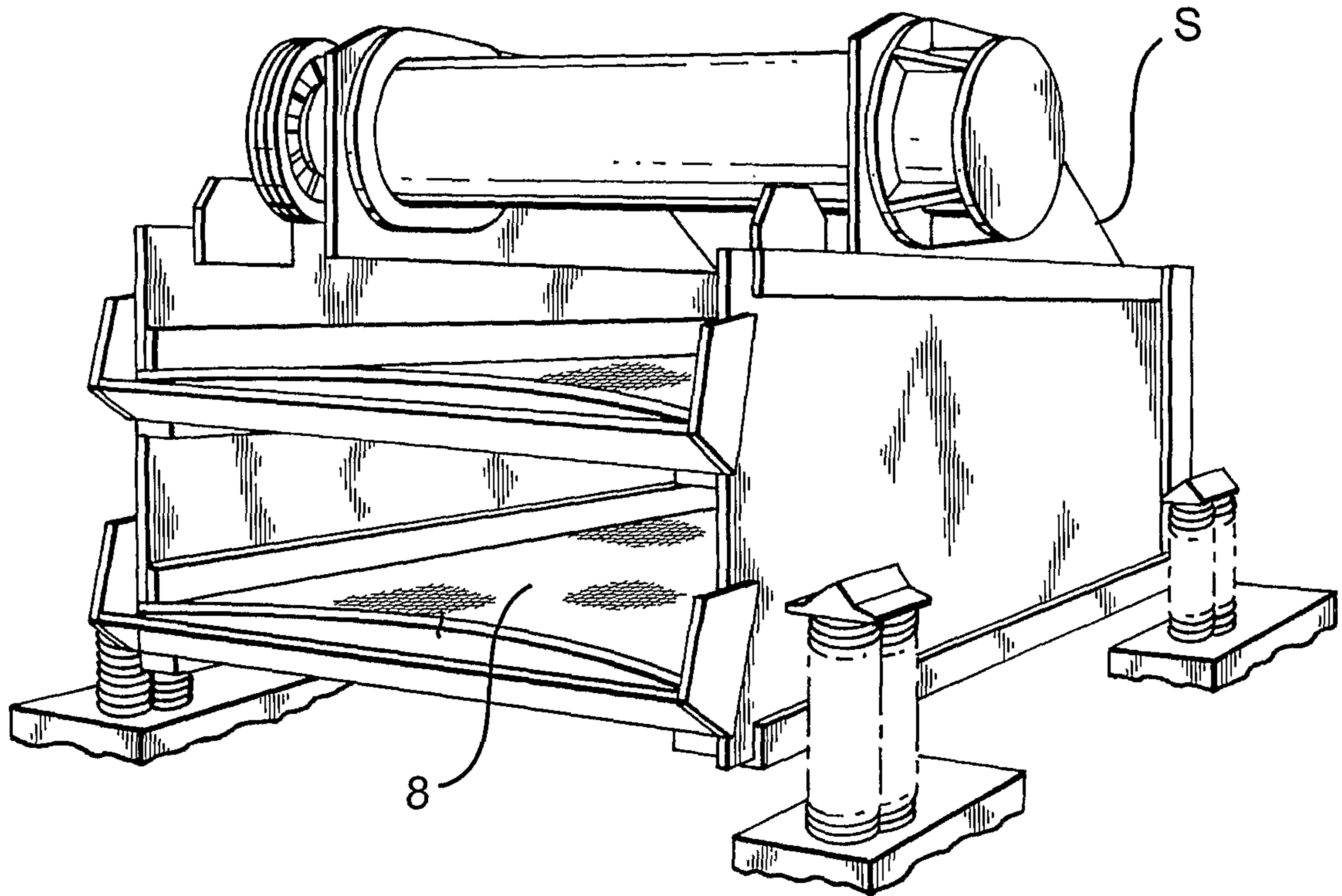


**Fig. 1F**

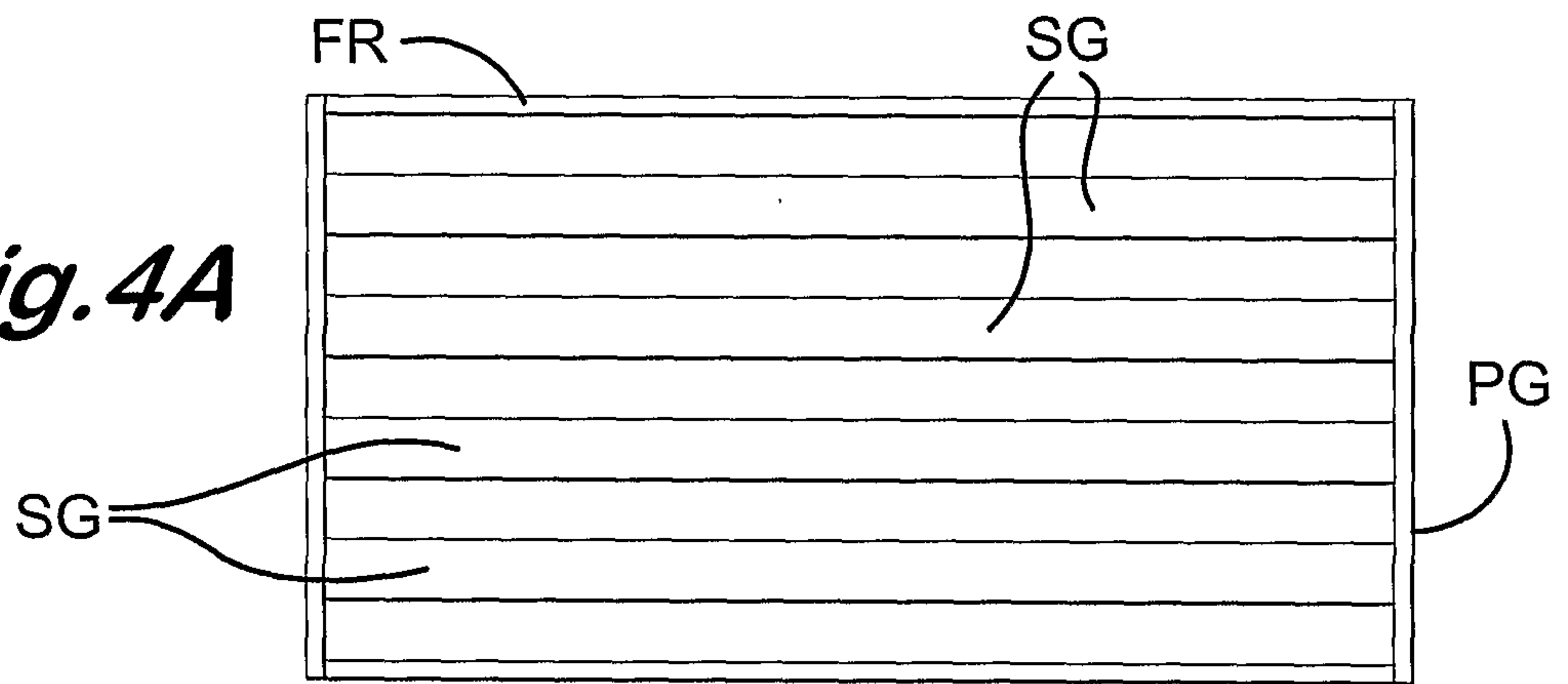


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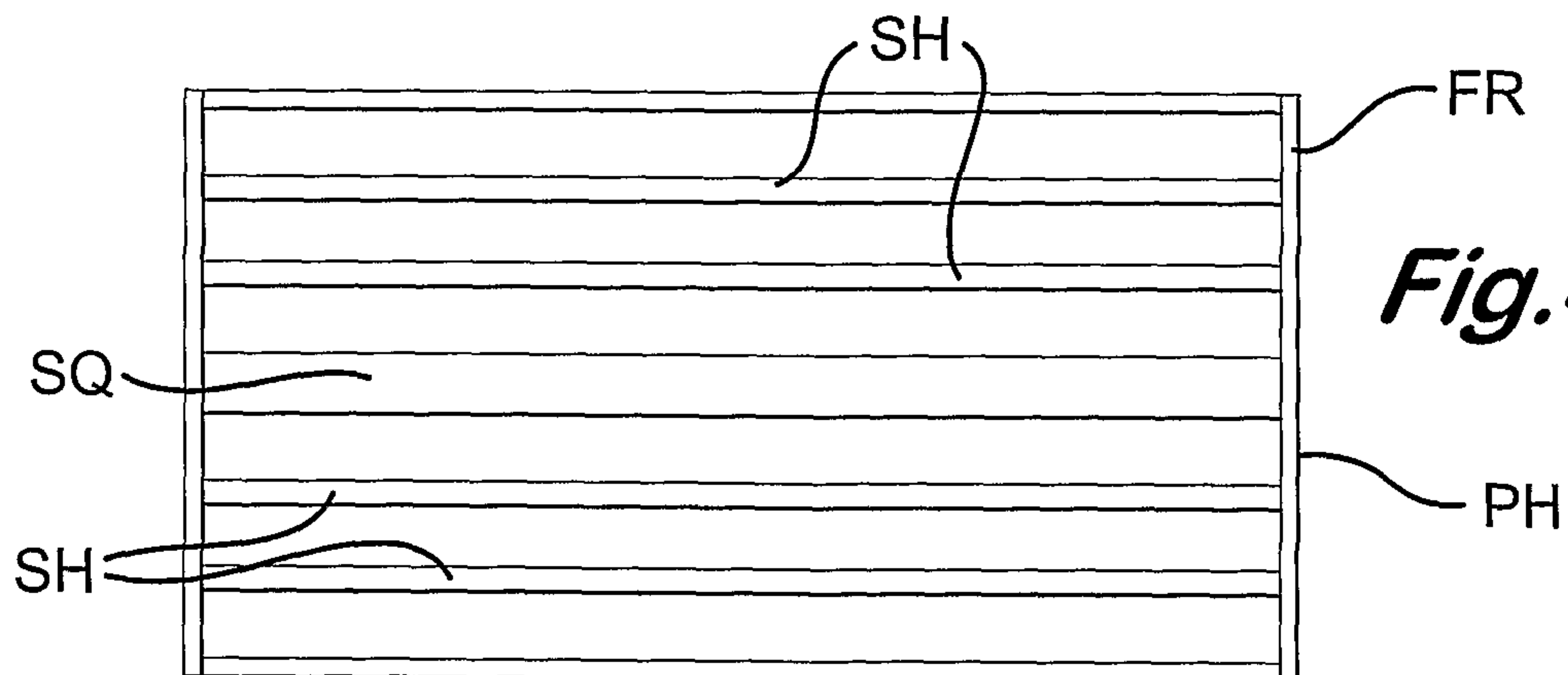
*Fig. 2*



