Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2796724 C 2015/04/07

(11)(21) 2 796 724

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2011/02/07
(87) Date publication PCT/PCT Publication Date: 2011/10/27
(45) Date de délivrance/Issue Date: 2015/04/07
(85) Entrée phase nationale/National Entry: 2012/10/17
(86) N° demande PCT/PCT Application No.: US 2011/023923
(87) N° publication PCT/PCT Publication No.: 2011/133238
(30) Priorité/Priority: 2010/04/19 (US12/763,046)

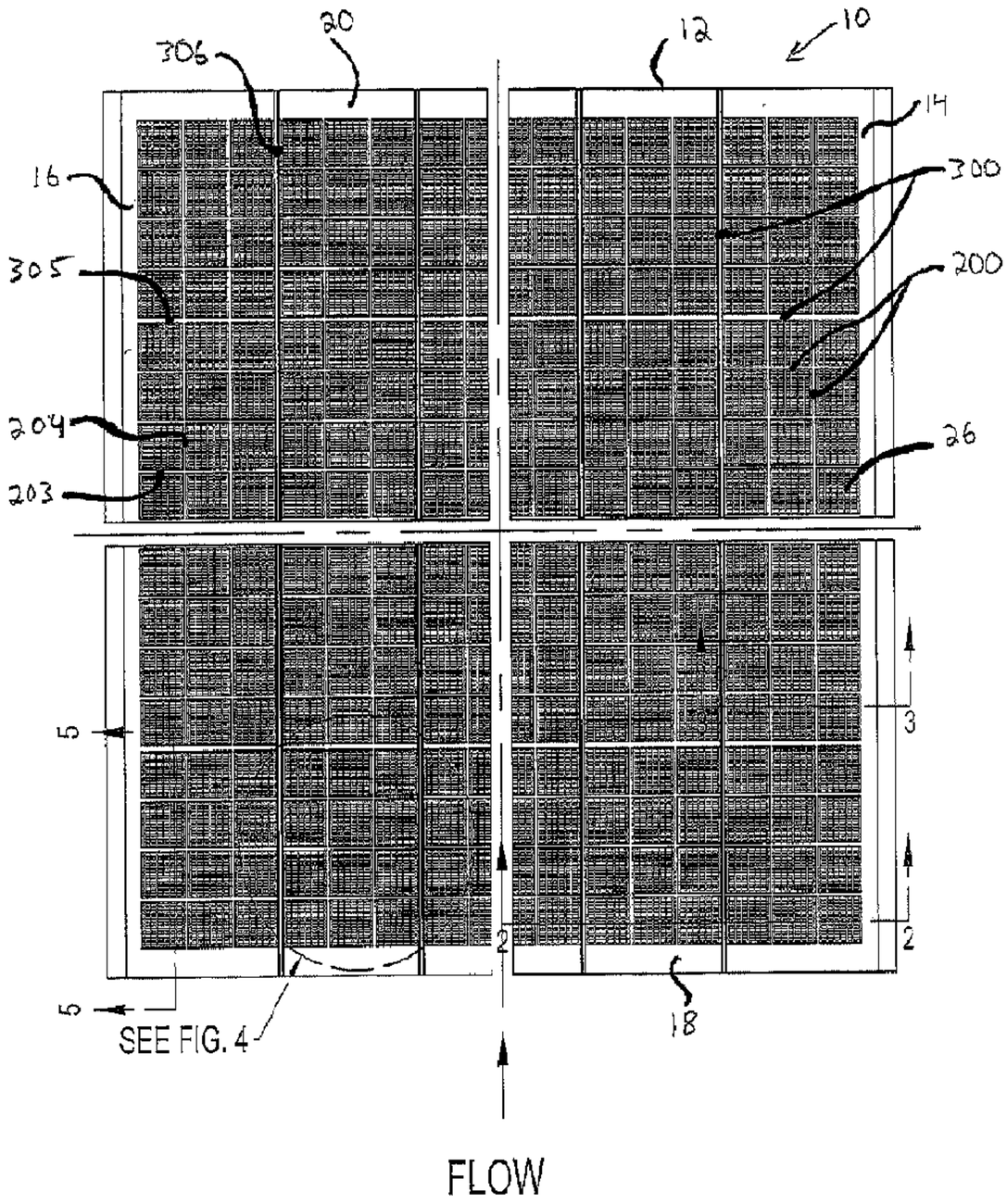
(51) Cl.Int./Int.Cl. *B07B 1/46* (2006.01),
B29D 28/00 (2006.01)

(72) Inventeurs/Inventors:
LIPA, ANTHONY J., US;
COLGROVE, JAMES R., US

(73) Propriétaire/Owner:
DERRICK CORPORATION, US

(74) Agent: SMART & BIGGAR

(54) Titre : TAMIS VIBRANT EN POLYURETHANE
(54) Title: POLYURETHANE VIBRATORY SCREEN



(57) Abrégé/Abstract:
A molded polyurethane vibratory screen including a body having opposite side edge portions, upper and lower edge portions, an upper surface and a lower surface, first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, reinforcement members molded integrally with the third and fourth members.

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 October 2011 (27.10.2011)

PCT

(10) International Publication Number
WO 2011/133238 A1

(51) International Patent Classification:
B07B 1/46 (2006.01) *B07B 13/00* (2006.01)

(21) International Application Number:
PCT/US2011/023923

(22) International Filing Date:
7 February 2011 (07.02.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/763,046 19 April 2010 (19.04.2010) US

(71) Applicant *(for all designated States except US)*: **DERRICK CORPORATION** [US/US]; 590 Duke Road, Buffalo, New York 14225 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **LIPA, Anthony J.** [US/US]; 262 Presidio Place, Williamsville, New York 14221 (US). **COLGROVE, James R.** [US/US]; 9613 Wagner Road, Holland, New York 14080 (US).

(74) Agent: **MUELLER, Jason P.**; Adams and Reese, LLP, 1221 McKinney Street, Suite 4400, Houston, Texas 77010 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

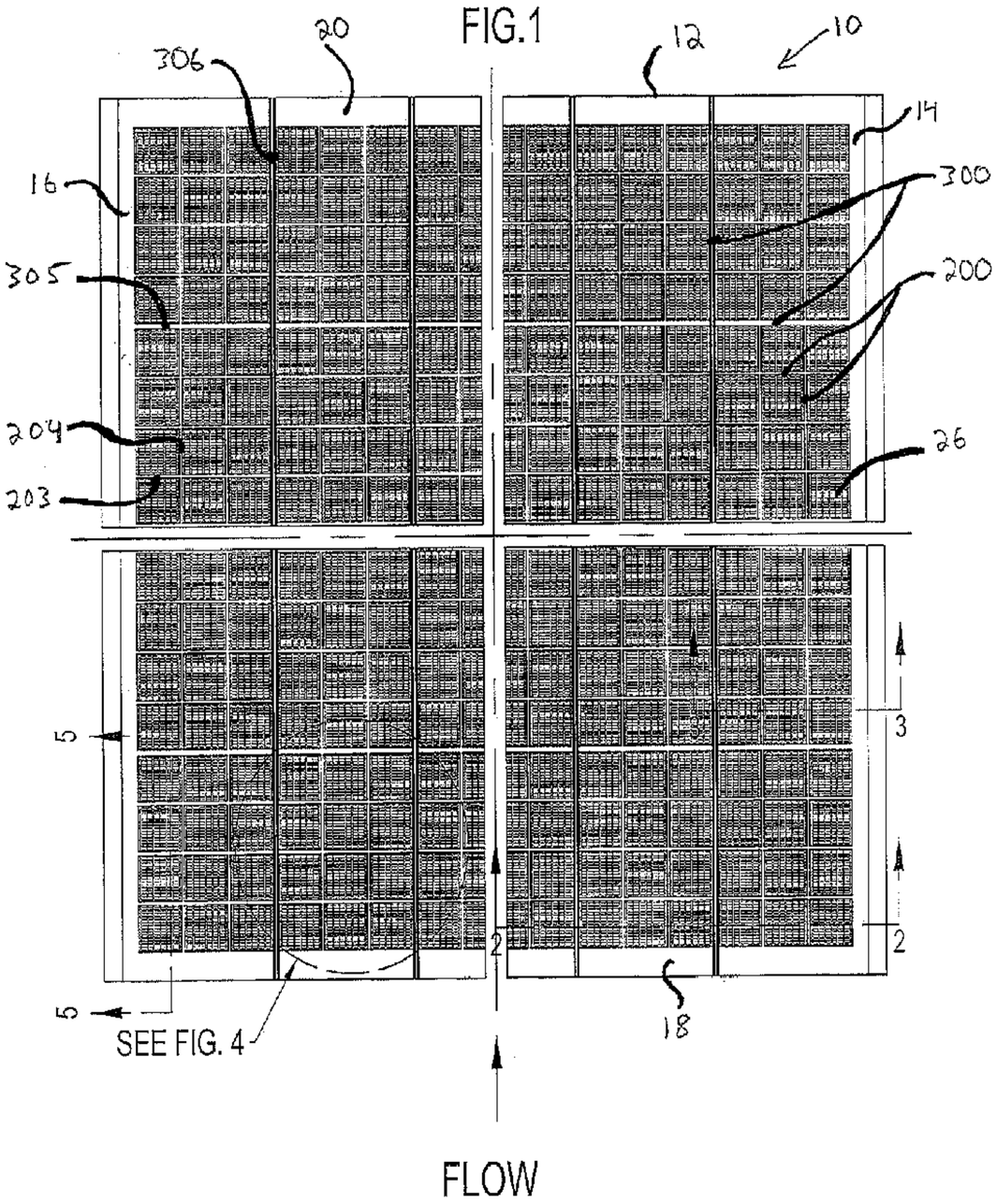
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG,

[Continued on next page]

(54) Title: POLYURETHANE VIBRATORY SCREEN

(57) Abstract: A molded polyurethane vibratory screen including a body having opposite side edge portions, upper and lower edge portions, an upper surface and a lower surface, first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, reinforcement members molded integrally with the third and fourth members.

