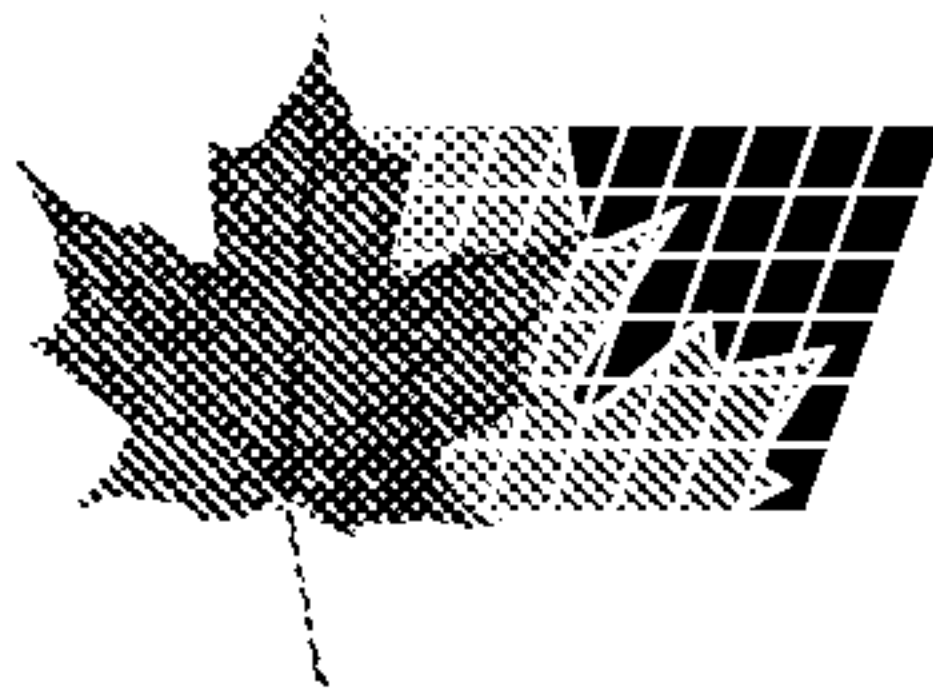




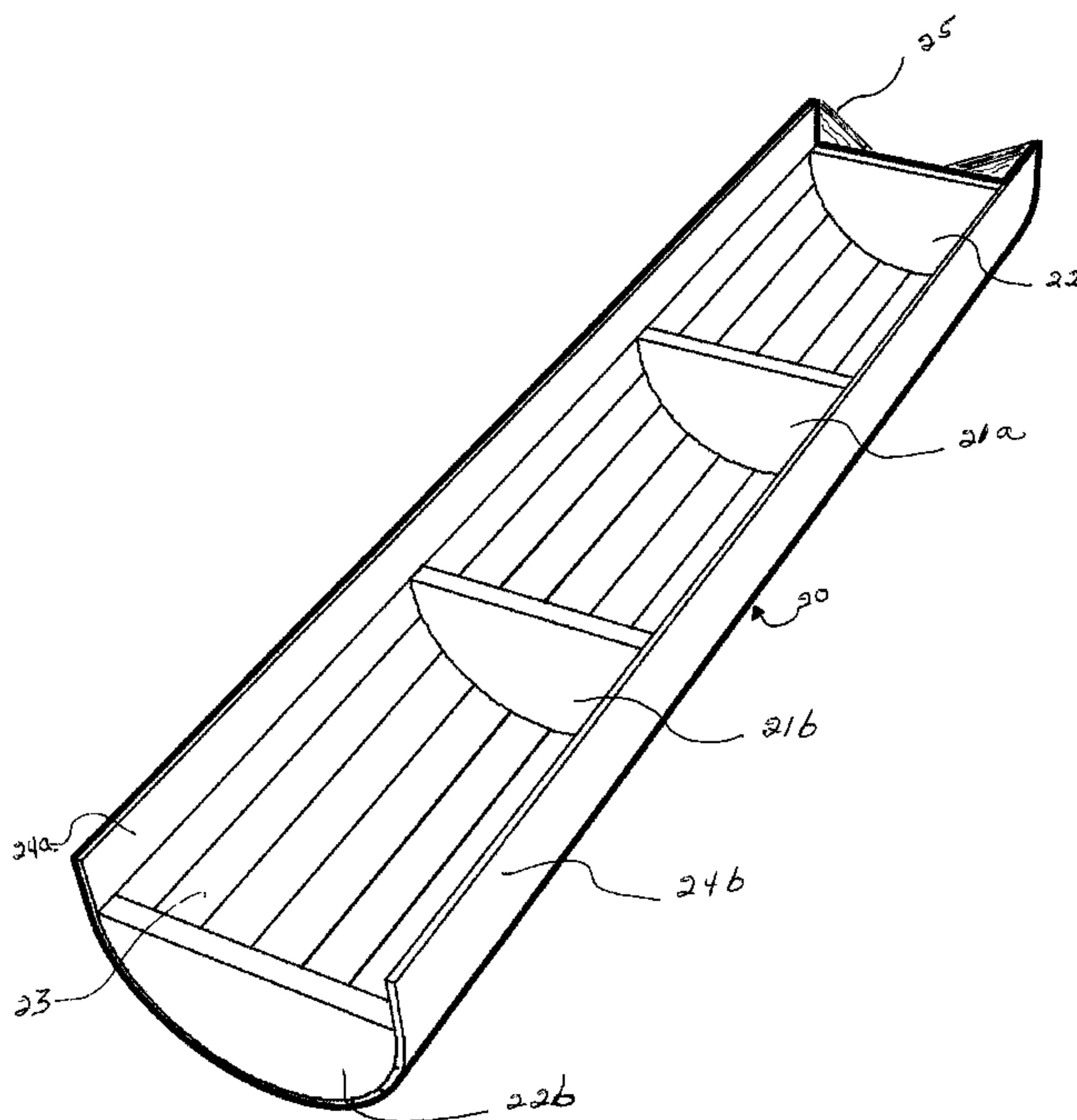
(72) LECOURS, YVES, CA

(71) LECOURS, YVES, CA

(51) Int.Cl.⁷ E04C 2/30

(54) **ELEMENT ARCHITECTURAL PREFABRIQUE INCURVE, ET
METHODE DE FABRICATION**

(54) **PREFABRICATED CURVED PROFILE ARCHITECTURAL
ELEMENT AND METHOD FOR FABRICATING THE SAME**



PREFABRICATED CURVED PROFILE ARCHITECTURAL ELEMENT AND
METHOD FOR FABRICATING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the invention:

The present invention relates to curved profile elements for the construction of curved wall, ceiling or self-supporting elements and to methods for the fabrication of such elements. More particularly, the invention relates to the manufacturing of factory fabricated curved profile architectural elements made from standard gypsum panels and destined to be installed on a construction site in the same manner as for flat gypsum panels and with the same finishing requirements.

2. Brief description of the prior art:

The application of gypsum panels to a wood or metal structure (drywalls) is currently the mostly used method for erection of interior walls and ceilings in buildings. However, although rigid gypsum drywall panels provide a fast and economical solution to basic architecture requirements, they introduce important limitations with regard to the construction of curved surfaces.

According to a common practice, curved profiles of a radius larger than about 18 in are made by laying a gypsum panel horizontally and wetting it with water to induce bending capability, prior to installation on an appropriate wall or ceiling structure. That method is very difficult to use with success and only applies to very

large diameters. Too much water or insufficient wetting for given atmospheric conditions lead to panel destruction.

Another method is known by specialised professionals to built curved sections in drywalls, which applies to small as well as large diameters. That prior art technique first consists in preparing and installing an appropriate wood or metal structure where the wall or ceiling curved portion is to be erected. In a second operation, gypsum panels are cut to size and grooves are then cut on one