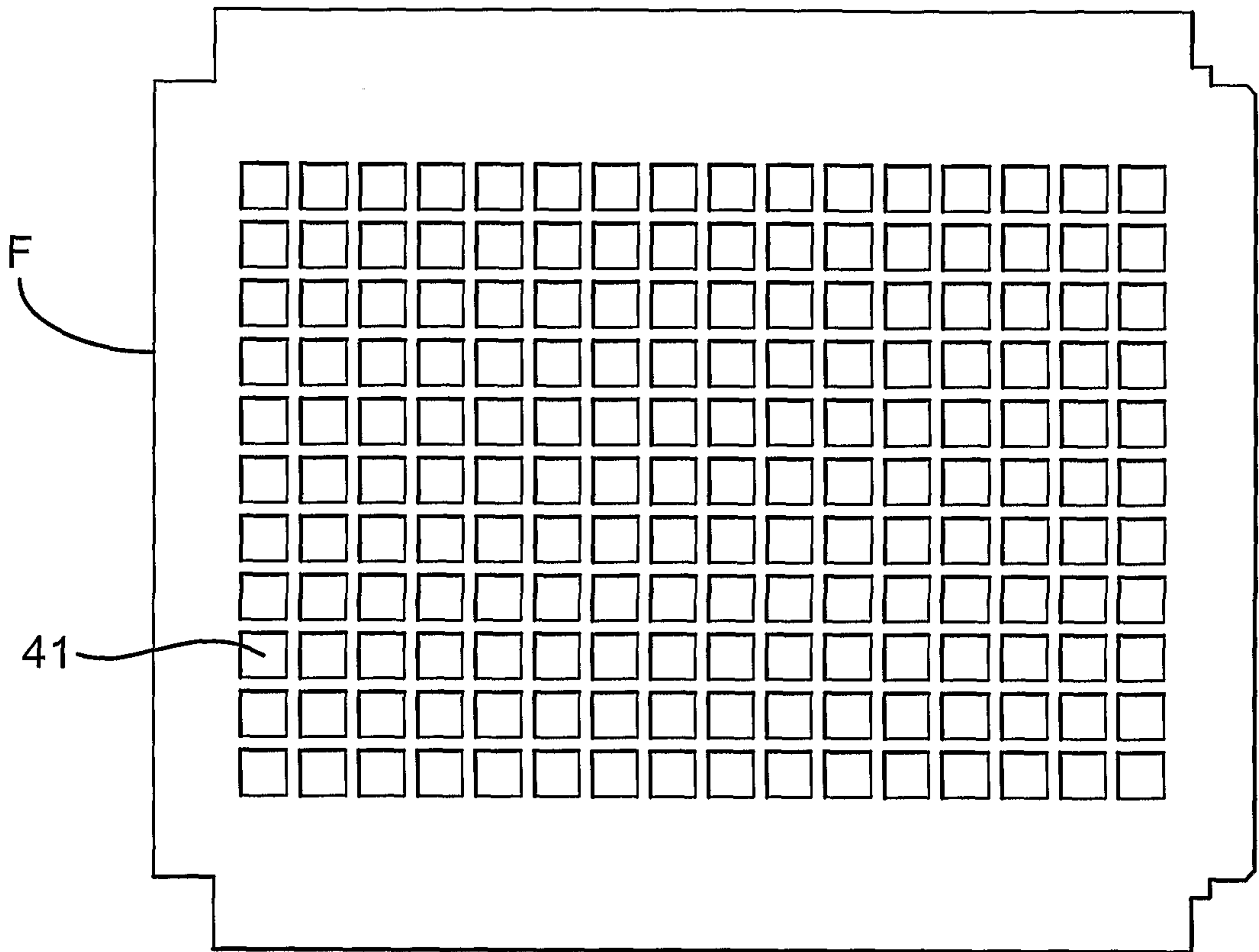
*Fig. 4A*



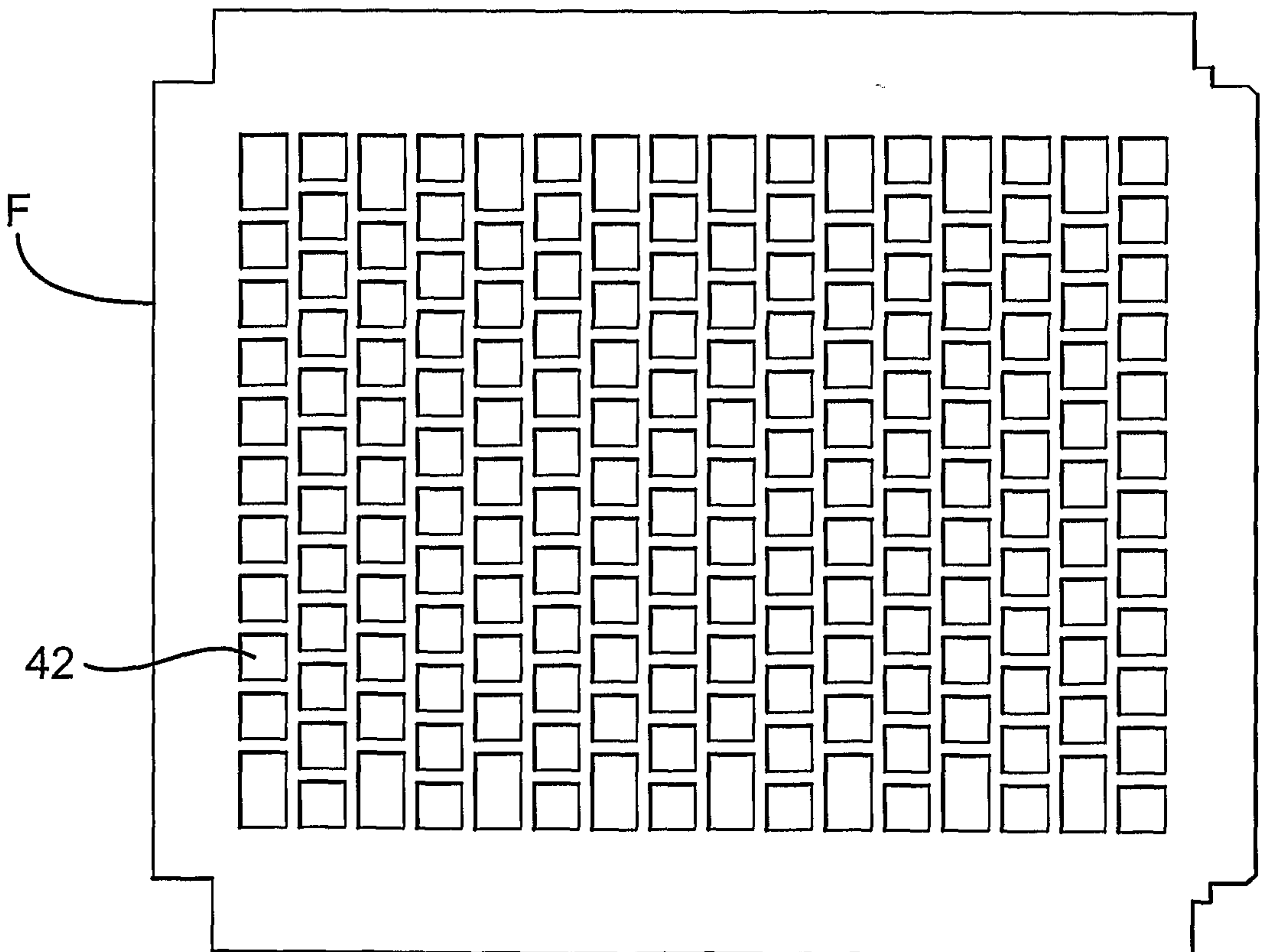
*Fig. 4B*



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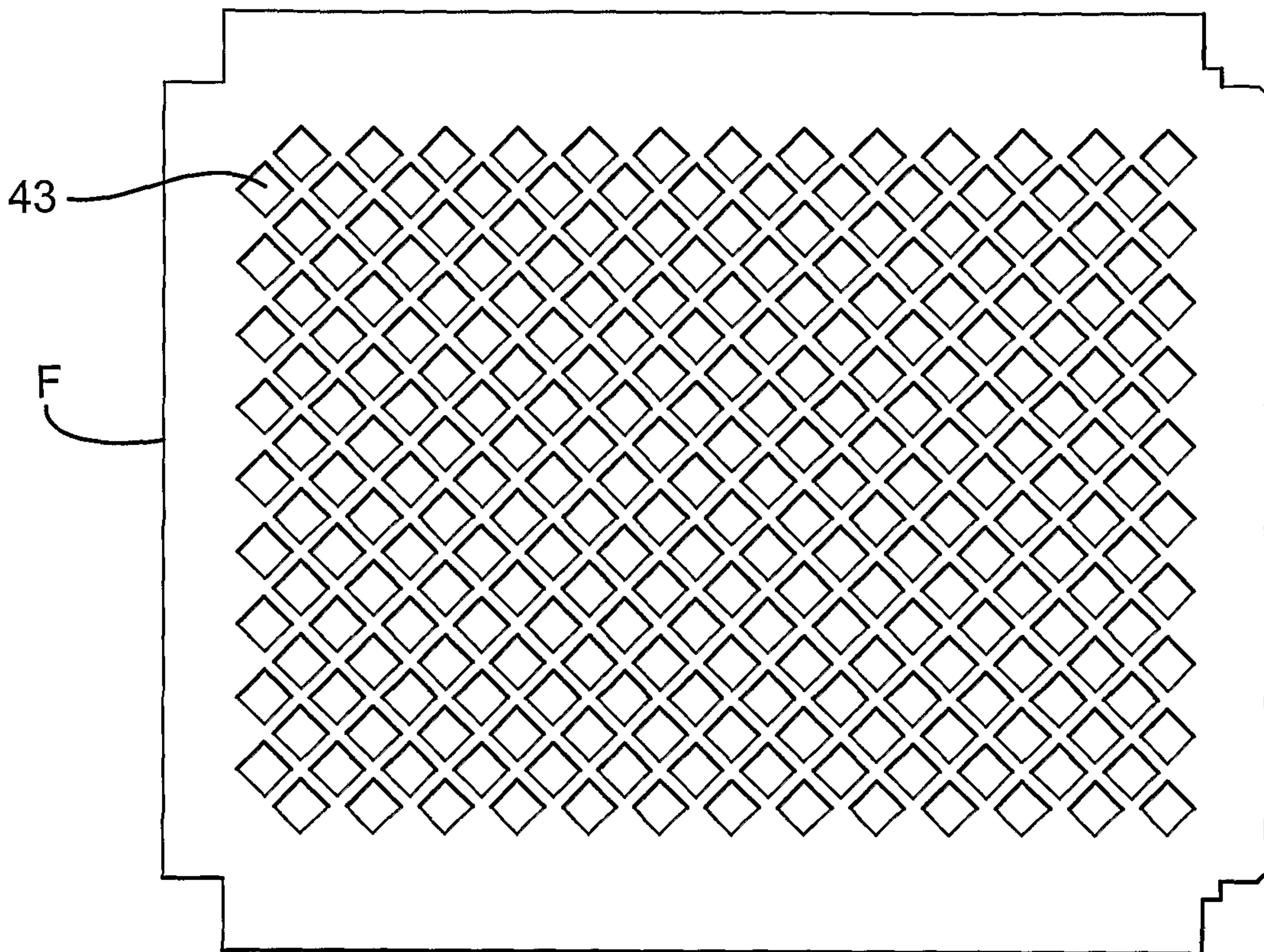