FIG.1



WO 2011/133238 A1

WO 2011/133238 A1

ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

51371-12

POLYURETHANE VIBRATORY SCREEN

FIELD OF THE INVENTION

The present invention relates to an improved molded polyurethane screen.

BACKGROUND

Molded polyurethane screens having reinforcement therein are known in the art. However, in the past the dividing strips between the openings were relatively large, thereby causing the open area of the screen to be an undesirably low percentage of its surface, thereby in turn causing the screen to be relatively inefficient.

The present invention is an improvement over U.S. Patent Nos. 4,819,809 and 4,857,176. The present invention provides improved screens with relatively high percentage open screening areas and high efficiencies.

SUMMARY

According to an exemplary embodiment of the present invention, a vibratory screen includes: a flexible molded polyurethane body having substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings and third and fourth members. The first members extend between the side edge portions. The second members extend between the lower edge portion and the upper edge portion. The third and fourth members may have a thickness greater than the first and second members. The third members are substantially parallel and extend transversely between the side edge portions and have multiple first members therebetween. The fourth members are substantially parallel and extend transversely between the lower edge portion and the

upper edge portion and have multiple second members therebetween. Reinforcement members are molded integrally with the third and fourth members.

In accordance with another embodiment of the invention, there is provided a vibratory screen comprising: a flexible molded polyurethane body having substantially parallel side edge portions at opposite ends of the body, a lower edge portion transversely disposed between the side edge portions, an upper edge portion disposed between the side edge portions and substantially parallel and opposite to the lower end portion, an upper surface, a lower surface, a first integrally molded grid structure, a second integrally molded grid structure, a third integrally molded grid structure and screen openings, wherein the first grid structure includes first and second members forming the screening openings, the first members substantially parallel and extending transversely between the side edge portions and the second members substantially parallel and extending transversely between the lower edge portion and the upper edge portion, wherein the second grid structure includes third and a fourth members, the third and fourth members having a thickness greater than the first and second members and having a portion extending downwardly below the lower surface of the body, the third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, first reinforcement members molded integrally with the third and fourth members, wherein the third grid structure includes fifth and sixth members, the fifth and sixth members having a thickness greater than the third and fourth members and having a portion extending downwardly away from the lower surface of the body, the fifth members substantially parallel and extending transversely between the side edge portions and having multiple third members therebetween, the sixth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple fourth members therebetween, second reinforcement members molded integrally with the fifth and sixth members.

In accordance with another embodiment of the invention, there is provided a vibratory screen, comprising: a flexible molded polyurethane body having substantially parallel side edge

portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, first reinforcement members molded integrally with the third and fourth members.

In accordance with another embodiment of the invention, there is provided a vibratory screen, comprising: a flexible molded polyurethane body, screen openings in the body, first substantially parallel flexible members defining opposite sides of the screen openings, second substantially parallel flexible members defining opposite sides of the screen openings, the first members substantially perpendicular to the second members, third members substantially parallel and having multiple first members therebetween, fourth members substantially parallel and having multiple second members therebetween, reinforcement members molded integrally with each of the third and fourth members, side edge portions substantially parallel at opposite sides of the body between which the third members and reinforcement members therein extend, first and second end portions substantially parallel at opposite ends of the body between which the fourth members and reinforcement members therein extend, the side portions substantially perpendicular to the end portions.

In accordance with another embodiment of the invention, there is provided a vibratory screen, comprising: a flexible molded polyurethane body having substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge

portions and the second members extending between the lower edge portion and the upper edge portion, reinforcement members molded integrally with the first and second members.

In accordance with another embodiment of the invention, there is provided a method of making a vibratory screen, comprising: creating a mold configured to fabricate the vibratory screen, the vibratory screening having a flexible molded polyurethane body; installing reinforcement members in the mold, the structural members configured to be molded integrally with the body; filling the mold with polyurethane; and forming the vibratory screen, the vibratory screen having substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversally between the lower edge portion and the upper edge portion and having multiple second members therebetween, reinforcement members molded integrally with the third and fourth members.

In accordance with another embodiment of the invention, there is provided a vibratory screen, comprising: a flexible molded polyurethane body having side edge portions opposite each other, a lower edge portion between the side edge portions and an upper edge portion between the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members running between the side edge portions and the second members running between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members running between the side edge portions and having multiple first members therebetween, the fourth members running between the lower edge

portion and the upper edge portion and having multiple second members therebetween, first reinforcement members molded integrally with the third and fourth members.

Example embodiments of the present invention are described in more detail below with reference to the appended Figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary plan view of a vibratory screen according to an exemplary embodiment of the present invention;

FIG. lA is a top isometric view of the screen shown in FIG 1;

FIG. 1B is a bottom isometric view of the screen shown in FIG 1;

FIG. 2 is a fragmentary cross sectional view taken substantially along line 2--2 of FIG. 1;

FIG. 3 is a fragmentary cross sectional view taken substantially along line 3--3 of FIG. 1;

FIG. 3A is an enlarged fragmentary cross sectional view of a portion of the screen shown in FIG. 3;

FIG. 4 is a plan view of a portion of the screen shown in FIG. 1;

FIG. 4A is an enlarged plan view of a portion of the screen shown in FIG. 4.

FIG. 5 is a fragmentary cross sectional view taken substantially along line 5--5 of FIG. 1;

FIG. 5A is an enlarged fragmentary cross sectional view of a portion of the screen shown in FIG. 5;

FIG. 6 is an enlarged fragmentary cross sectional view similar to the view taken substantially along line 5--5 of FIG. 5, but showing only a cross section configuration of a modified shape of first members having reinforcement members;

FIG. 7 is a view similar to FIG. 6 but showing first members without reinforcement members;

51371-12

FIG. 8 is a fragmentary cross sectional view showing the manner in which the improved screen of FIG. 1 is mounted in a vibratory screening machine; and

FIG. 9 is an enlarged isometric view of a portion of a vibratory screen according to an exemplary embodiment of the present invention having reinforcement members integral with first and second members forming screen openings.

DETAILED DESCRIPTION

Like reference characters denote like parts in the several Figures.

According to an exemplary embodiment of the present invention, a vibratory screen 10 includes a body 12 of molded polyurethane having unperforated side edge portions 14, 16. Side edge portions 14, 16 may each have a U-shape and may each include a cast-in structural member, such as angle 15 shown in FIG. 2. Angle 15 may extend the entire length of side edge portions 14, 16. Side edge portions 14, 16 may be configured for mounting vibratory screen 10 in a vibratory screening machine, as is well known. Body 12 also includes a lower edge portion 18 and an upper edge portion 20 which, in combination with side edge portions 14, 16, define an outer border of the screen 10. Body 12 further includes an upper surface 22 and a lower surface 24 and includes first members 101 and second members 102 forming screen openings 26. Body 12 futher includes third members 203, fourth members 204, fifth members 305 and sixth members 306. Body 12 may include various configurations of third members 203, fourth members 204, fifth members 305 and/or sixth members 306. The third members 203, fourth members 204, fifth members 305 and/or sixth members 306 may or may not include reinforcement members 50 and are generally configured to provide support to screen openings 26 formed by first and second members 101, 102.

First and second members 101, 102 form a first integrally molded grid structure 100 that defines screen openings 26. Third and fourth members 203, 204 form a second integrally molded grid structure 200. Fifth and sixth members form a third integrally molded grid structure 300. As shown in the exemplary embodiment depicted in FIGS. 1, 2, 3, 4 and 5, grid structures 200 and 300 include bi-directional integrally molded reinforcement members forming support grids within the members. Because of the properties of the reinforcement members 50, further discussed herein, and their configuration into a bi-directional grid structure, the members in which the

reinforcement members 50 are embedded have a relatively small size and provide for increased open screening area. The grid structures provide screen strength, support for openings 26 during vibratory loading and significantly increase open screening area. Although second and third grid structures are discussed herein, additional grid structures may be provided.

First members 101 may be substantially parallel to each other and extend transversely between side edge portions 14, 16. The second members 102 may be substantially parallel to each other and extend transversely between the lower edge portion 18 and the upper edge portion 20. Second members 102 may have a thickness greater than the first members to provide additional structural support to screen openings 26.

First members 101 and/or second members 102 may include reinforcement members 50 and may or may not be supported by additional support members or support grid structures. See, e.g., FIGS. 6 and 9. As shown in FIG. 9, body 12 has first and second members 101, 102 with bi-directional reinforcement members 50 molded integrally therewith. Such configurations may be beneficial for screening applications requiring screens with larger screen openings.

As shown in FIG. 4, the screen openings 26 are elongated with a greater length dimension along sides and between ends thereof than width dimensions between the sides and their length dimensions extending in a direction transverse to the side edge portions 14, 16. Screen openings 26 may be about .044 mm to about 4 mm in width (i.e., between the inner surfaces of adjacent first members 101) and about .088 mm to about 60 mm in length (i.e., between inner surfaces of adjacent second members 102). Screen openings 26 may have different shapes including a generally square shape. The overall dimensions of screen 10 may be about 1.2 meters times 1.6 meters, or any other desired size. All of the dimensions set forth herein are by way of example and not of limitation.

Screen openings 26 may diverge downwardly between the upper surface 22 and the lower surface 24 and the first members 101 may be substantially in the shape of inverted trapezoids. See, e.g., Figures 6 and 7. This general shape of the first members 101 prevents blinding in screens 10. As shown in Figure 6, first members

101 include reinforcement members 50. As shown in Figure 7, first members 101 do not include reinforcement members 50.

Screens with the various screen opening sizes and support configurations described herein have a relatively large open screening areas. Open screening areas may range, for example, from between about 40 percent to about 46 percent. As further discussed herein, the relatively large open screening areas may be obtained through the placement of bi-directional reinforcement members 50 in cross members (e.g., members 203, 204) as described in the various embodiments herein. The reinforcement members significantly decrease the size of both of the bi-directional support cross members and allow for a thinner screen members, 101, 102 forming the screen openings 26. The grid work of support members and reinforcement members provide for a structurally sound screen that maintains the necessary screen openings during vibratory operation.