side of the gypsum panel at an appropriate spacing in the longitudinal axis of the curved profile to be made. The grooves are cut manually using a gypsum panel knife. Thirdly, the piece of gypsum panel is bent in order to break along each score line while preserving the integrity of the paper layer on the non-grooved side and is then screwed on the wood or metal structure frame to form the curved shaped wall or ceiling section. It should be mentioned that since the grooved piece of gypsum panel can only be bent in one direction to form a curved profile, concave wall sections expose the non-grooved paper side while the visible side of convex wall sections show the grooves opened into a V shape. Finally, the visible face of the wall must be finished by applying paper tape and drywall compound, drying and sanding, repeating some of the operations until a satisfactory finish is obtained. The surface can then be painted.

Obviously, the finishing of a curved surface in a vertical wall or ceiling is a complex and labour intensive task mainly due to the thickness of compound to be applied namely in wide and deep V grooves encountered in convex sections while the gravity is acting adversely. Therefore, the erection of curved wall or ceiling sections is currently a complex, labour intensive, long and costly operation and is only seldom used, thus limiting the

spectrum of architectural variations in building construction. Self-standing architectural elements such as decorative columns also present interest in construction but remain very expensive items. Indeed, such elements are currently machined and assembled from wood, metal, polystyrene foam etc. and sold for hundreds of dollars a piece. Although gypsum panels and drywall compound are cheap materials, the prior art does not provide any solution to fabricating low cost architectural elements such as curved cross-section columns made of these materials.

There is thus a need for pre-fabricated architectural elements with a curved profile that would permit rapid construction of curved wall or ceiling sections or columns in an easy and economical manner, while having the same finishing requirements as an ordinary flat drywall section.