*Fig. 3A*

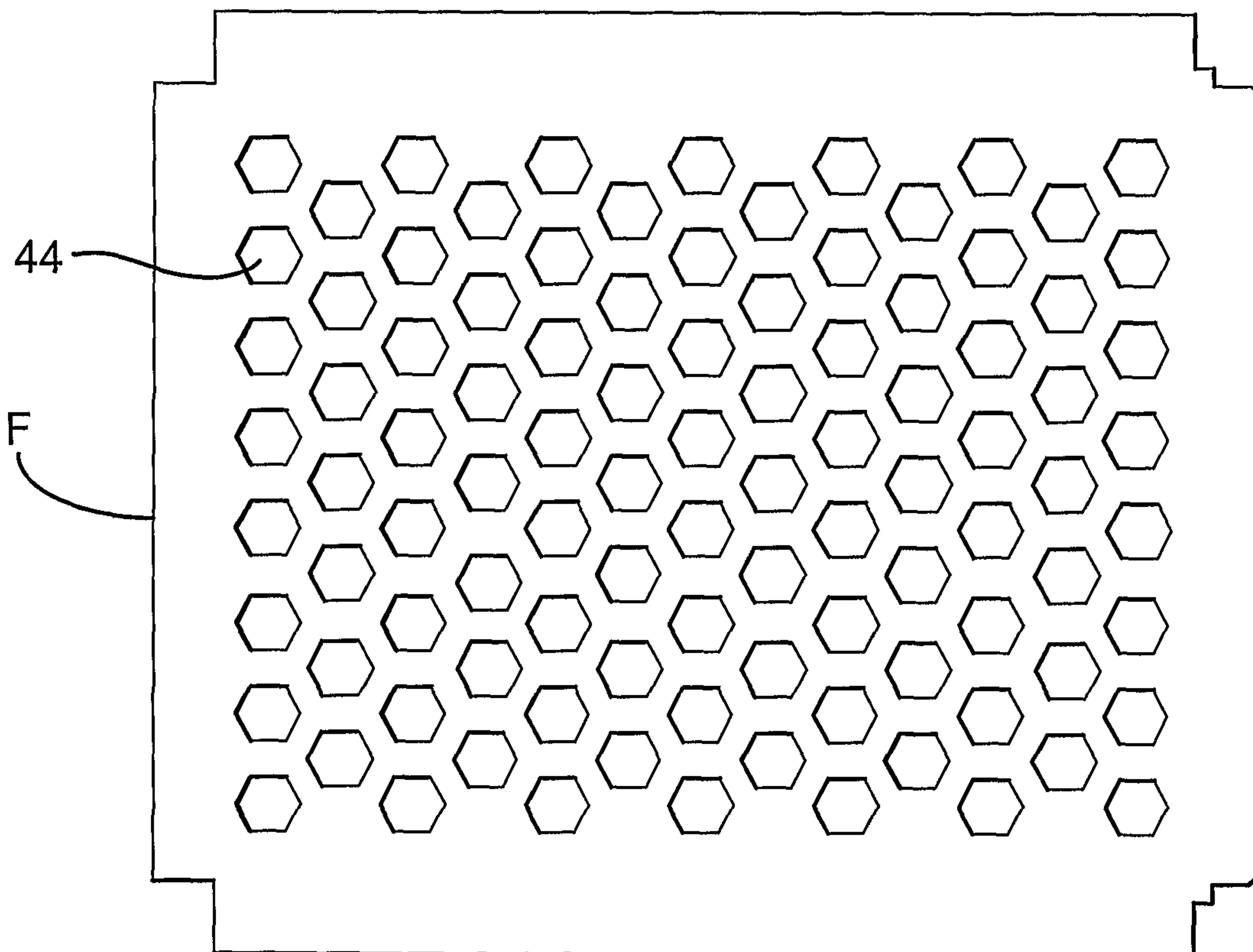


*Fig. 3B*

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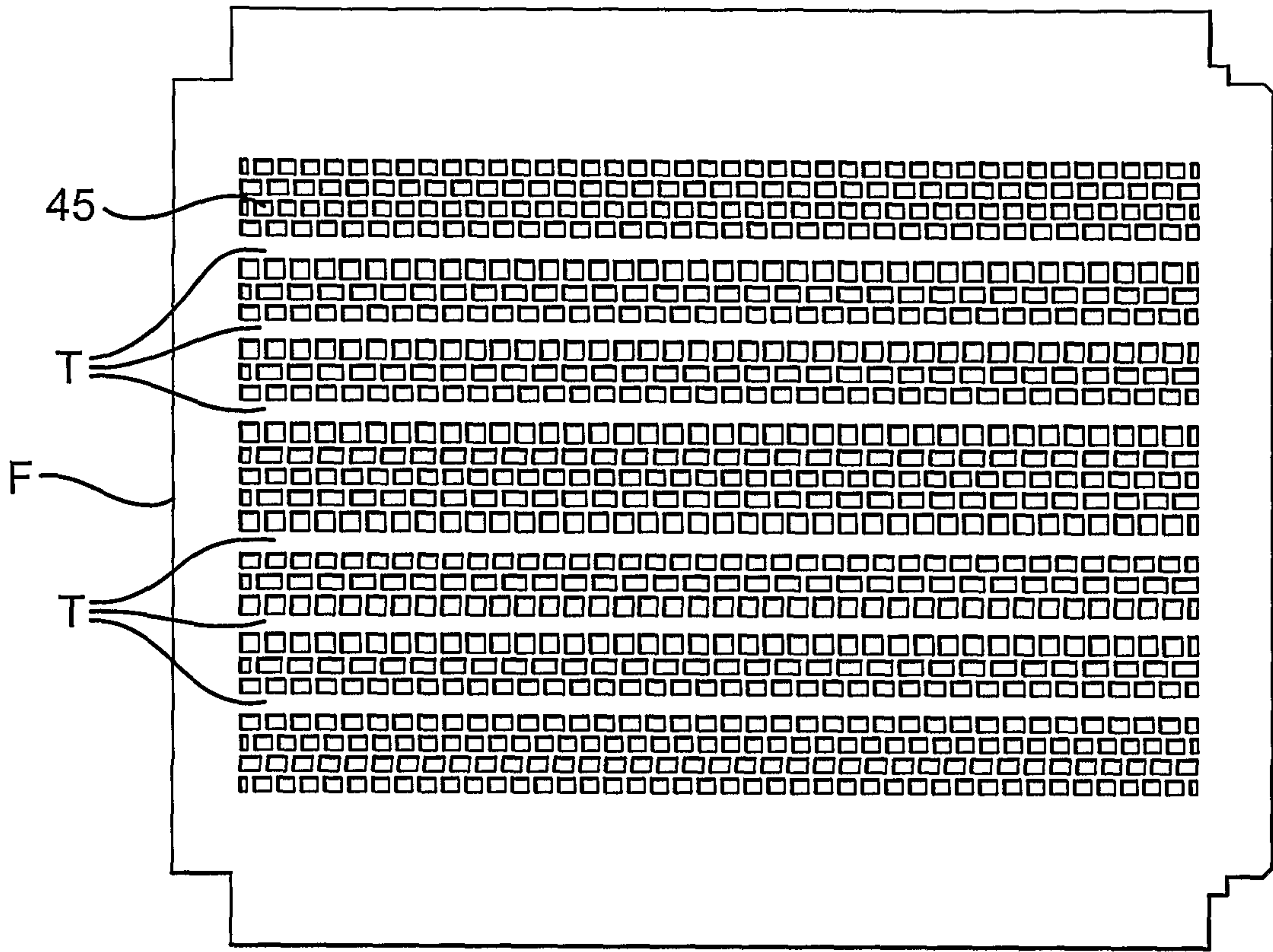


*Fig. 3C*

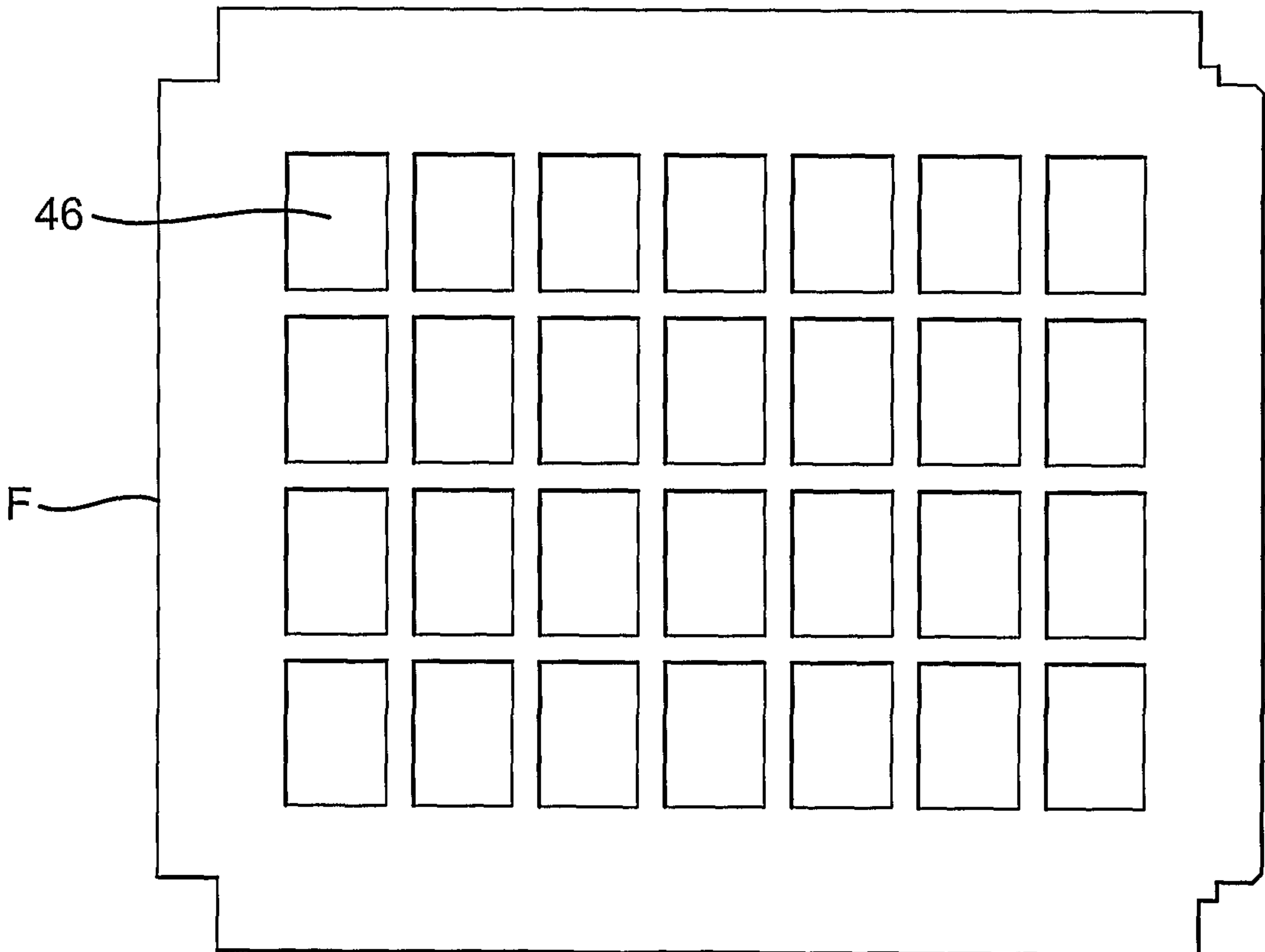


*Fig. 3D*

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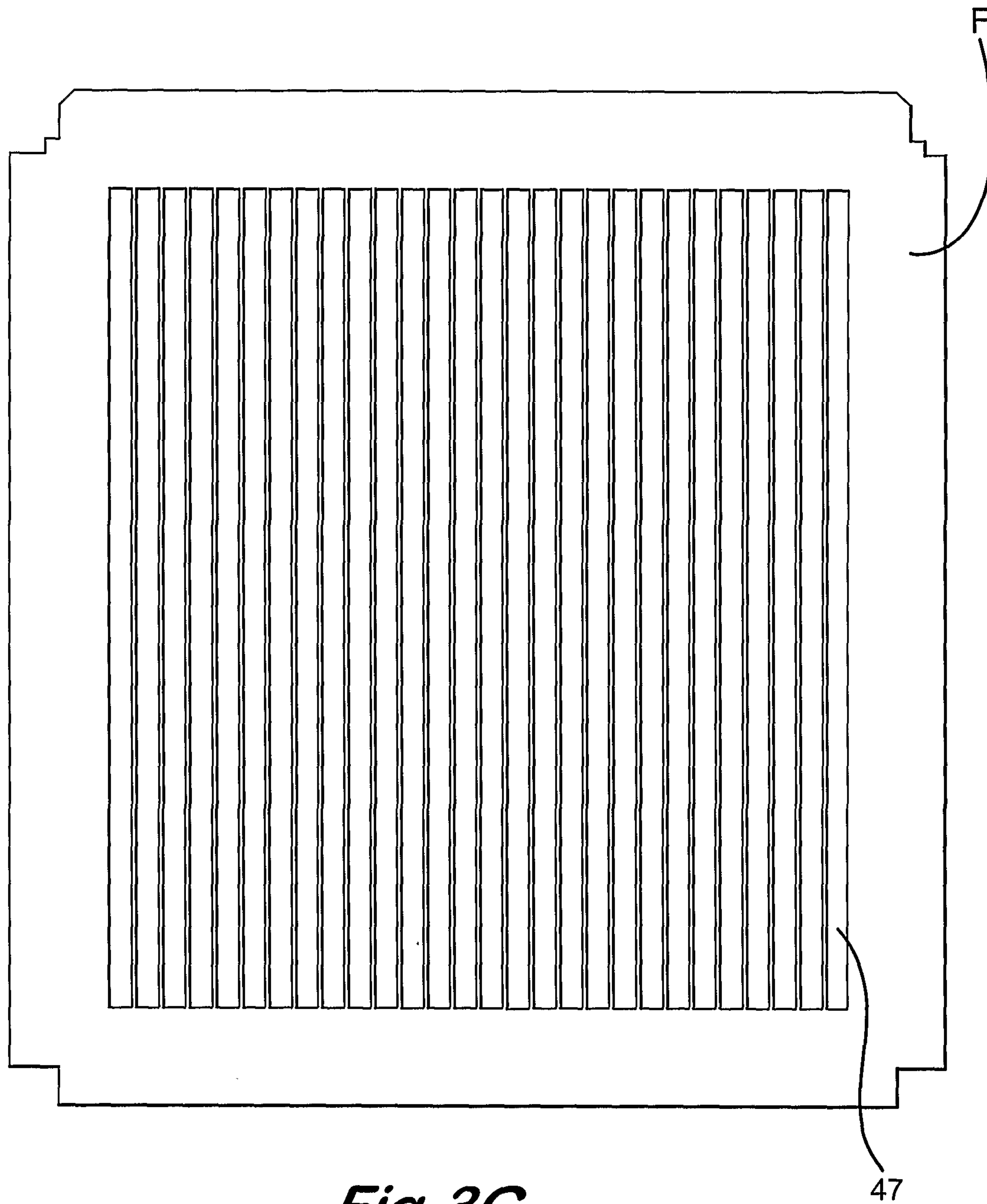