Third and fourth members 203, 204 may have a thickness greater than the first and second members 101, 102 and may have a portion 210 extending downwardly below the lower surface 24 of body 12. The greater thickness and portion extending downwardly may provide additional structural support to first and second members 101, 102. As shown in FIG. 1B, portion 210 may be substantially triangular in cross-section with apexes projecting away from the lower surface 24 of body 12. The third members 203 may be substantially parallel and extend transversely between the side edge portions 14, 16 and may have multiple first members 101 therebetween. The fourth members 204 may be substantially parallel and extend transversely between the lower edge portion 18 and the upper edge portion 20 and having multiple second members 102 therebetween. Reinforcement members 50 may be molded integrally with the third and fourth members 203, 204. See, e.g., FIGS. 3A, 5A. Third and fourth members 203, 204 may be configured to have a minimal thickness through inclusion of reinforcement members 50, while providing the necessary structural support to maintain the screen openings 26 formed by first and second members 101, 102 during vibratory screening applications. The bi-direction support system provided by reinforced third and fourth members 203, 204 greatly reduces the thickness of the support members and provides for increased open screening area and overall screen efficiencies.

Fifth members 305 and sixth members 306 may be included in body 12. Fifth and sixth members may have a thickness greater than the third and fourth members and may have a portion 310 extending downwardly away from the lower surface of the body. The greater thickness and portion extending downwardly may to provide additional structural support to first and second members 101, 102. The sixth members 306 may include a portion 320 extending upwardly away from the upper surface of the body. Portion 320 may be substantially triangular in cross-section with apexes projecting away from the upper surface 22 of body 12. Sixth members 306 are shown in FIG. 2 with portion 320 extending upwardly away from the upper surface of body 12 and acting as flow guides. The fifth members 305 may be substantially parallel and extending transversely between the side edge portions 14, 16 and have multiple third members 203 therebetween. The sixth members 306 may be substantially parallel and extending transversely between the lower edge portion 18 and the upper edge portion 20 and have multiple fourth members 204 therebetween. Reinforcement members 50 may be molded integrally with fifth and sixth members 305, 306. Fifth and sixth members 305, 306 may be provided for additional support to screen openings 26 and may be configured to have a minimal thickness through inclusion of reinforcement members 50, while providing the necessary structural support to maintain screen openings 26 during vibratory screening applications. The bi-direction support system provided by reinforced fifth and sixth members 305, 306 greatly reduces the thickness of the support members and provides for increased open screening area and overall screen efficiencies.

FIG. 1A shows an exemplary embodiment of the present inventions having first and second members 101, 102 forming screen openings 26 and members 203, 204 forming a support grid structure for openings 26. As shown in FIG. 1A, screen 10 does not include fifth and sixth members 305, 306.

In use, the vibratory screen 10 is mounted on a vibratory screening machine 30 (FIG. 8) in the well known manner. More specifically, it is mounted on the screen deck bed 31 which is mounted on the frame (not shown) of the machine. The screen deck bed 31 includes spaced substantially parallel frame members 32 secured to each other by spaced substantially parallel cross frame members (not shown). Extending

transversely between the cross frame members are a plurality of substantially parallel stringers 33 which mount channel rubbers 34. Mounted on parallel frame members 32 are channel-shaped draw bars 35 having lower portions 36 which are received within side edge portions 14, 16. Draw bolts 37 draw bars 35 apart to thereby tension vibratory screen 10 with the required force. The foregoing type of screen deck bed is well known in the art. Screen 10 may be mounted to other vibratory screening machines and side edge portions 14, 16 may be configured in other shapes to accommodate different vibratory screening machines.

Reinforcement members 50 as described herein may be an aramid fiber (or individual filaments thereof), a naturally occurring fiber or others material having relatively large tensile strengths with relatively small cross sectional areas. When an aramid fiber is used as reinforcement fiber 50 it may be aramid fibers that are commercially obtainable under the trademark KEVLAR of the DuPont Company and further identified by the designation KEVLAR 29. The reinforcement members 50 may also be at least one of aramid fibers that are commercially obtainable under the trademarks TWARON, SULFRON, TEIJINCONEX, and TECHNORA of the Teijin Company. In addition, the aramid fibers may be twisted or woven multistrand so that they act as nature of wicks to absorb the polyurethane which is molded around them to thereby provide an extremely good bond therewith. The twisted or a woven multistrand fibers may be about 55 denier to about 2840 denier, preferably approximately 1500 denier. The flexibility of the aramid fibers provides a flexible reinforcement system for the molded polyurethane which is able to return to its original molded shape after the necessary bending and flexing that occurs during handling and installation into the vibratory frame member 32. Furthermore, flexible aramid fibers permit the flexible polyurethane screen to be flexed without harm into an arcuate condition and tensioned as shown in FIG. 8. Reinforcement members 50 may be tensioned before polyurethane is molded around them. Various configurations of reinforcement members 50 may be provided in any one of the first, second, third, fourth, fifth and sixth members 101, 102, 203, 204, 305, 306. Each member may include zero, one or more reinforcement members 50 and the reinforcement members 50 may be of different sizes and materials. Reinforcement members 50 may be located in the bottom halves of the members so as not to be exposed relatively early as the upper surface of the screen wears.

During operation, first members 101 will vibrate to enhance the screening action. In this regard, it is to be noted that because first members 101 are flexible and relatively thin they will provide a relatively high amplitude of desirable vibration. The reason the first members 101 can be made relatively thin, creating screen openings described herein, is because of a support framework of bi-directional support members and reinforcement members, as described herein, having relatively large tensile strengths with relatively small cross sectional areas. The making of the support members and the first members 101 relatively thin results in the screen having a greater percentage of open area, which, in turn, increases its capacity.

According to an exemplary embodiment of the present invention a vibratory screen 10 includes a flexible molded polyurethane body 12 having substantially parallel side edge portions 14, 16 at opposite ends of body 12, a lower edge portion 18 substantially perpendicular to the side edge portions 14, 16, an upper edge portion 20 substantially perpendicular to the side edge portions 14, 16 and opposite the lower edge portion 18, an upper surface 22, a lower surface 24, first and second members 101, 102 forming screening openings 26, the first members 101 extending between the side edge portions 14, 16 and the second members 102 extending between the lower edge portion 18 and the upper edge portion 20. The body also includes third and fourth members 203, 204. Third and fourth members 203 and 204 have a thickness greater than the first and second members 101, 102. Third members 203 are substantially parallel and extend transversely between the side edge portions 14, 16 and have multiple first members 101 therebetween. Fourth members 204 are substantially parallel and extend transversely between the lower edge portion 18 and the upper edge portion 20 and have multiple second members 102 therebetween. Reinforcement members 50 are molded integrally with the third and fourth members 203, 204. The body also includes fifth and sixth members 305, 306. Fifth members 305 are substantially parallel and extending transversely between the side edge portions 14, 16. Sixth members 306 are substantially parallel and extending transversely between the lower edge portion 18 and the upper edge portion 20. The fifth and sixth members have a thickness greater than the third and fourth members and include reinforcement members 50 molded integrally therewith. Vibratory screens according to this configuration may have open screening areas greater than

forty percent and mesh sizes ranging from approximate .375 mesh to approximately 400 mesh. By way of example, screens tested having the aforementioned configuration include a 43 mesh size screen, a 140 mesh size screen and a 210 mesh size screen. Each of these screens had open screening areas of approximately 40 percent to approximately 46 percent. Such large screening areas for such fine mesh sizes are achieve through the relatively strong and thin grid framework created by the third, fourth, fifth and sixth members, 203, 204, 305, 306 and reinforcement members molded integrally therewith. In the aforementioned exemplary embodiment and examples, the size of each grid unit formed by the intersection of the third and fourth members, 203 and 204 is approximately 1" by 1". Generally, grid units may be larger for screens with larger screen openings and grid units are smaller for screens with smaller screen openings. This principle may be generally applicable for each example embodiment discussed herein. Grid units may also have a generally rectangular shape or any other suitable shape for supporting the screen openings.

According to an exemplary embodiment of the present invention, a method of making a vibratory screen, includes: creating a mold configured to fabricate the vibratory screen, the vibratory screening having a flexible molded polyurethane body; installing reinforcement members in the mold, the structural members configured to be molded integrally with the body; filling the mold with polyurethane; and forming the vibratory screen that has: substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, reinforcement members molded integrally with the third and fourth members.

While preferred embodiments of the present invention have been disclosed, it will be appreciated that it is not limited thereto but may be otherwise embodied within the scope of the following claims.

What is claimed is:

1. A vibratory screen comprising: a flexible molded polyurethane body having substantially parallel side edge portions at opposite ends of the body, a lower edge portion transversely disposed between the side edge portions, an upper edge portion disposed between the side edge portions and substantially parallel and opposite to the lower end portion, an upper surface, a lower surface, a first integrally molded grid structure, a second integrally molded grid structure, a third integrally molded grid structure and screen openings, wherein the first grid structure includes first and second members forming the screening openings, the first members substantially parallel and extending transversely between the side edge portions and the second members substantially parallel and extending transversely between the lower edge portion and the upper edge portion, wherein the second grid structure includes third and a fourth members, the third and fourth members having a thickness greater than the first and second members and having a portion extending downwardly below the lower surface of the body, the third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, first reinforcement members molded integrally with the third and fourth members, wherein the third grid structure includes fifth and sixth members, the fifth and sixth members having a thickness greater than the third and fourth members and having a portion extending downwardly away from the lower surface of the body, the fifth members substantially parallel and extending transversely between the side edge portions and having multiple third members therebetween, the sixth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple fourth members therebetween, second reinforcement members molded integrally with the fifth and sixth members.

2. The vibratory screen of claim 1, wherein the openings are about .044 mm to about 4 mm between inner surfaces of the first members and about .088 mm to about 60 mm between inner surfaces of the second members.

3. The vibratory screen of claim 1, wherein at least one of the first and the second reinforcement members are at least one of an aramid fiber and naturally occurring fiber.

4. The vibratory screen of claim 3, wherein at least one of the first and second reinforcement members is an aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

5. A vibratory screen, comprising: a flexible molded polyurethane body having substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members substantially parallel and extending transversely between the side edge portions and having multiple first members therebetween, the fourth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion and having multiple second members therebetween, first reinforcement members molded integrally with the third and fourth members.