OBJECTS OF THE INVENTION

The present invention provides pre-fabricated curved profile architectural elements and a method for factory manufacturing such architectural elements which overcome the limitations and drawbacks of the above mentioned solutions of the prior art, and more specifically:

- a first object of the instant invention is to provide pre-fabricated curved profile architectural elements made from gypsum drywall panels, that are factory semi-finished and which can be sold as standard items by lumber suppliers in a variety of popular or custom shapes and sizes.
 - a second object of the present invention is to provide pre-fabricated curved profile architectural elements
-

that can be manufactured at low cost according to the method of the present invention;

- a third object of the present invention is to provide pre-fabricated curved profile architectural elements that can be installed easily and rapidly on construction site like flat gypsum drywall panels by ordinary skilled carpenters, thus also providing significant reduction in installation costs;
- a fourth object of the present invention is to provide pre-fabricated curved profile architectural elements featuring perfect uniformity in shape and surface finish quality;
- a fifth object of the present invention is to provide pre-fabricated curved profile architectural elements that speed-up the erection of curved wall and ceiling portions on construction sites;
- a sixth object of the present invention is to provide pre-fabricated curved profile architectural elements featuring a usually higher rigidity and structural resistance than elements built on construction sites according to the methods of the prior art;
- a further object of the present invention is to provide pre-fabricated curved profile architectural elements that can be factory shaped into the form of curved cross-section columns according to a method of the present invention;
- a still further object of the present invention is to provide a method for the factory fabrication of pre-fabricated curved profile architectural elements, which

is flexible and allows the fabrication of a wide
variety of shapes in small lot sizes;

- another object of the present invention is to provide a method for the factory fabrication of pre-fabricated curved profile architectural elements, allowing performance of the finishing steps in a generally horizontal set-up, with positive or negligible impact of the gravity on the process.

SUMMARY OF THE INVENTION

More specifically, in accordance with the invention as broadly claimed, there is provided a pre-fabricated curved profile architectural element structure and a method for the factory production of curved profile architectural elements. The elements comprise a curved scored gypsum drywall panel assembled on transversally oriented structural brace members. The outer face of the elements is finished with drywall compound into a uniform, smooth and regular surface, the outer face of convex profiles being reinforced with tape prior to finishing. Preferably, a sealing compound is applied on the outer surface and corner protecting devices are installed on corners for protection during transportation and storage. A method is disclosed for the production of curved profile architectural elements which basically comprises the steps of 1) cutting parallel grooves into a piece of gypsum drywall panel 2) removably installing properly spaced apart brace members on a supporting jig to define a generally horizontal element longitudinal axis, 3) placing, forming and assembling the piece of gypsum panel on the brace members, 4) applying a finishing coating comprising tape and/or drywall finish compound to the outer surface of the element,

5) releasing the brace members and 6) drying the element⁶
in a generally horizontal position.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an architectural realisation incorporating prefabricated curved profile elements according to the present invention.

Figure 2 is a perspective view of the inside of incorporating prefabricated curved profile elements according to the present invention.

Figure 3a represents an polygonal shape to be obtained from a gypsum drywall panel for the fabrication of a prefabricated curved profile element according to the present invention.

Figure 3b represents a narrow groove cut in a gypsum drywall panel to induce bending capability.

Figure 3c represents the scored panel section of Figure 3b once bent in the direction of the non-scored surface.

Figure 3d represents a wide rectangular groove cut in a gypsum drywall panel to induce bending capability.

Figure 3e represents the scored panel section of Figure 3d once bent in the direction of the scored surface.

Figure 3f represents a wide triangular groove cut in a gypsum drywall panel to induce bending capability.

Figure 3g represents the scored panel section of Figure 3f once bent in the direction of the scored surface.

Figure 4a is a top view of a cut and grooved piece gypsum drywall panel for the fabrication of a prefabricated curved profile element according to the present invention.

Figure 4b is a frontal view of the grooved piece of gypsum panel of Figure 4a.

Figure 4c is a close-up view of a portion of the grooved section of Figure 3b.

Figure 4d is a frontal view of the grooved piece of gypsum panel of Figure 3a after bending to form a polygonal shape.

Figure 5a is a cross-sectional view taken along the longitudinal axis of a finished convex element according to the present invention made from a gypsum panel bent in the direction of its non-scored surface.

Figure 5b is a cross-sectional view taken along the longitudinal axis of a finished convex element according to the present invention made from a gypsum panel bent in the direction of its scored surface.

Figure 6a is a cross-sectional view taken along the longitudinal axis of a finished concave element according to the present invention made from a gypsum panel bent in the direction of its scored surface.

Figure 6b is a cross-sectional view taken along the longitudinal axis of a finished concave element

according to the present invention made from a gypsum panel bent in the direction of its non-scored surface.

Figure 7 is a cross-sectional view taken along the longitudinal axis of a finished curved element made from a gypsum panel according to the present invention. The element comprises both convex and concave portions and has the scored surface of its gypsum panel directed outwardly.

Similar reference numerals refer to similar parts throughout the various Figures.

DETAILED DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the pre-fabricated curved profile architectural element structures and method for the factory production of curved profile architectural elements according to the present invention will now be described in detail referring to the appended drawings.

Referring to Figure 1, there is illustrated an example of an architectural realisation incorporating prefabricated curved profile elements made from gypsum drywall panels according to the present invention. The illustrated realisation incorporates a semi-circular profile vertically installed element 1 simulating a column, and a quarter-round profile element 2 horizontally installed at the intersection of the wall and ceiling surfaces. A wide variety of such architectural realisations can be made easily, rapidly and economically using different prefabricated curved profile architectural elements in different modes. The prefabricated elements are merely assembled on a mounting structure as simple flat gypsum drywall panels. They also require the same finishing steps, i.e. filling of screw holes, jointing between

elements, reinforcing corner edges and applying sealer/primer and paint.