*Fig. 3E*

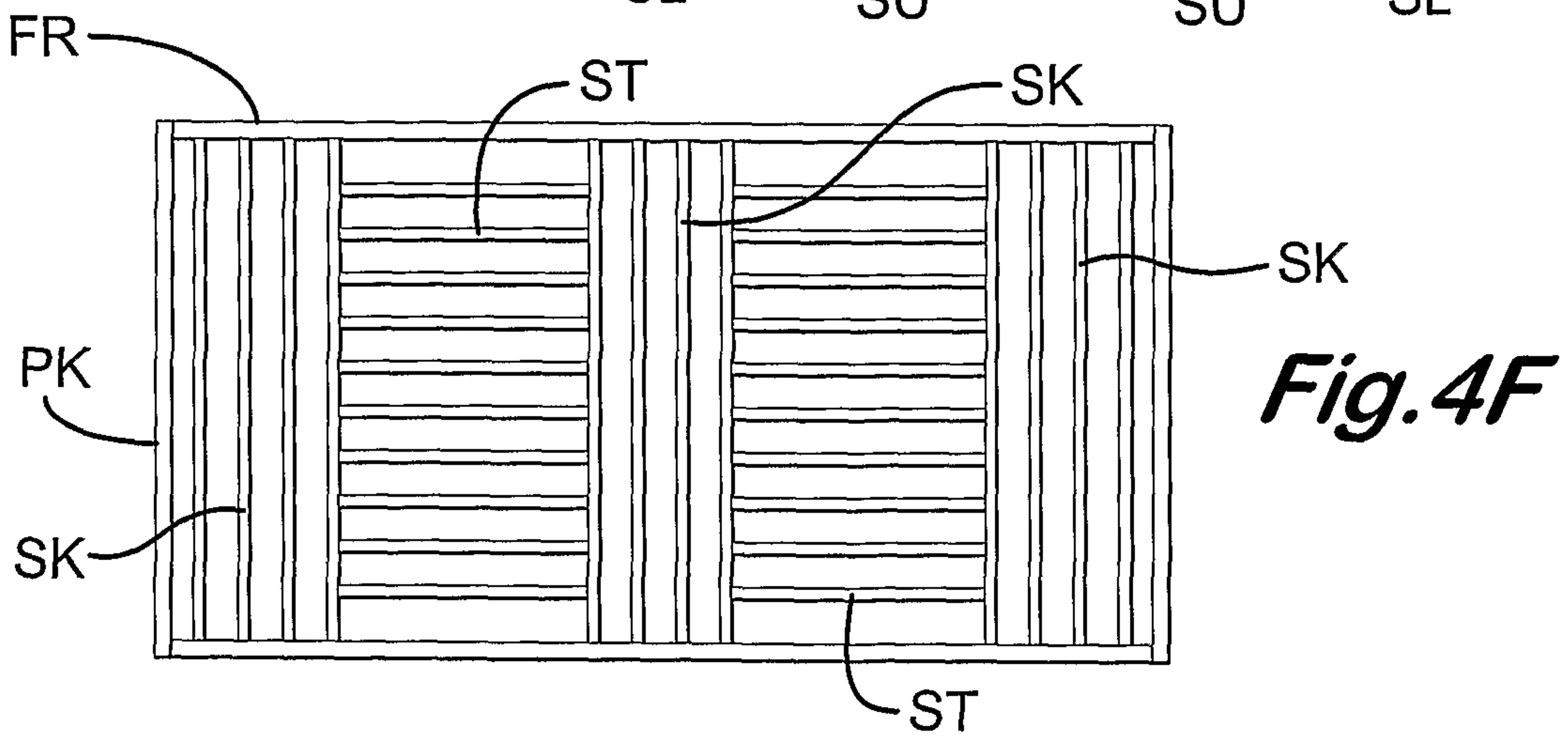
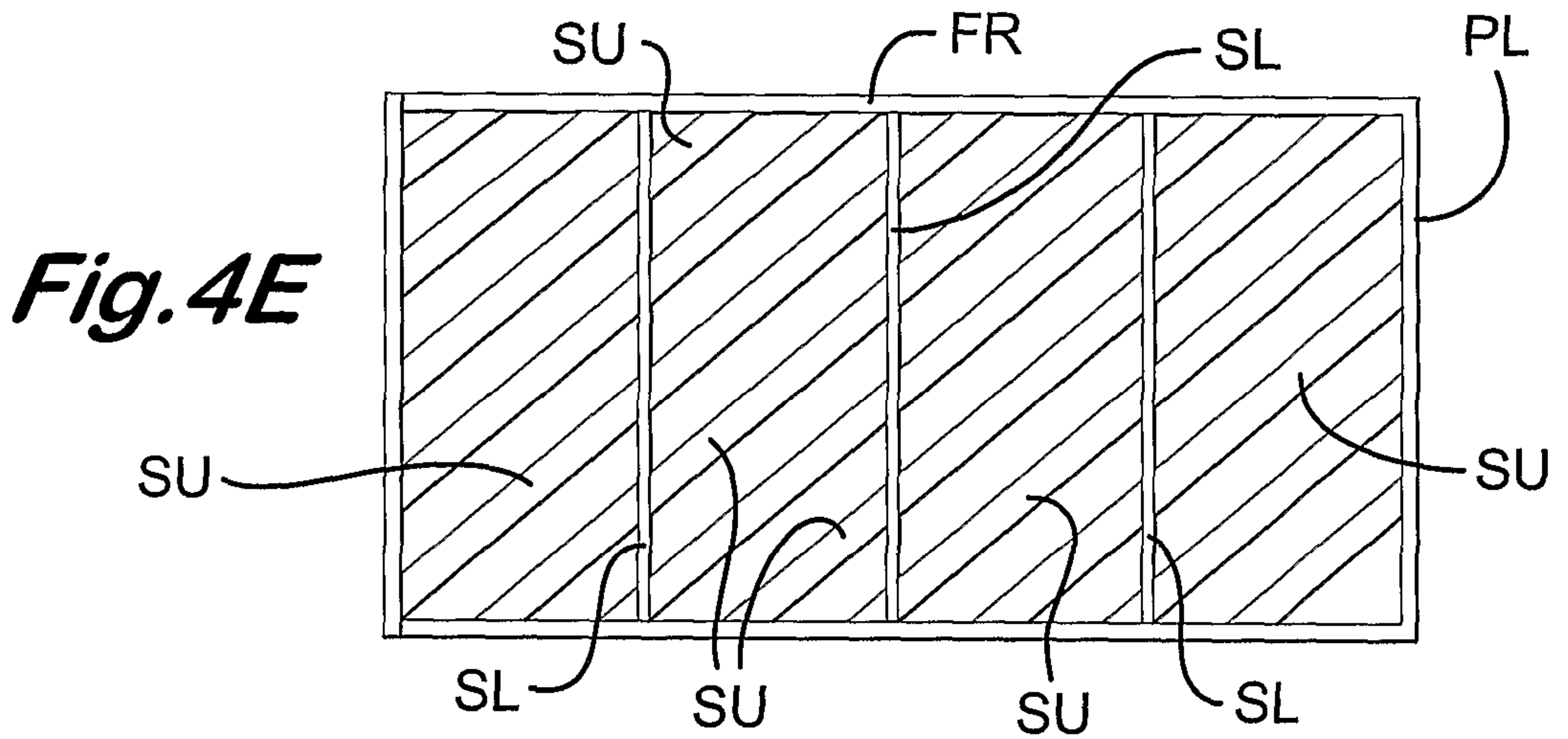
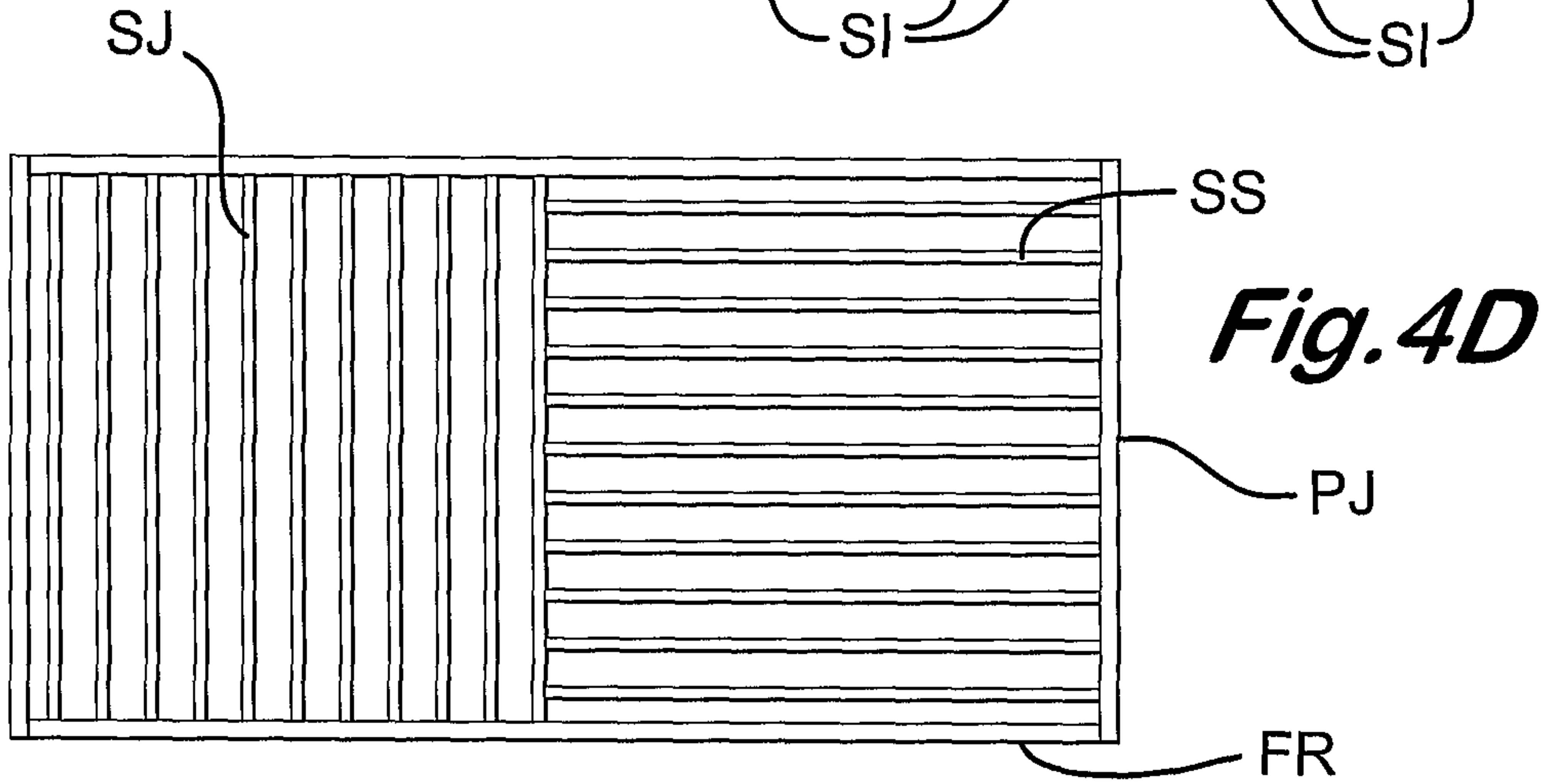
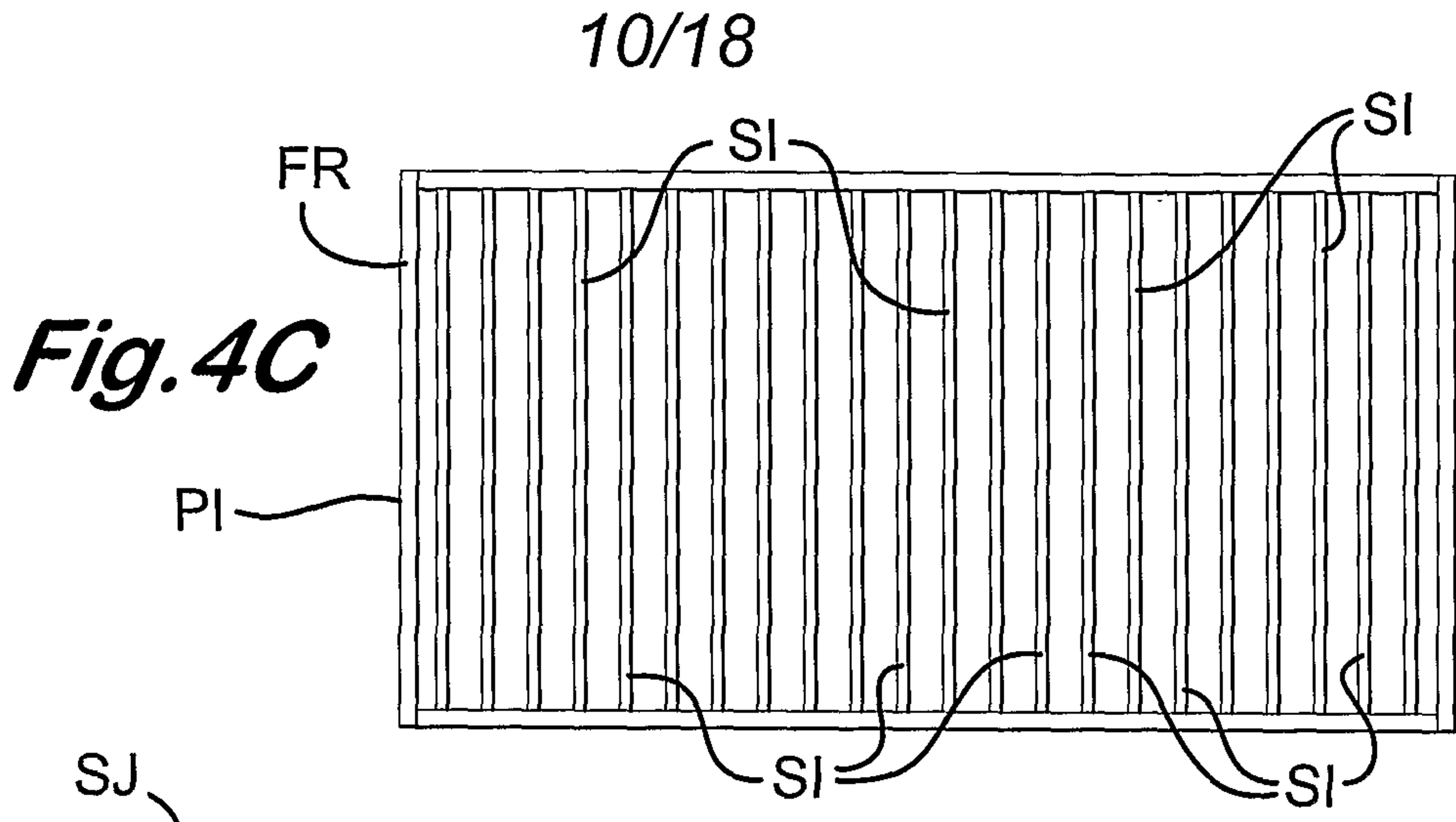