6. The vibratory screen of claim 5, wherein the first and second reinforcement members are different sizes.

7. The vibratory screen of claim 5, wherein the second members have a thickness greater than the first members.

8. The vibratory screen of claim 5, wherein the openings are about .044 mm to about 4 mm between inner surfaces of the first members and about .088 mm to about 60 mm between inner surfaces of the second members.

9. The vibratory screen of claim 5, wherein the side edge portions are formed into U-shaped configurations.

10. The vibratory screen of claim 5, wherein the screen openings diverge downwardly between the upper surface and the lower surface.

11. The vibratory screen of claim 5, wherein the first members are substantially in the shape of inverted trapezoids.

12. The vibratory screen of claim 5, wherein the first reinforcement members are at least one of an aramid fiber and a natural fiber.

13. The vibratory screen of claim 12, wherein the first reinforcement member is an aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

14. The vibratory screen of claim 12, wherein the reinforcement members is an aramid fiber that is at least one of a twisted and a woven multistrand, wherein the fibers are about 55 denier to about 2840 denier.

15. The vibratory screen of claim 5, wherein the third and fourth members have a portion extending downwardly away from the lower surface of the body.

16. The vibratory screen of claim 5, wherein the side edge portions include a cast-in member.

17. The vibratory screen of claim 5, wherein the vibratory screen has an open screening area greater than forty percent.

18. The vibratory screen of claim 5, further comprising fifth and sixth members, the fifth members substantially parallel and extending transversely between the side edge portions and the sixth members substantially parallel and extending transversely between the lower edge portion and the upper edge portion.

19. The vibratory screen of claim 18, wherein at least one of the fifth and sixth members has a thickness greater than at least one of the third and fourth members,

20. The vibratory screen of claim 18, further comprising a second reinforcement member molded integrally with the fifth and sixth members.

21. The vibratory screen of claim 18, wherein the second reinforcement members are at least one of an aramid fiber and a natural fiber.

22. The vibratory screen of claim 21, wherein at least one of the first and second reinforcement members is an aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

23. The vibratory screen of claim 18, wherein at least one of the fifth and sixth members have a portion extending downwardly away from the lower surface of the body.

24. The vibratory screen of claim 18, wherein the sixth members have a portion extending upwardly away from the upper surface of the body.

25. The vibratory screen of claim 24, wherein the portion extending upwardly is substantially triangular in cross-section with apexes projecting away from the lower surface of the body.

26. A vibratory screen, comprising: a flexible molded polyurethane body, screen openings in the body, first substantially parallel flexible members defining opposite sides of the screen openings, second substantially parallel flexible members defining opposite sides of the screen openings, the first members substantially perpendicular to the second members, third members substantially parallel and having multiple first members therebetween, fourth members substantially parallel and having multiple second members therebetween, reinforcement members molded integrally with each of the third and fourth members, side edge portions substantially parallel at opposite sides of the body between which the third members and reinforcement members therein extend, first and second end portions substantially parallel at opposite ends of the body between which the fourth members and reinforcement members therein extend, the side portions substantially perpendicular to the end portions.

27. The vibratory screen of claim 26, wherein the second members have a thickness greater than the first members.

28. The vibratory screen of claim 26, wherein the openings are about .044 mm to about 4 mm between inner surfaces of the first members and about .088 mm to about 60 mm between inner surfaces of the second members.

29. The vibratory screen of claim 26, wherein the first reinforcement members are at least one of an aramid fiber and a natural fiber.

30. The vibratory screen of claim 29, wherein the first reinforcement member is an aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

31. The vibratory screen of claim 26, wherein the openings are elongated with a greater length dimension along sides and between ends thereof than width dimensions between the sides and their length dimensions extending in a direction transverse to the side edge portions.

32. The vibratory screen of claim 26, further comprising integrally molded large ribs and first small ribs extending transversely to the first members, the large ribs having portions extending upwardly above the upper surface and integrally molded second small ribs extending transversely to the second members, the first and second small ribs forming a grid shaped support structure supporting the openings.

33. The vibratory screen of claim 26, wherein the reinforcement members in at least one of the third and fourth members is a single aramid fiber.

34. The vibratory screen of claim 26, wherein the screen opening diverge downwardly between the upper surface and the lower surface.

35. A vibratory screen, comprising: a flexible molded polyurethane body having substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, reinforcement members molded integrally with the first and second members.

36. The vibratory screen of claim 35, wherein the openings are about .044 mm to about 4 mm between inner surfaces of the first members and about .088 mm to about 60 mm between inner surfaces of the second members.

37. The vibratory screen of claim 35, wherein the screen openings diverge downwardly between the upper surface and the lower surface.

38. The vibratory screen of claim 35, wherein the reinforcement members are at least one of an aramid fiber and a natural fiber.

39. The vibratory screen of claim 35, wherein the reinforcement member is an aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

40. A method of making a vibratory screen, comprising:

creating a mold configured to fabricate the vibratory screen, the vibratory screening having a flexible molded polyurethane body;

installing reinforcement members in the mold, the structural members configured to be molded integrally with the body;

filling the mold with polyurethane; and

forming the vibratory screen, the vibratory screen having substantially parallel side edge portions at opposite ends of the body, a lower edge portion substantially perpendicular to the side edge portions, an upper edge portion substantially perpendicular to the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members extending between the side edge portions and the second members extending between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members substantially parallel and extending transversely between the side edge portions and having multiple

first members therebetween, the fourth members substantially parallel and extending transversally between the lower edge portion and the upper edge portion and having multiple second members therebetween, reinforcement members molded integrally with the third and fourth members.

41. A vibratory screen, comprising: a flexible molded polyurethane body having side edge portions opposite each other, a lower edge portion between the side edge portions and an upper edge portion between the side edge portions and opposite the lower edge portion, an upper surface, a lower surface, first and second members forming screening openings, the first members running between the side edge portions and the second members running between the lower edge portion and the upper edge portion, third and fourth members having a thickness greater than the first and second members, the third members running between the side edge portions and having multiple first members therebetween, the fourth members running between the lower edge portion and the upper edge portion and having multiple second members therebetween, first reinforcement members molded integrally with the third and fourth members.

42. The vibratory screen of claim 41, wherein the first and second reinforcement members are different sizes.

43. The vibratory screen of claim 41, wherein the second members have a thickness greater than the first members.

44. The vibratory screen of claim 41, wherein the openings are about .044 mm to about 4 mm between inner surfaces of the first members and about .088 mm to about 60 mm between inner surfaces of the second members.

45. The vibratory screen of claim 41, wherein the first reinforcement members are at least one of an aramid fiber and a natural fiber.

46. The vibratory screen of claim 45, wherein the first reinforcement member is an

aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

47. The vibratory screen of claim 41, wherein the vibratory screen has an open screening area greater than forty percent.

48. The vibratory screen of claim 41, further comprising fifth and sixth members, the fifth members running between the side edge portions and the sixth members running between the lower edge portion and the upper edge portion.

49. The vibratory screen of claim 48, wherein at least one of the fifth and sixth members has a thickness greater than at least one of the third and fourth members.

50. The vibratory screen of claim 48, further comprising a second reinforcement member molded integrally with the fifth and sixth members.

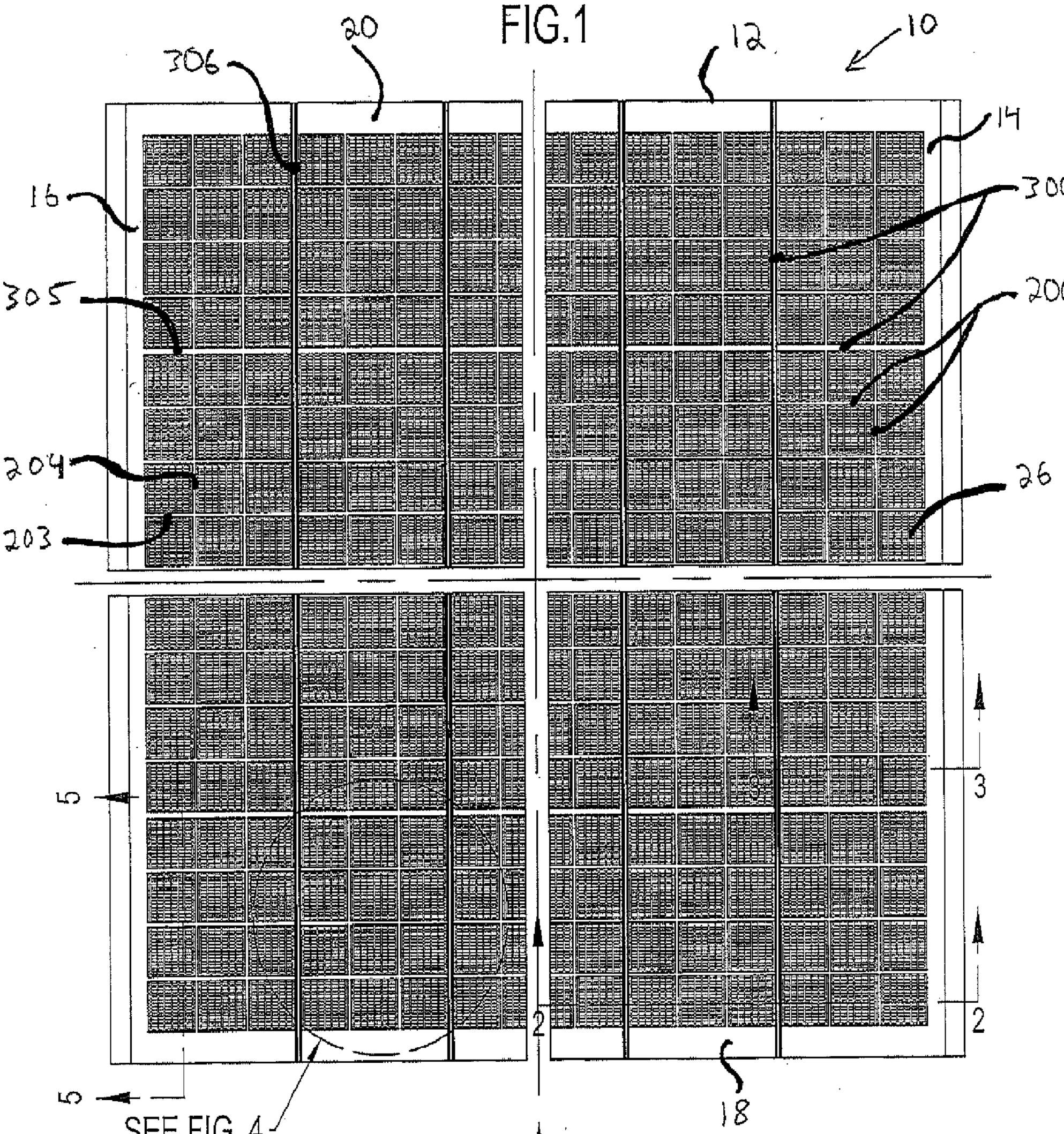
51. The vibratory screen of claim 48, wherein the second reinforcement members are at least one of an aramid fiber and a natural fiber.