Figure 2 shows the inside of a typical prefabricated curved profile architectural element 20 according to the present invention provided with a semi-circular convex cross-section. The element 20 is basically made from a folded scored piece of gypsum drywall panel 23 assembled on end brace members 22a,b and intermediate brace members 21a,b. Mounting flanges 24a,b are also provided to enable easy assembly of the element on wood or metal studs using ordinary gypsum screws. The corners of the mounting flanges may be protected against damages during handling, transport and storage by removable brace members such as 25 or caps made of wood or cardboard. As better seen on Figures 5, 6 and 7, the scored piece of gypsum panel is assembled on the brace members using adhesive or fasteners 57, such as staples, screws or nails, and its external surface is coated with drywall compound (such as 53 in the example of Figure 5a) and generally reinforced with radial paper tape bands (such as 52 on Figure 5a) to provide a smooth and uniform finish. Optionally, a sealer may be added on the external surface of the element to provide further protection against erosion. As shown on Figures 5, 6 and 7, the structural elements of the present invention may form different curved profiles of either convex, concave or combined shape.

The bending capability of the piece of drywall gypsum panel 23 (Figure 2) is induced by cutting grooves 40 on one side, in the axial direction of the element 43 to be fabricated as illustrated in Figure 4. Basically, since gypsum is a very brittle material, grooves of depth d of about $2/3$ of the panel thickness t enable breakage of the panel about each groove by folding the panel in the opposite direction. A series of parallel panel sections 41

connected by one of the paper layers 42 is thereby produced. Referring to Figure 3a, it can be seen that the relative angular positions of the panel sections can be set to constitute a polygonal profile. To make smooth curves of a given radius R , experience has shown that the base polygonal shape shall be formed with fold angles θ of less than 10 degrees. Since the length of an arc of radius R over a 10 degree angle is given by $l = \pi R/18$, the spacing L between grooves shall be continuously adjusted to smaller than about $R/6$, while it is rarely set to better than $R/9$ (6.3 degrees). For example, to make a circular column of 12 in in diameter, the spacing L between grooves shall advantageously be set to 1 in or less.

Figure 3b shows a groove cut into a piece of gypsum panel with the blade of a drywall knife. That type of groove is in the shape of a narrow triangle with an apex angle of α degrees and has a depth of $2t/3$ as previously stated, t being the thickness of the gypsum panel. When, the piece of gypsum panel is folded about axis p in the direction of the non-grooved surface, to form the polygon of figure 3a, a triangular prismatic cavity of apex angle $\beta = \alpha + \theta$ is thereby created. The panel sections are only connected to each other by the lower paper layer. Therefore, when that folding technique is used, these cavities 30 must be filled with finishing compound.

A second folding technique is illustrated in Figure 3d,e where relatively wide rectangular grooves are cut into the gypsum panel. With that technique, the panel can be bent in the direction of the grooved surface if the following conditions are respected. Otherwise, a rectangular groove will still permit bending in the direction of the non-grooved surface. The depth d is such that only about 0.060 to 0.080 in of material is left from

the total thickness t . The width of the groove is set to form the folding angle θ as the apex angle of the triangle formed by folding point p and the top edges of the groove O and Q . Minimum groove width W for is thus given by $W = 2t \tan(\theta/2)$. Therefor, a 1/8 in wide blade will cut grooves permitting folding to a maximum of about 10 degrees, which satisfies most applications. After bending, a prismatic inner cavity **32** is formed in which the gypsum material left at the base of the groove is compressed. The weakness of the gypsum material is such that at the specified thickness, it is compressed without affecting the integrity of the outer paper layer along folding line p .

Referring to Figures 3f,g, a similar process can be carried out with a wide V shaped groove of apex angle greater or equal to the folding angle θ . With the appropriate angle and a depth of the groove almost reaching the paper layer **34**, a neat folding line is obtained since the formation of θ broken gypsum particles can be almost totally avoided.

It can then be understood that different bending techniques can be used to obtain convex, concave, or combined shapes with the grooves appearing on the inner or outer face of the non-finished architectural element. Examples are illustrated at Figures 5 through 7.

Figure 5a shows the preferred embodiment of the structure of a prefabricated convex profile architectural element **50** destined to be installed with drywall screws **58** on mounting studs **24a,b** at the project site. A drywall gypsum panel is cut to the appropriate size and scored with a narrow blade to generate a minimum of dust and produce cavities as small as possible since the panel is folded in the direction of its non-scored surface, making the

12
cavities visible on the outer surface of the unfinished element. The resulting scored panel piece 51 is then assembled on brace members 56 placed with a spacing of 12 to 24 in between each other. The brace members 56 are preferably made of wood, although plastic, cardboard or similar material could be used. The gypsum panel piece 51 is preferably assembled with staples 57 on bracing members 56 to speed-up the operation and for economy, but nails, screws, adhesive or any combinations thereof could be used as well. Cavities 54 are then filled with drywall compound and pieces of paper tape 52 are applied transversely with respect to the longitudinal axis of the architectural element, with a spacing of about 16 in. Filling of the cavities provides compression strength to the element to resist against outward flexion strain, while the paper bands 54 provide tensile strength to resist to inward flexion strain. A finishing coat of drywall compound 53 is finally applied to the outer surface to provide a smooth and uniform surface, thus completing the structure of the convex profile architectural element 50. Some wet or dry abrasion may be required after drying to obtain the desired finish softness. The finished surface may then be optionally coated with a sealer for protection.