*Fig. 3F*

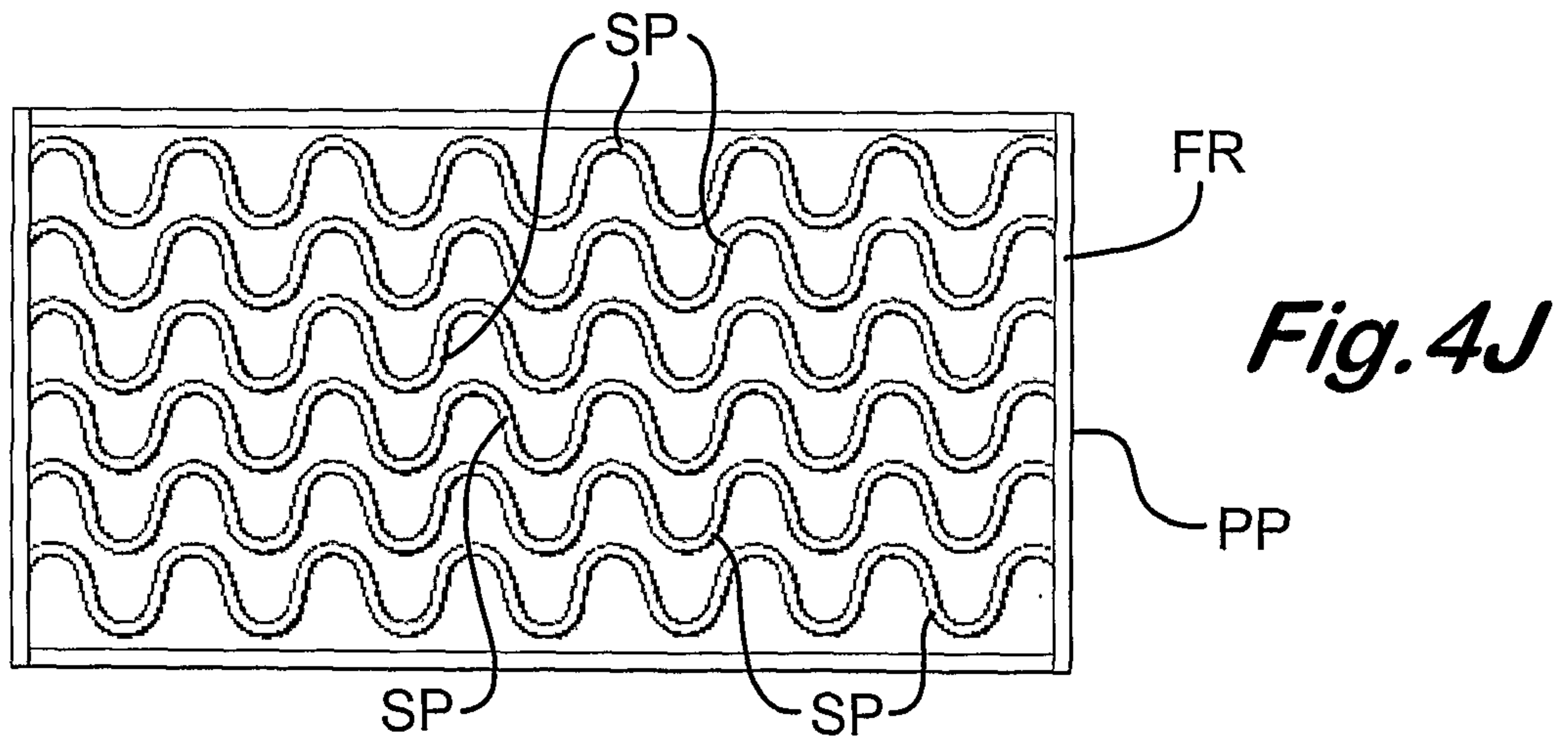
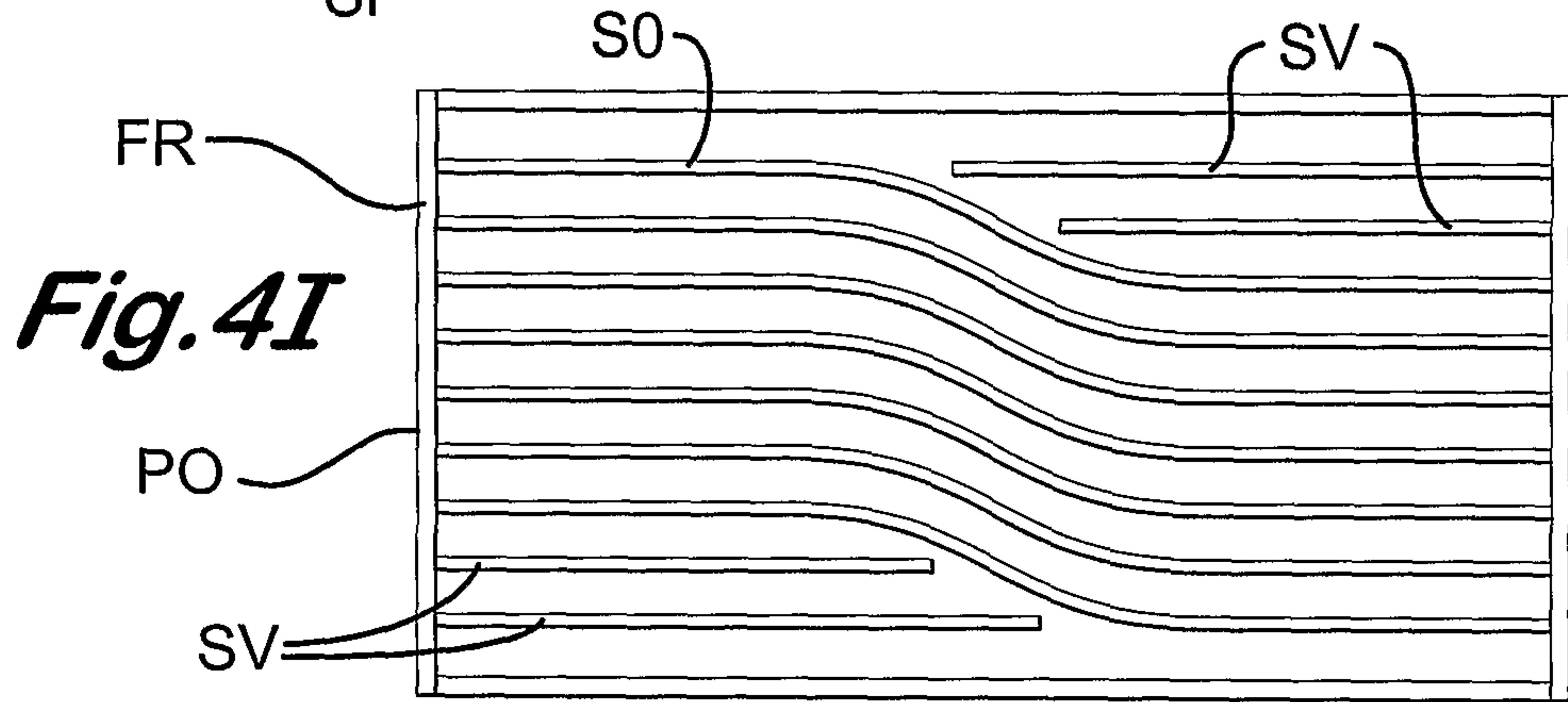
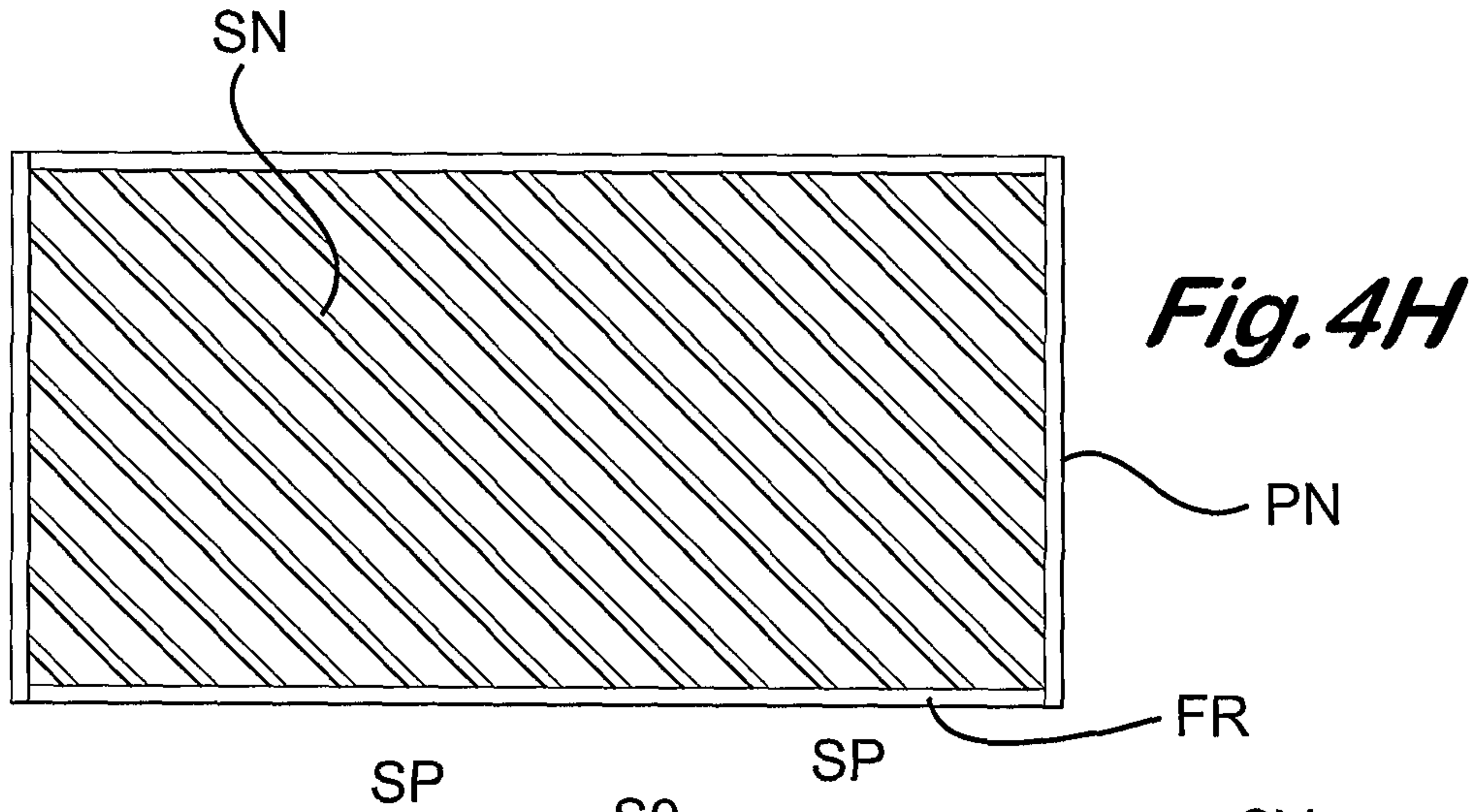
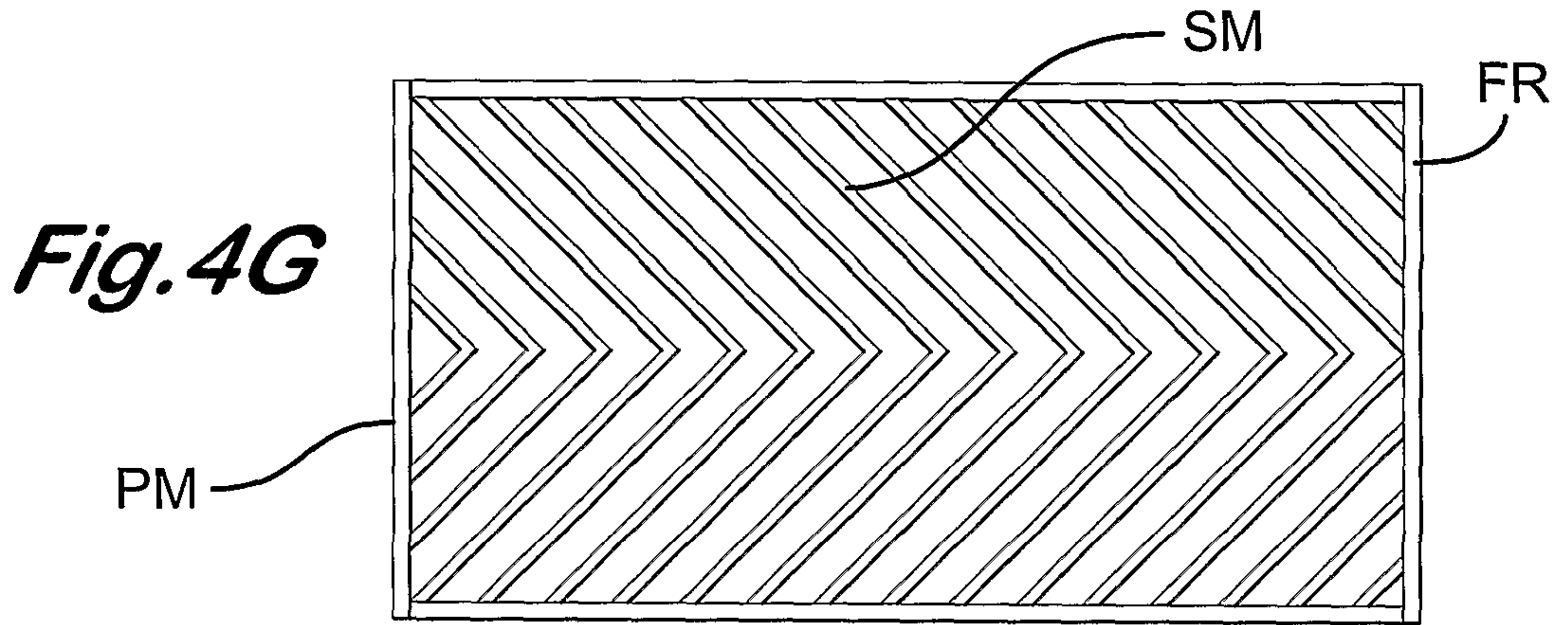
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*Fig. 3G*