52. The vibratory screen of claim 51, wherein at least one of the first and second reinforcement members is an aramid fiber that is at least one of a twisted multistrand and a woven multistrand and wherein the polyurethane impregnates the multistrand forming a bond between the first member and the fiber therein and a bond between the second member and the fiber therein.

53. The vibratory screen of claim 41, wherein the first and third member extend between and attach to the side edge portions and the second and fourth members extend between and attach to the lower edge portion and the upper edge portion.

54. The vibratory screen of claim 48, wherein the fifth member extends between and attaches to the side edge portions and the sixth member extends between and attaches to the lower edge portion and the upper edge portion.

FIG.1


20
306
12
10
14
16
300
305
200
204
26
203
5
3
2
5
SEE FIG. 4
18
FLOW

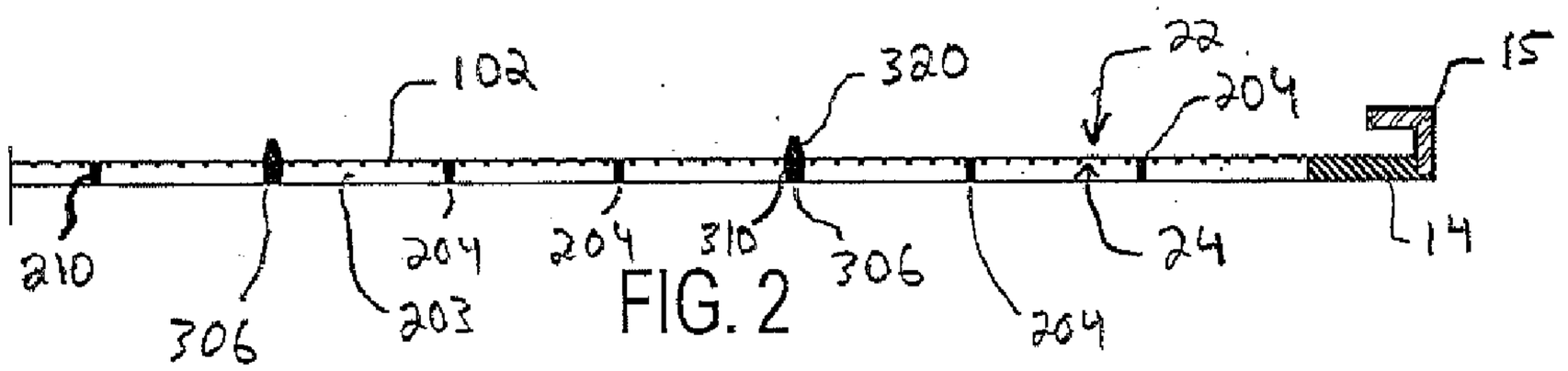

102
320
22
204
15
210
306
204
204
310
306
24
14
203
204

FIG. 2

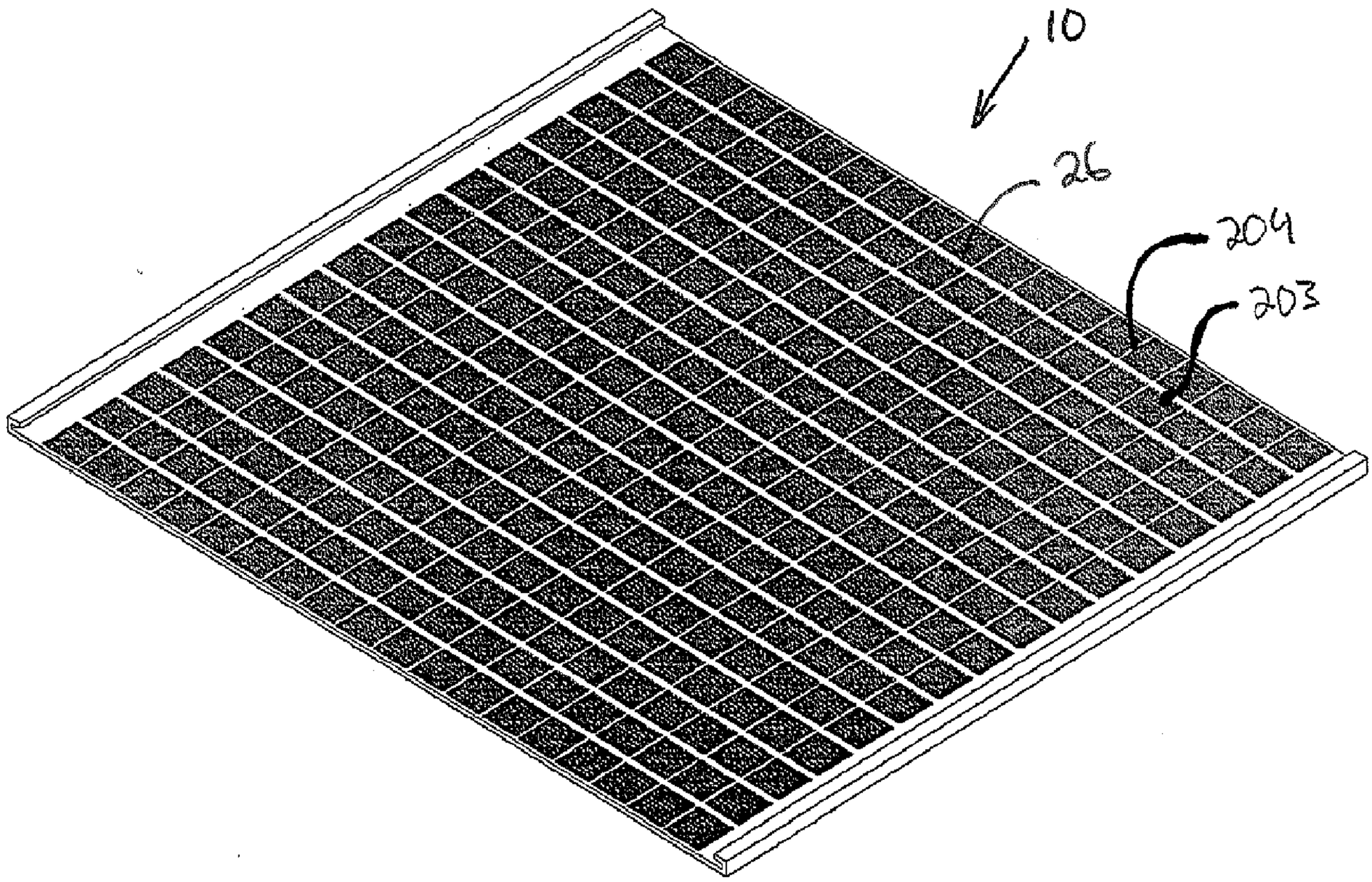


FIG. 1A

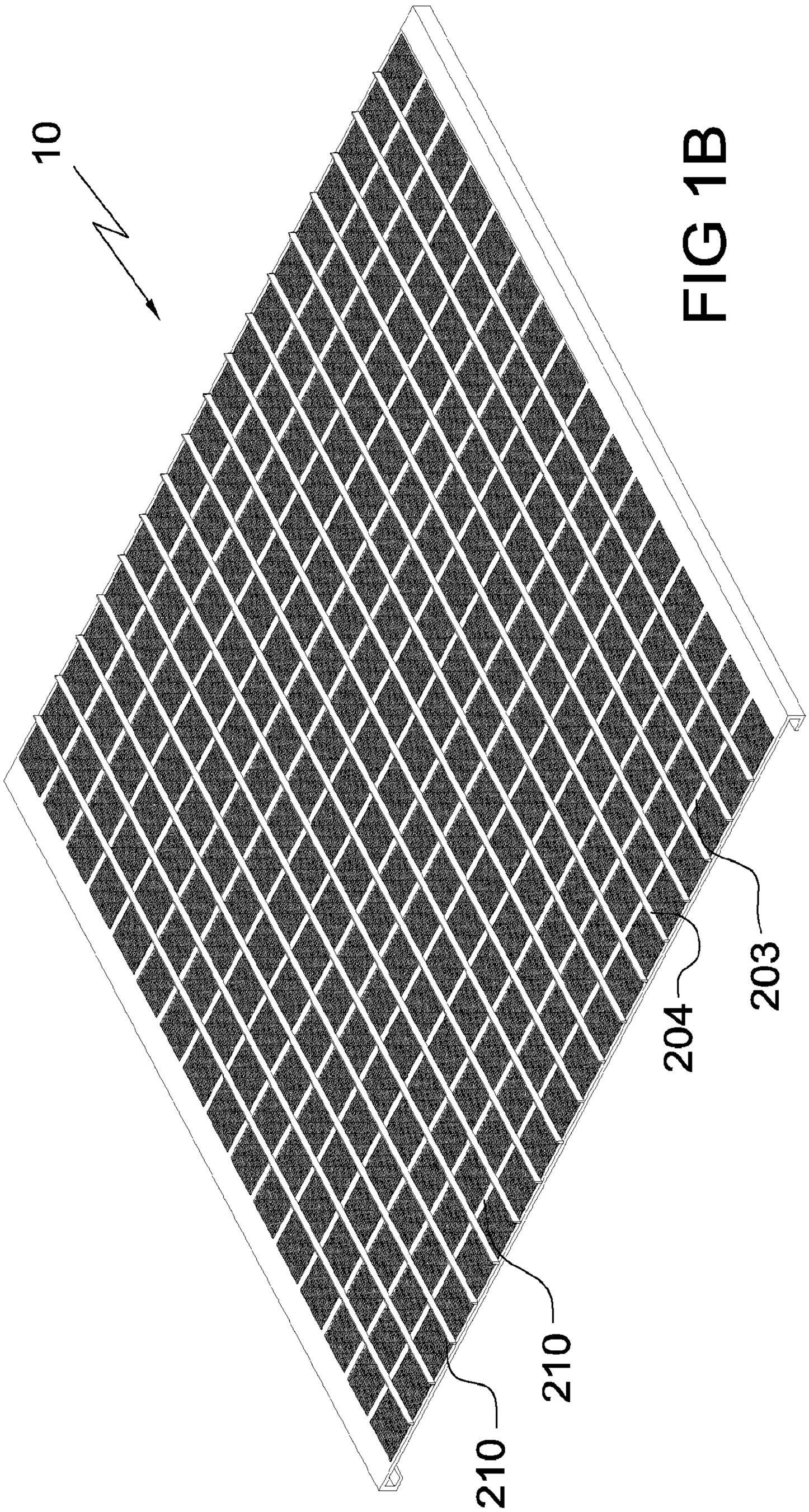


FIG 1B

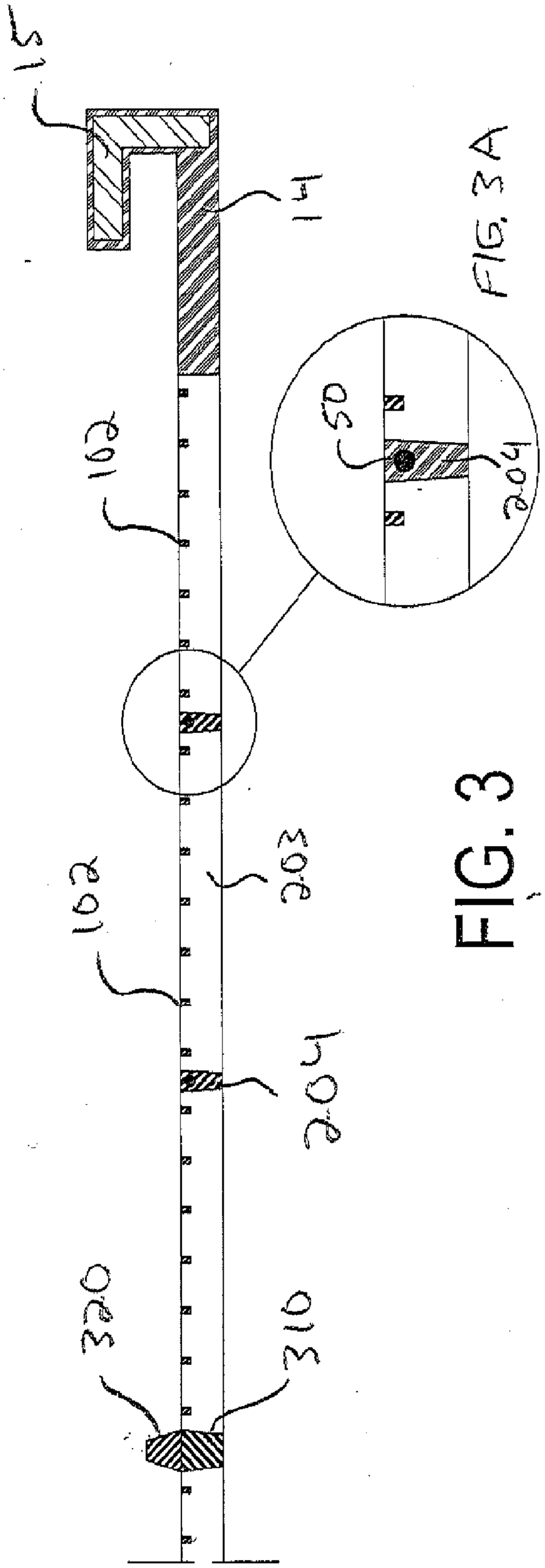


FIG. 3A

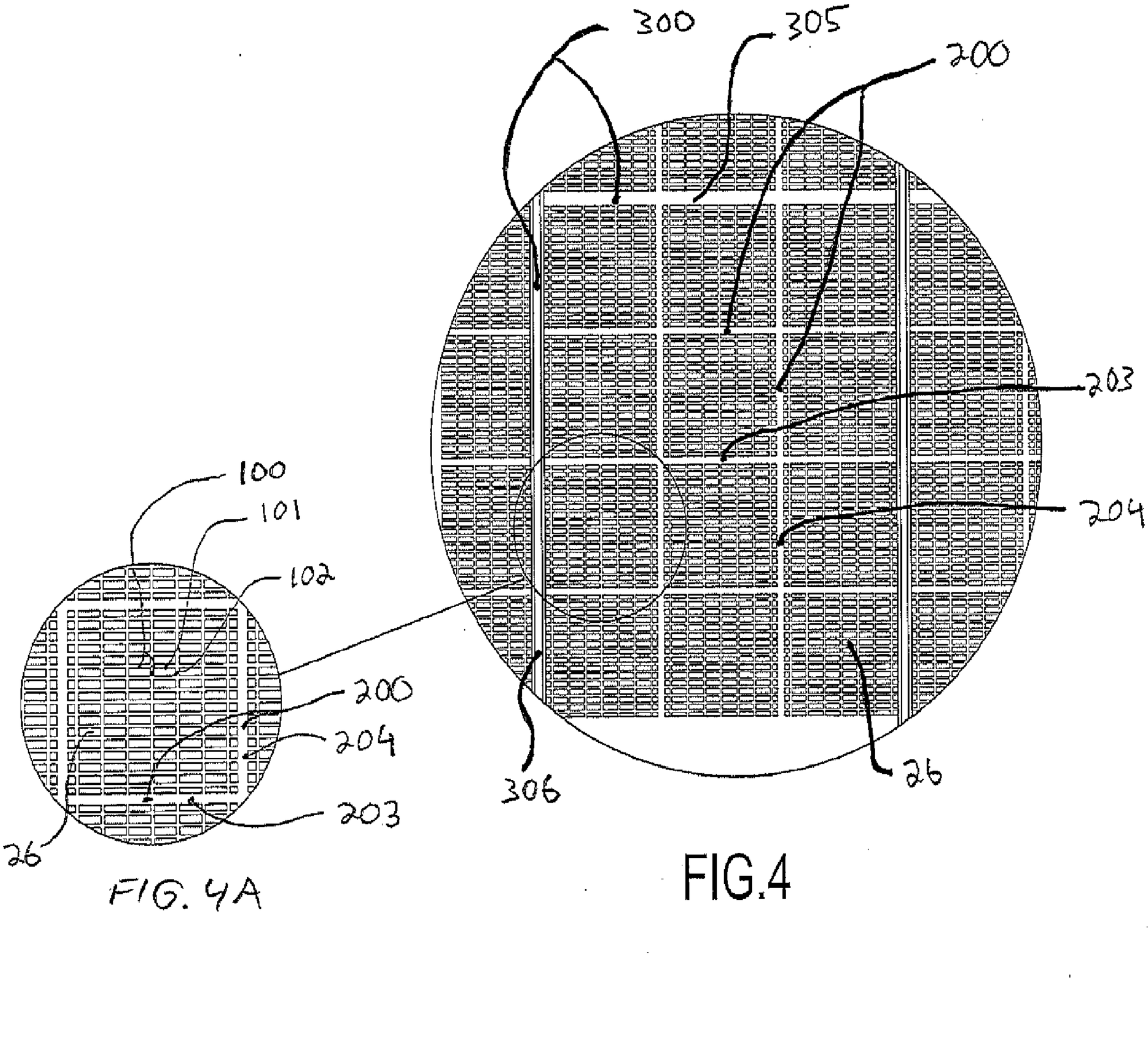


FIG. 4A

FIG.4

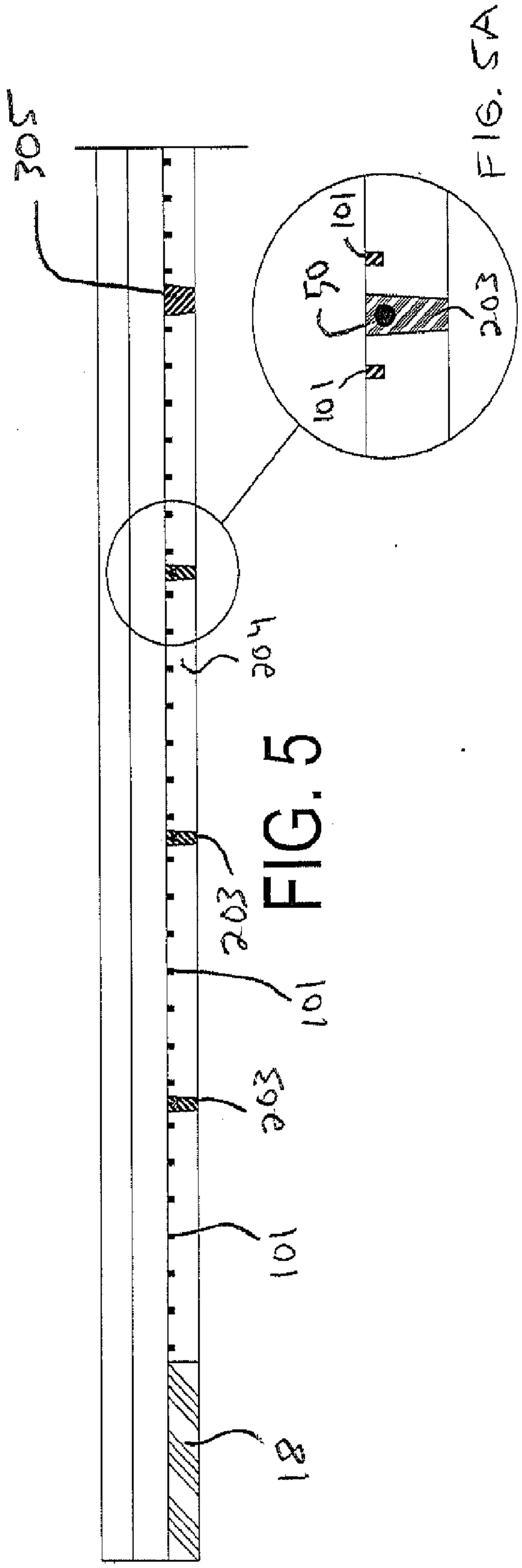