Figure 5b shows an alternate embodiment of the structure of a prefabricated convex profile architectural element 500. Wide rectangular or V shaped grooves are used and the piece of gypsum panel 501 is bent in the direction of its scored surface and is assembled on the brace members 502 as described above. That technique prevents the presence of cavities on the outer side and therefor only requires application of a finishing coat of drywall compound 503 to provide a smooth and uniform circular surface. Although the architectural element so fabricated is cheaper to manufacture, it has significantly lower mechanical and structural resistance.

Figures 6a and 6b represent quarter-round concave prefabricated architectural elements. The element of Figure 6a has been obtained from a panel folded in the direction of the rectangular or V shaped grooves, and finished in the same way as element 50 of Figure 5a. The panel 61 is assembled with staples 57 on brace members 62 and covered with paper tape bands 63 and a finishing coat of drywall compound 64. That technique provides better mechanical and structural properties to the element as compared to the technique illustrated in Figure 6b. Indeed, in that element 600, the internal surface is left with unfilled exposed cavities 604 such that the wall thickness at groove locations is only equal to the thickness of the paper layer of the gypsum panel 601 plus the thickness of the compound coating 603. To obtain a reasonable mechanical resistance with such an arrangement, finishing of the back of the panel would be required in addition the finishing of the front surface. Therefor, for convex curves as for concave curves, a structure with outwardly oriented grooves is preferred for optimal resistance and economy.

An example of an architectural element 70 combining concave and convex curvilinear sections is illustrated in Figure 7. As stated above, all the grooves have been cut on the same side of the piece of gypsum panel 71 and oriented in the direction of the finished (outer) surface. For practical considerations, all the grooves may be made with a similar cutting tool such as a 1/8 in wide rotating blade. The cavities 75 are filled with drywall compound, paper tape bands 73 are applied transversally on top and covered with a finishing coat of drywall compound or similar material 74. Obviously, that type of element could also be fabricated with inwardly oriented grooves or a combination of inwardly and outwardly oriented grooves, with or without some reinforcing finish applied to the

internal surface with less interesting results from an economic and/or structural point of view.

The prefabricated curved profile architectural element structures according to the present invention described above can be advantageously obtained by applying the following preferred method:

- 1) cut one or more drywall gypsum panels into pieces as required by the element to be fabricated;
- 2) Cut parallel grooves on one side of the pieces of gypsum panels with cross-sectional shape and depth appropriate to the curves to be shaped;
- 3) Removably install brace members properly spaced apart on a supporting jig to define a generally horizontal element longitudinal axis;
- 4) Place, form and assemble the grooved pieces of drywall gypsum panels on the brace members with the grooves facing outwardly;
- 5) Fill cavities with drywall compound;
- 6) Place paper tape bands transversally with respect to groove axis;
- 7) Apply a finishing coat of drywall compound to obtain a smooth and uniform curvilinear surface;
- 8) Remove the architectural element from the generally horizontal mounting jig and let dry in a generally horizontal position.

It shall be noted that a major advantage of prefabricating the structural elements according to the above method of the present invention is that the element is assembled horizontally. Accordingly, even in a long

element the drywall compound is adhering to the cavities and to the panel surface under the effect of gravity, instead of downwardly slipping along the groove axis. The jig can even be rotated about the element longitudinal axis during the process to maintain an always optimal orientation.

Closed profiles, such as round columns, can be prefabricated using a centre hole provided in the brace members for installation on a mounting jig comprising an elongated member inserted through all the brace members as a shish-kebob.

The prefabrication method also permit the use of a manually of electronically programmable groove cutting table or conveyor to cut all the grooves at the appropriate depth and spacing in a single pass.

Custom shaping and/or drywall compound dispensing jigs may also be used to shape the external surface of the element according to a standard pattern in a minimal number of passes.

Therefor, it can be seen that the pre-fabricated curved profile architectural element structures and method for the factory production of curved profile architectural elements according to the present invention can be advantageously used to provide a wide variety of aesthetic yet economical architectural solutions for the construction market.

Although the present invention has been described by means of preferred embodiments thereof, it is contemplated that various modifications may be made thereto without departing from the spirit and scope of the present invention. For example, the standard drywall compound could

be substituted by a polymer based compound featuring higher structural and abrasion resistance, or a mixture incorporating Paris plaster to reduce or eliminate shrinkage and accelerate drying. Accordingly, it is intended that the embodiments described be considered only as illustrative of the present invention and that the scope thereof should not be limited thereto but be determined by reference to the claims hereinafter provided and their equivalents.