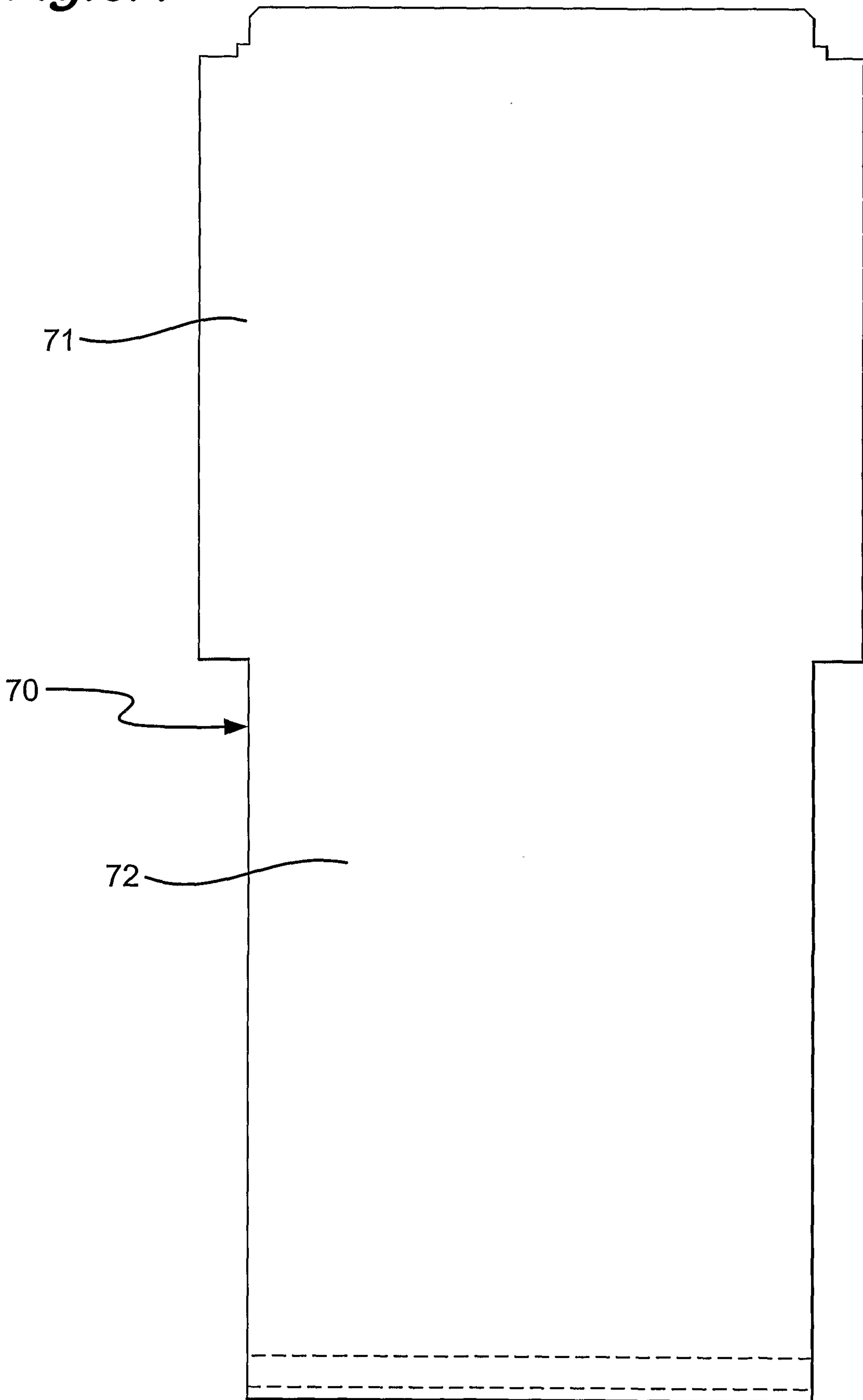


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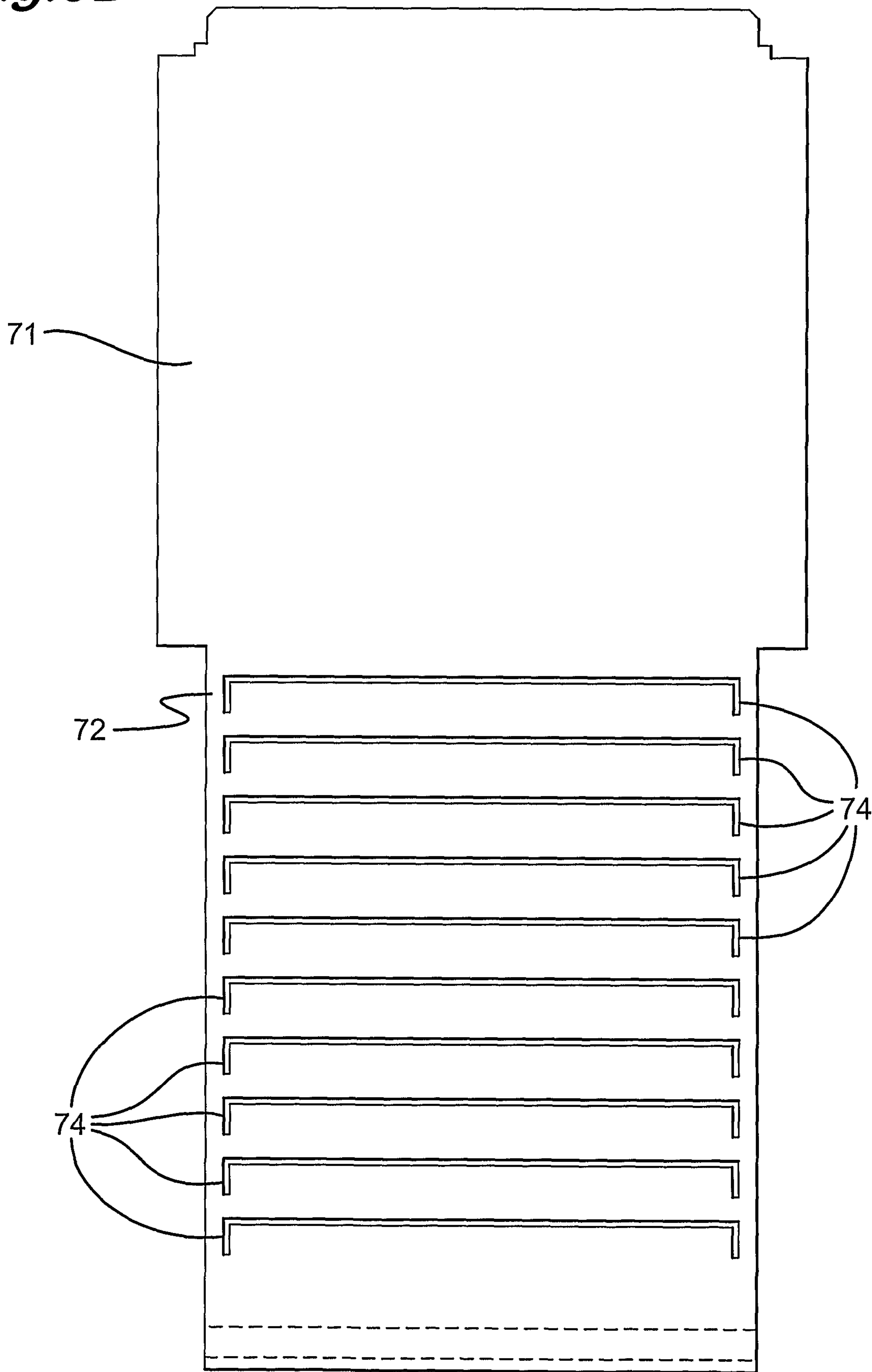
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**Fig. 5A**