FIG. 5A

FIG. 5

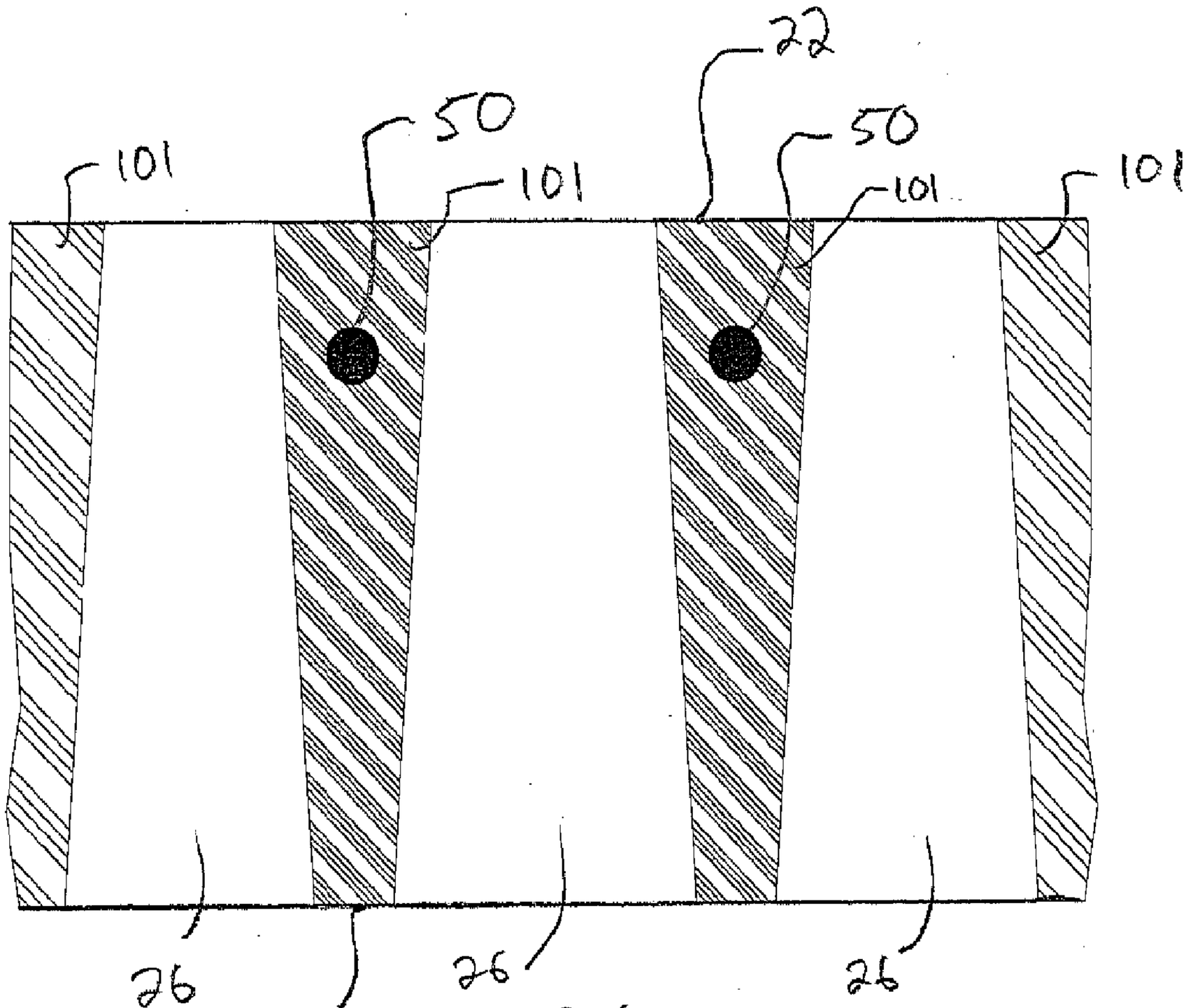

22
50
50
101
101
101
101
101
26
24
26
26

FIG. 6

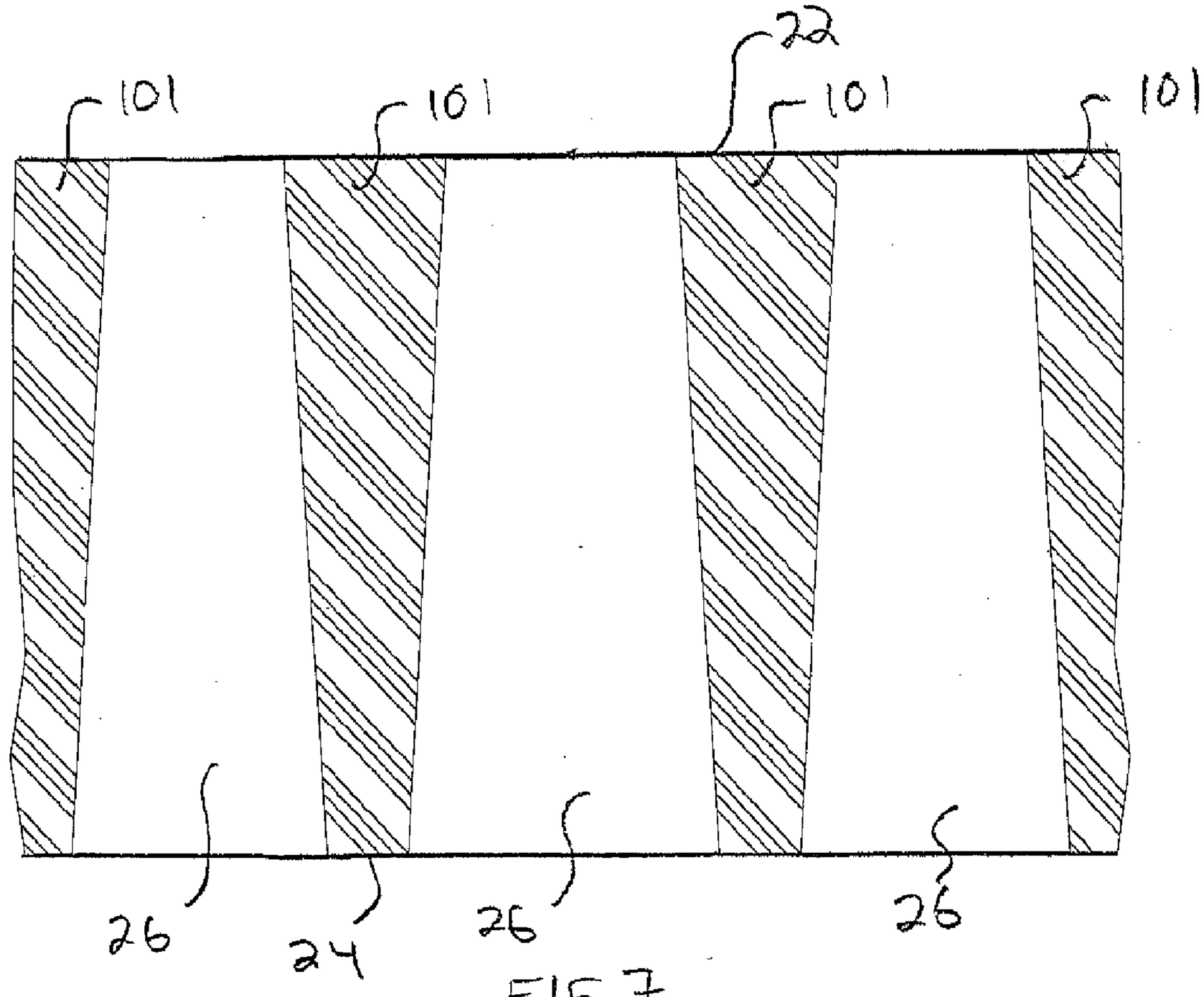

22
101
101
101
101
26
24
26
26

FIG. 7

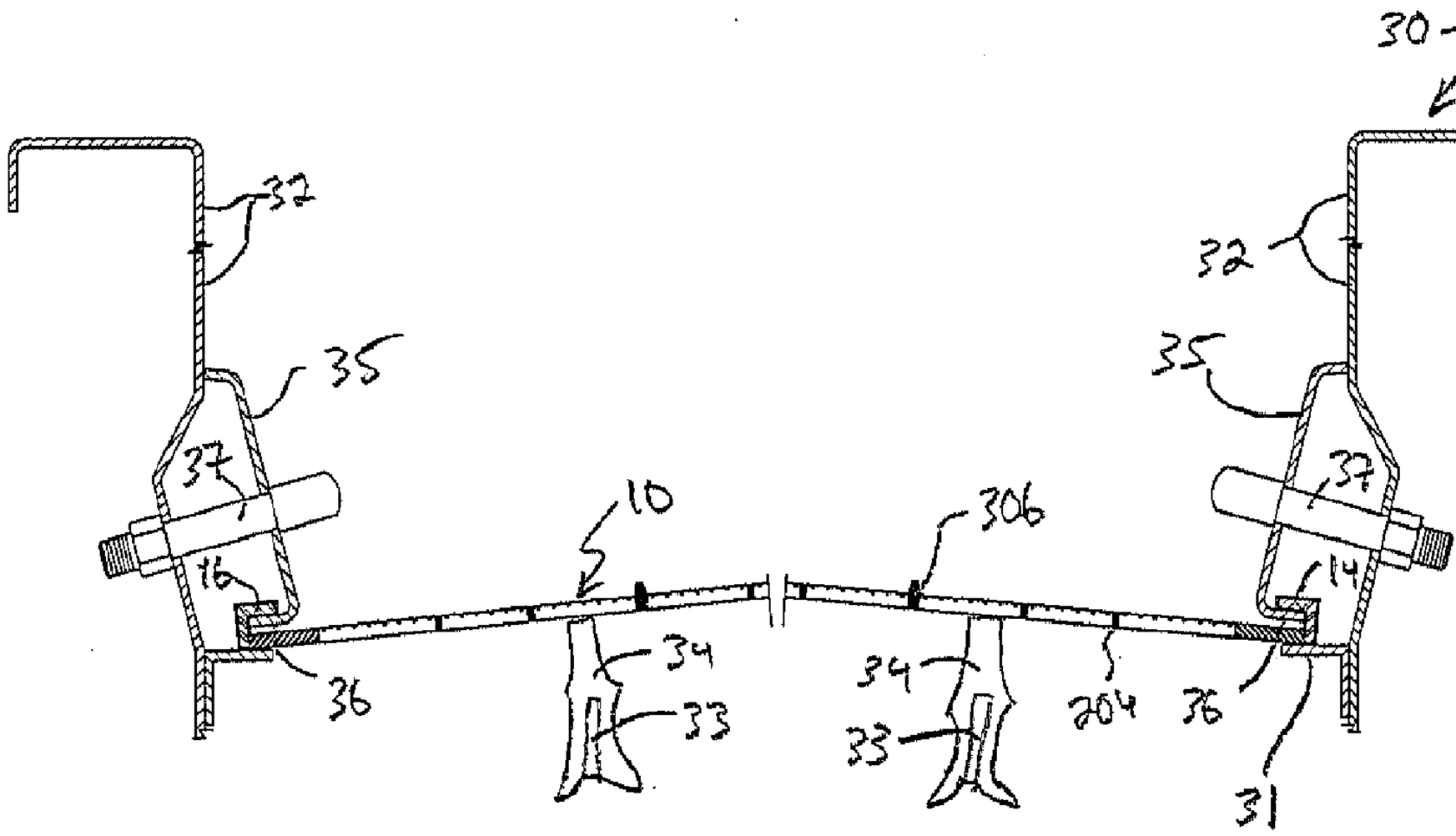


FIG. 8

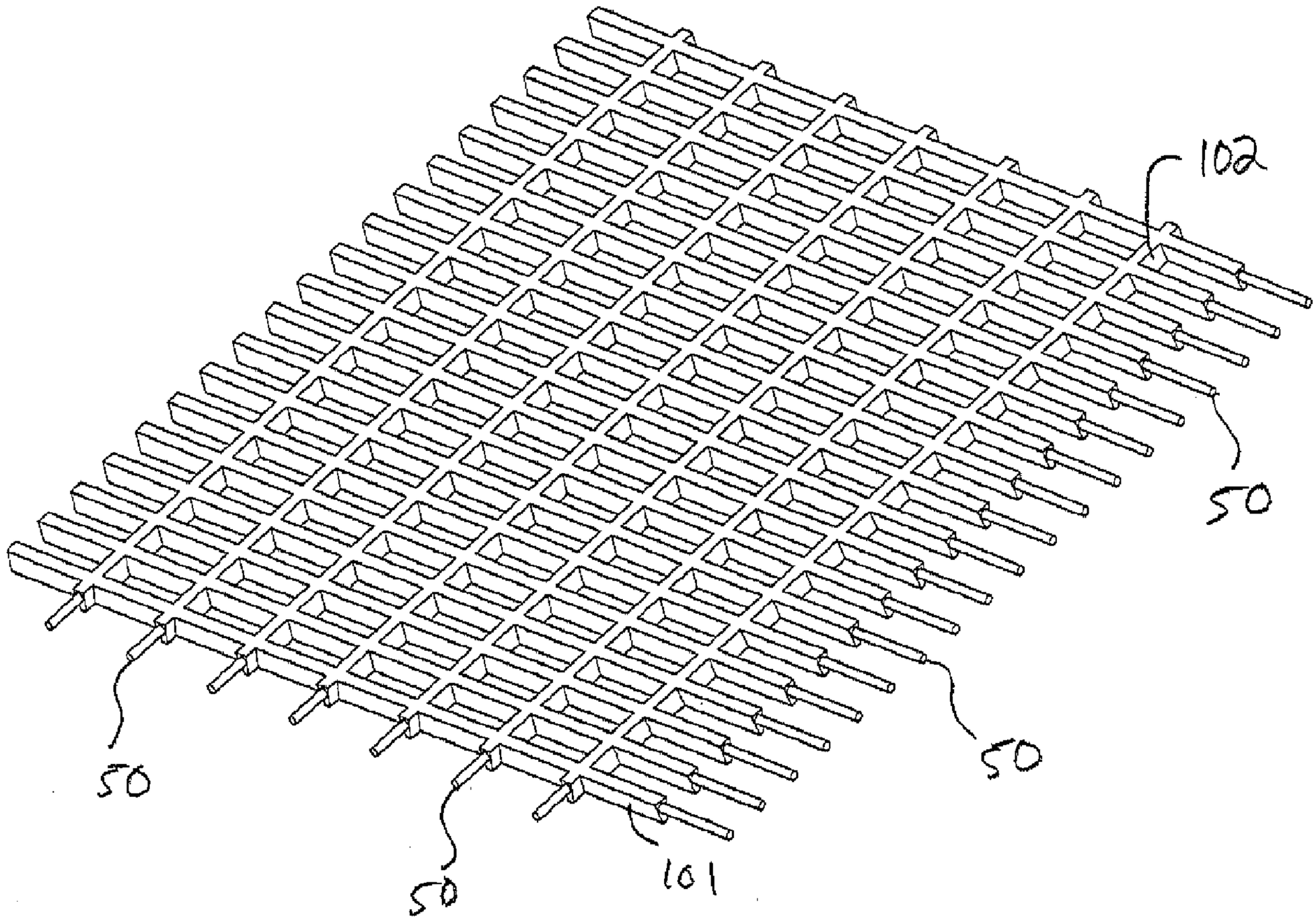
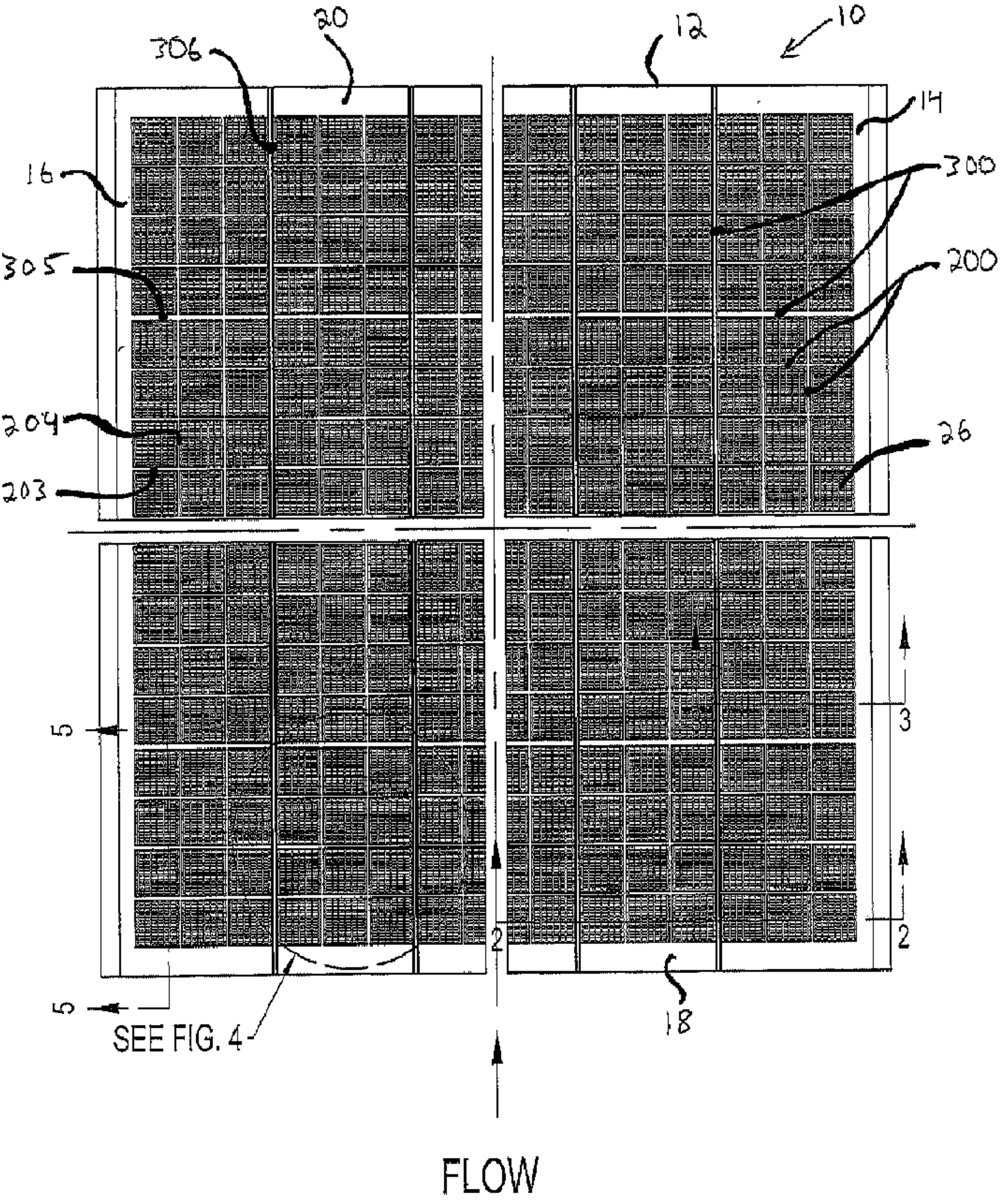


FIG. 9


20
306
16
305
204
203
12
10
14
300
200
26
5
3
2
2
18
5
SEE FIG. 4
FLOW