INVENTOR

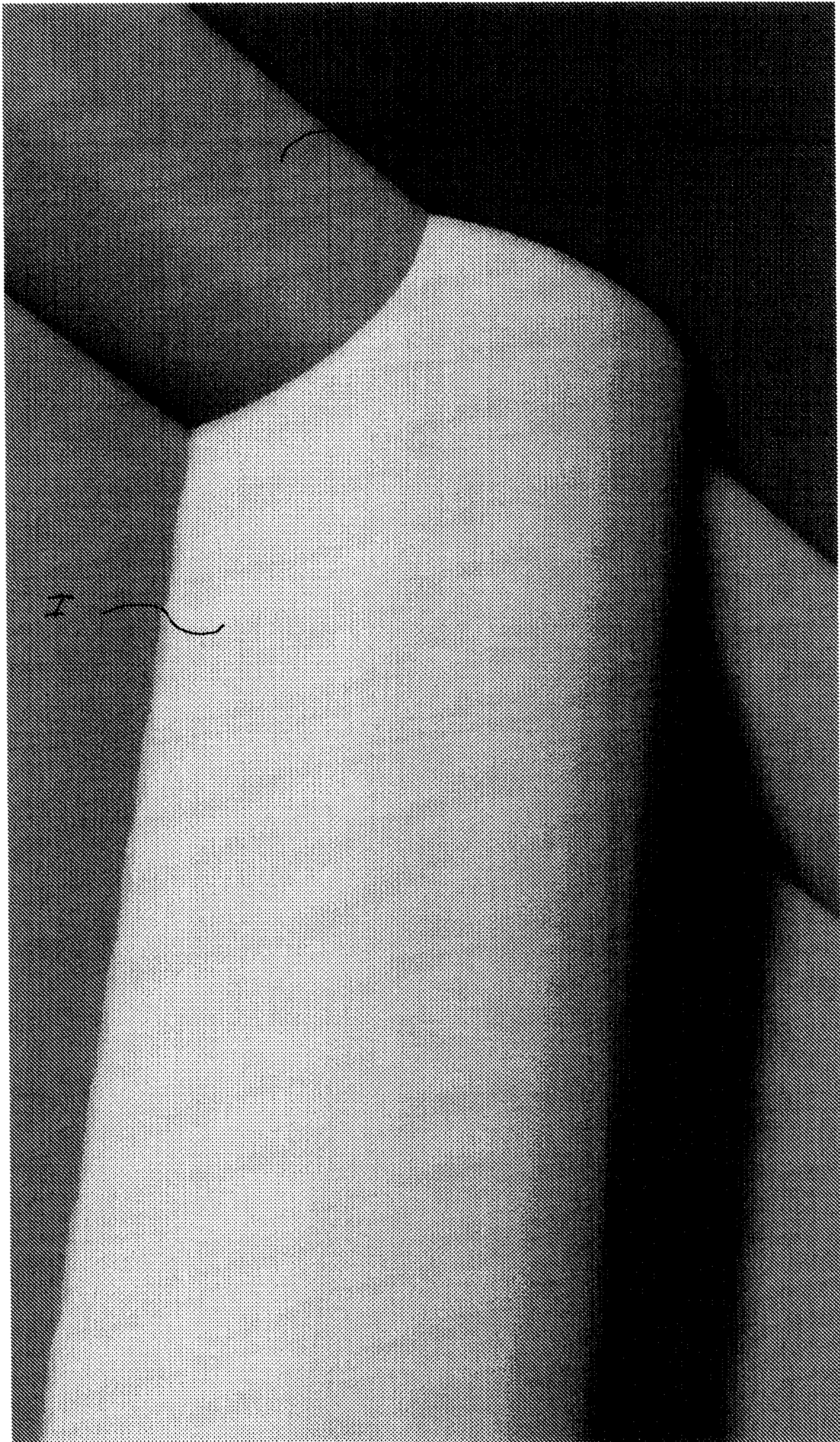
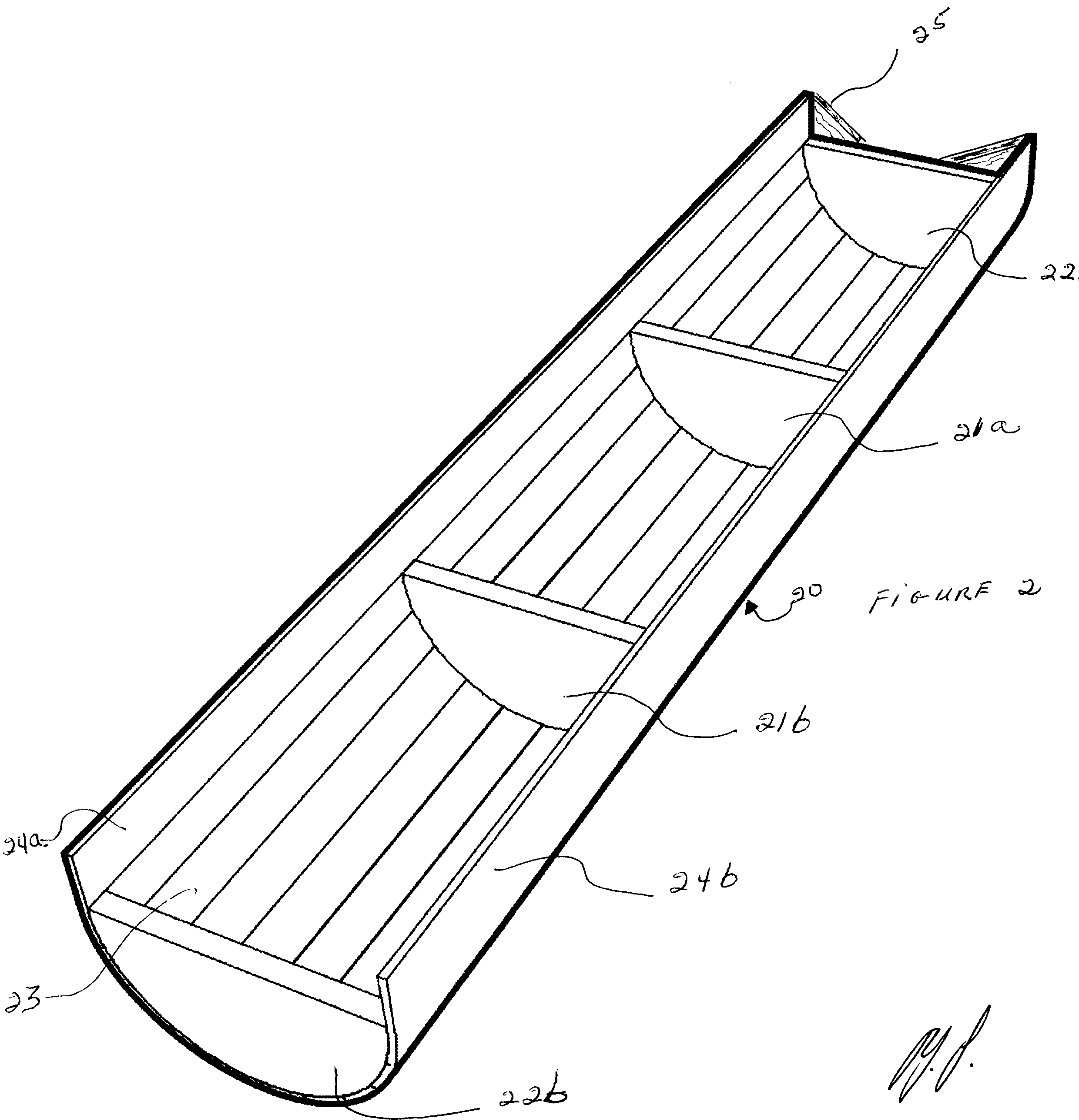