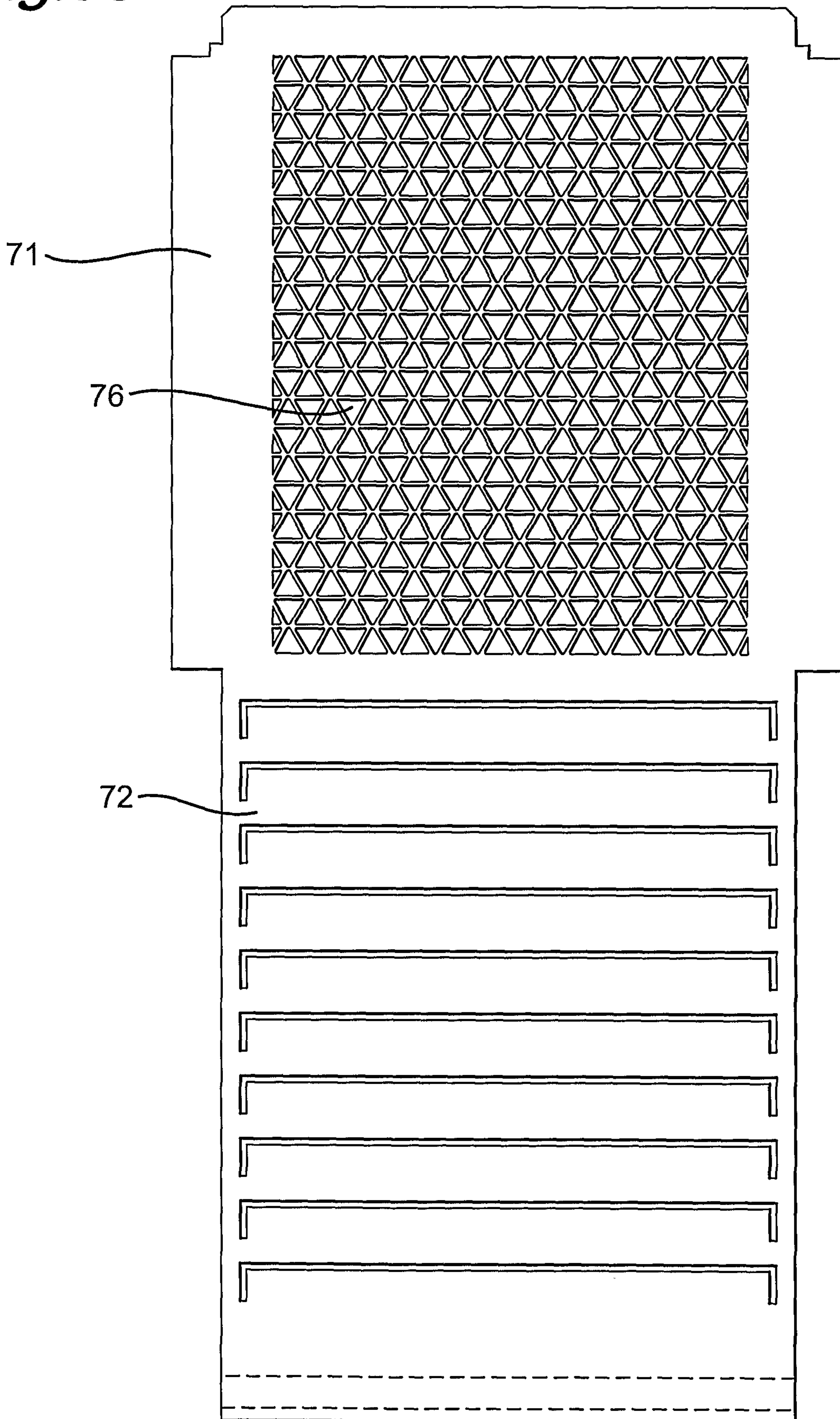
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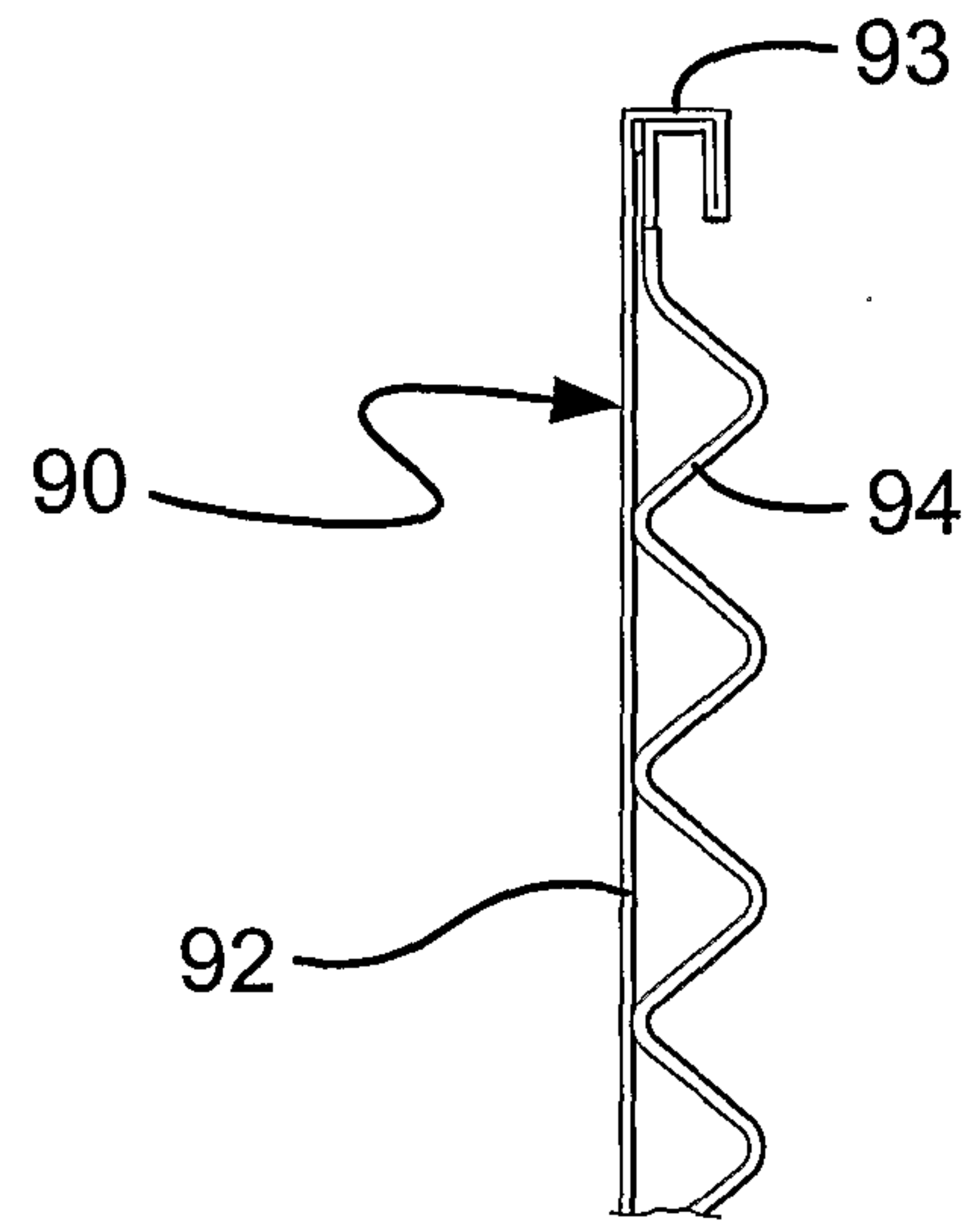
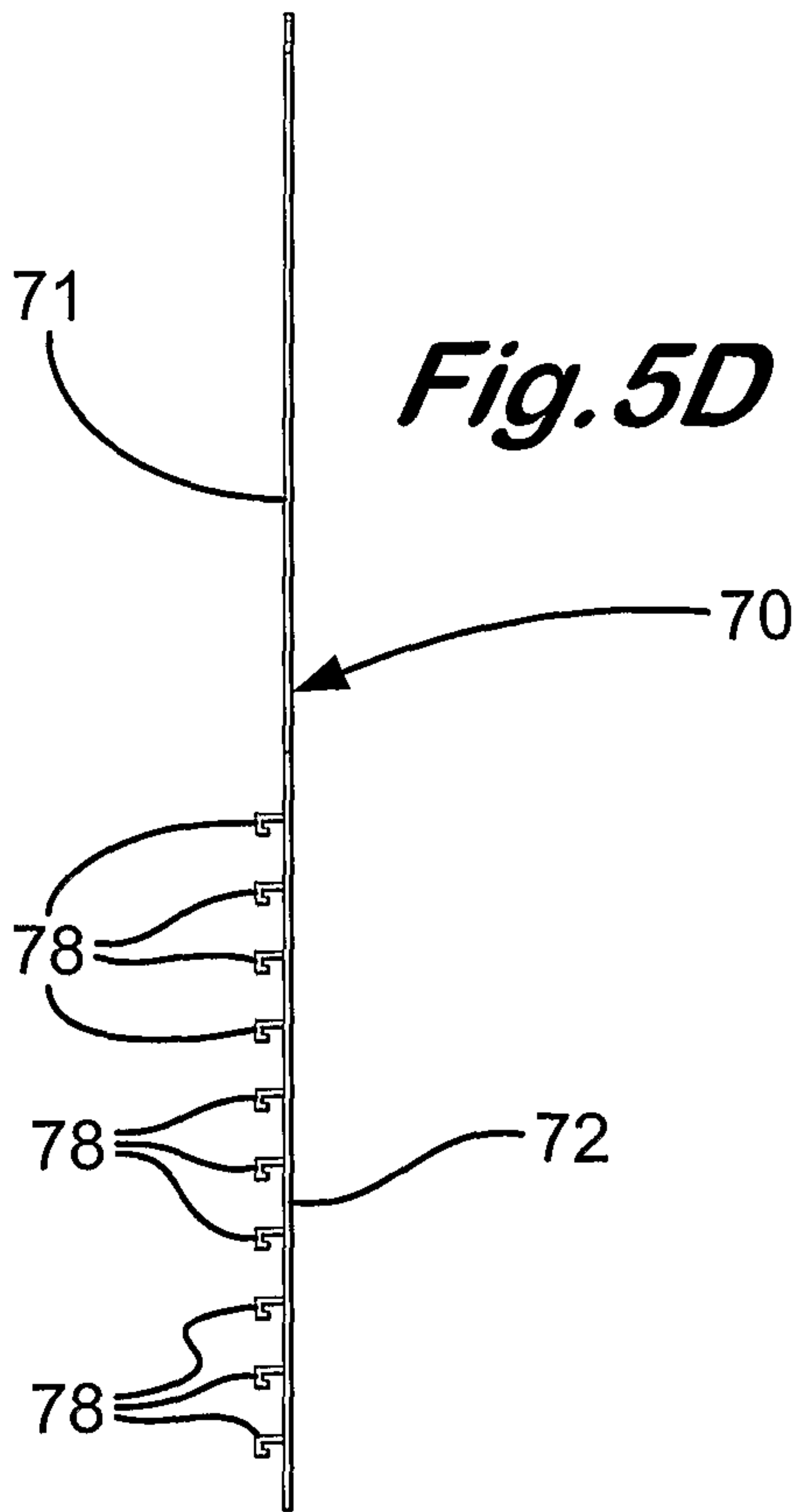
**Fig. 5B**