FIGURE
I

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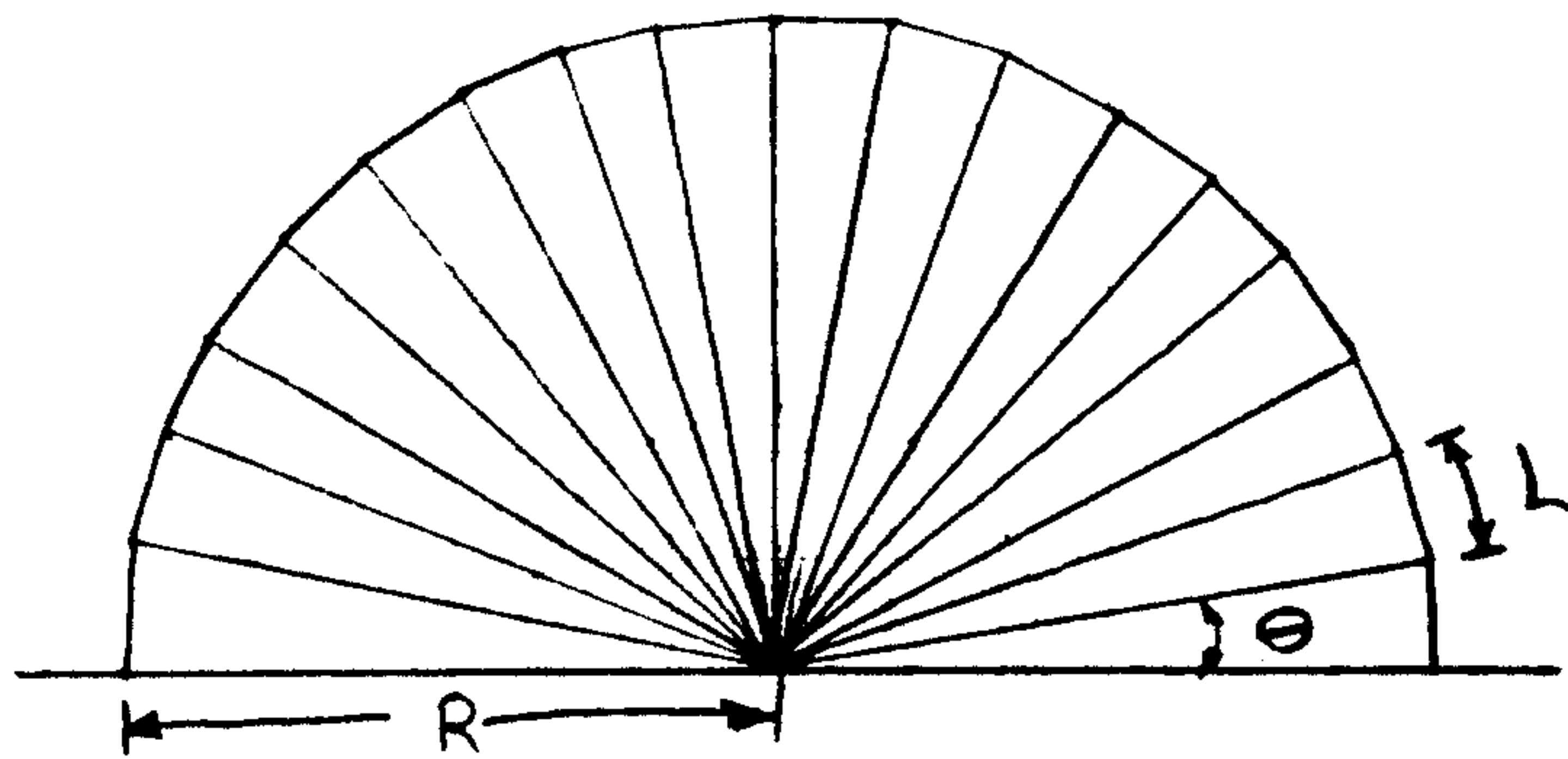