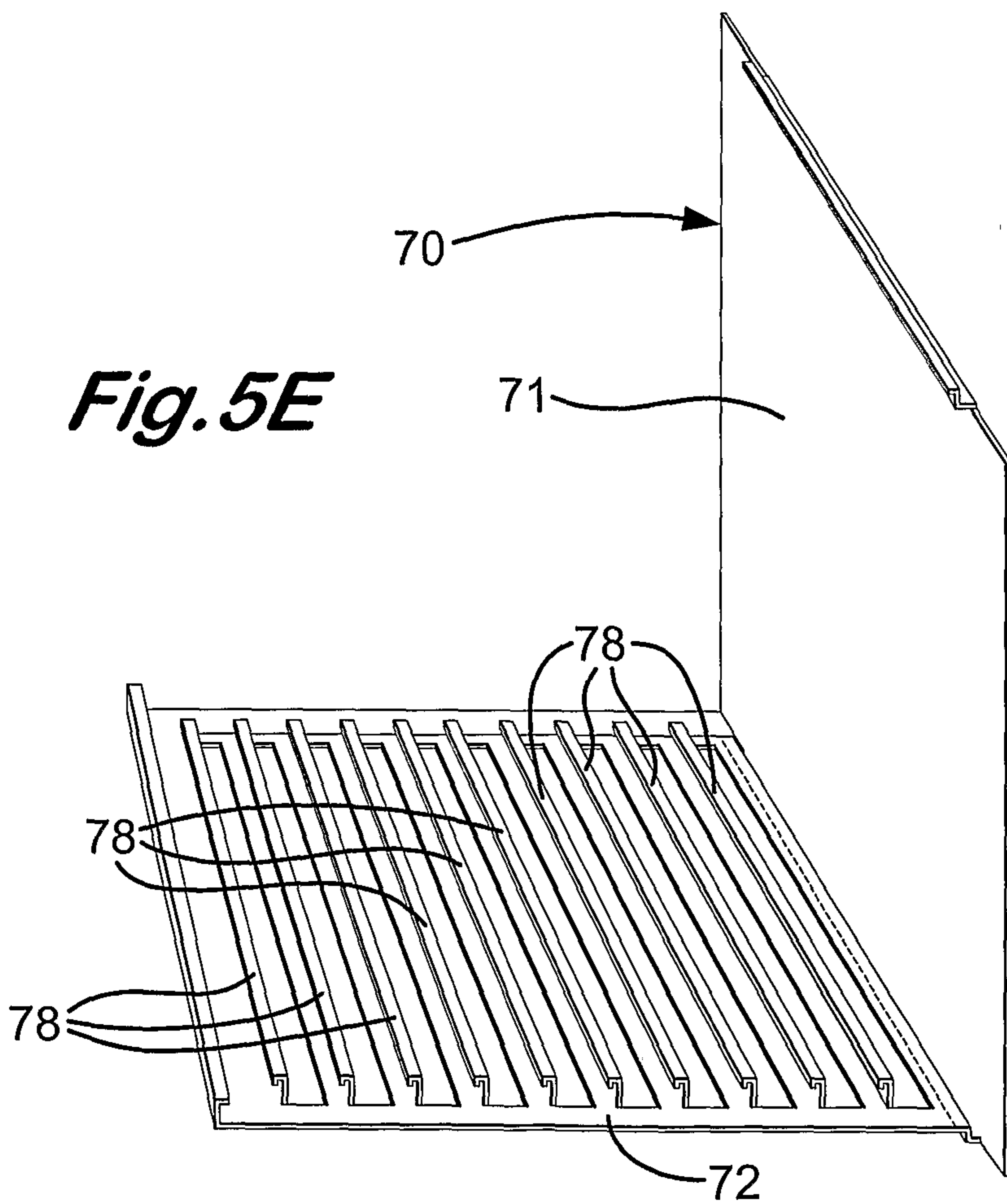
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*Fig. 5C*

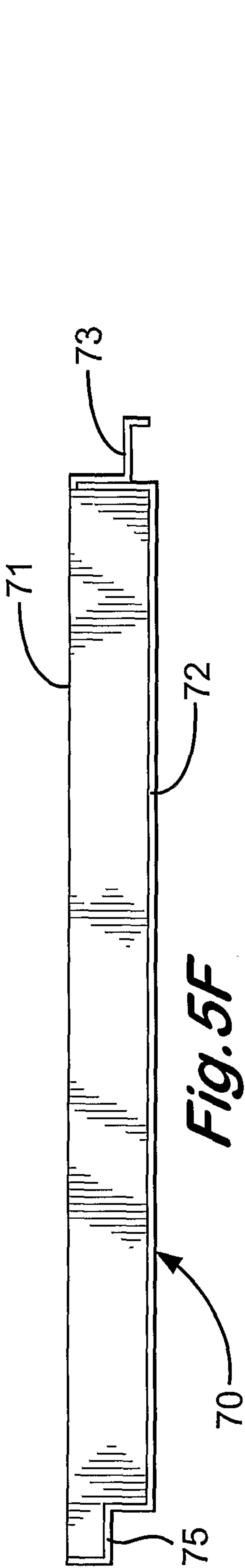




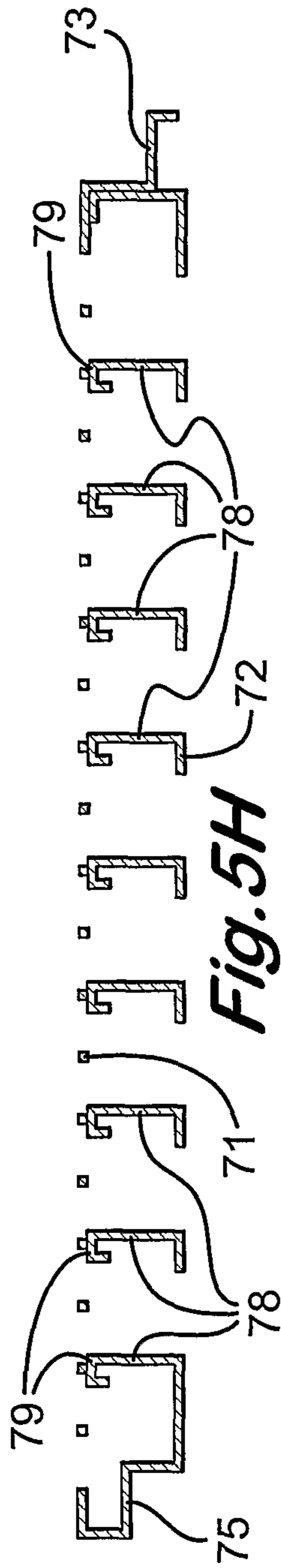
**Fig. 6**



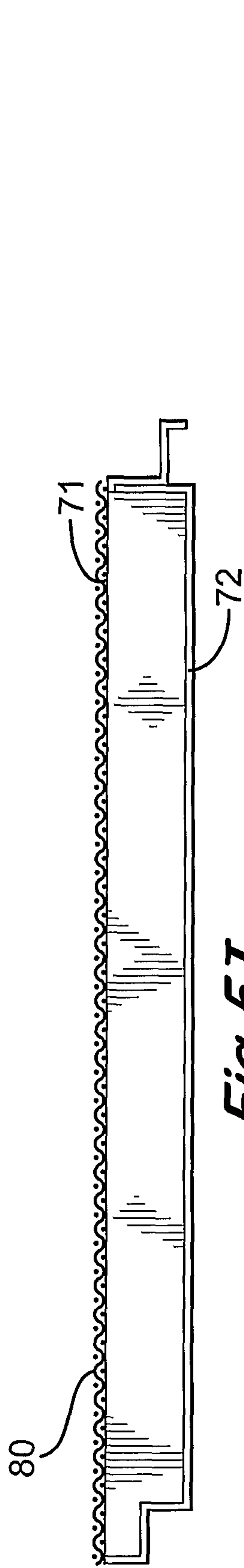
**Fig. 5E**



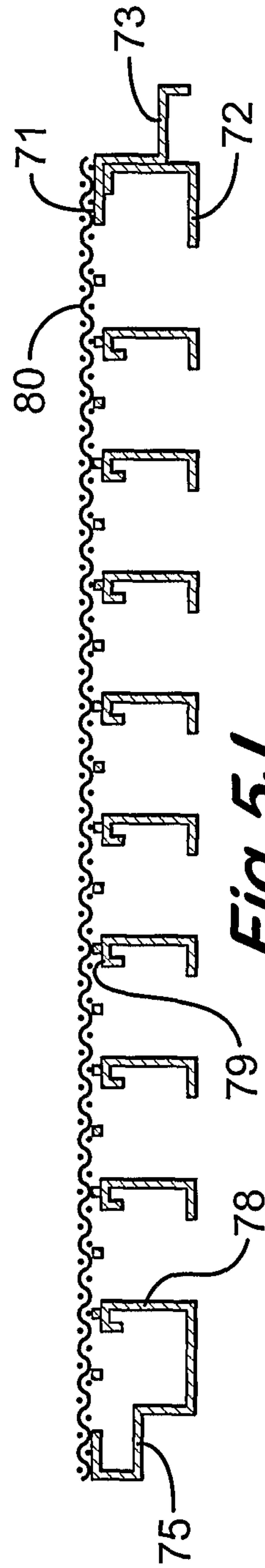
**Fig. 5F**



**Fig. 5H**

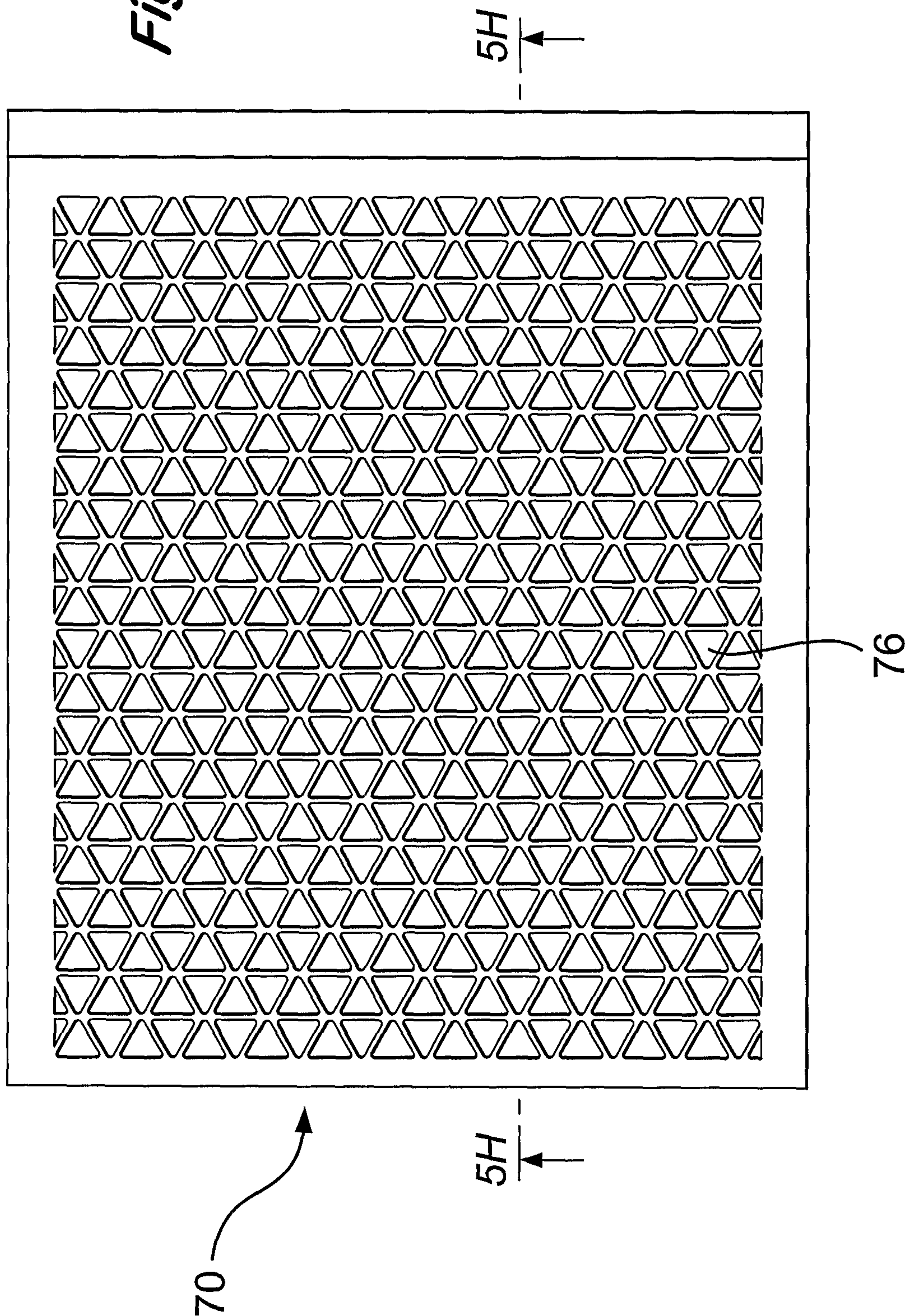


**Fig. 5I**



**Fig. 5J**

*Fig. 5G*



*Fig. 5K*