Fig. 3a

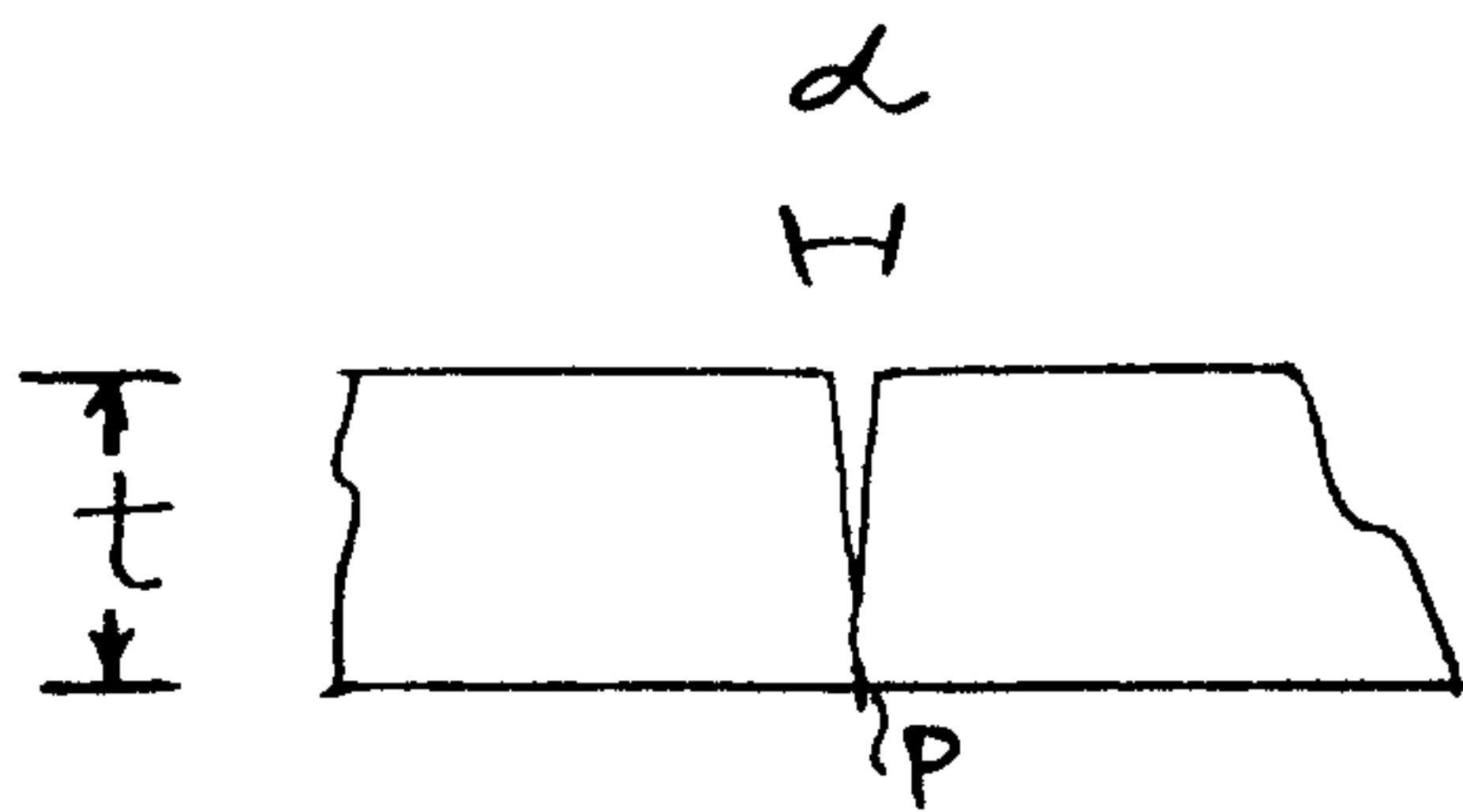


Fig. 3b

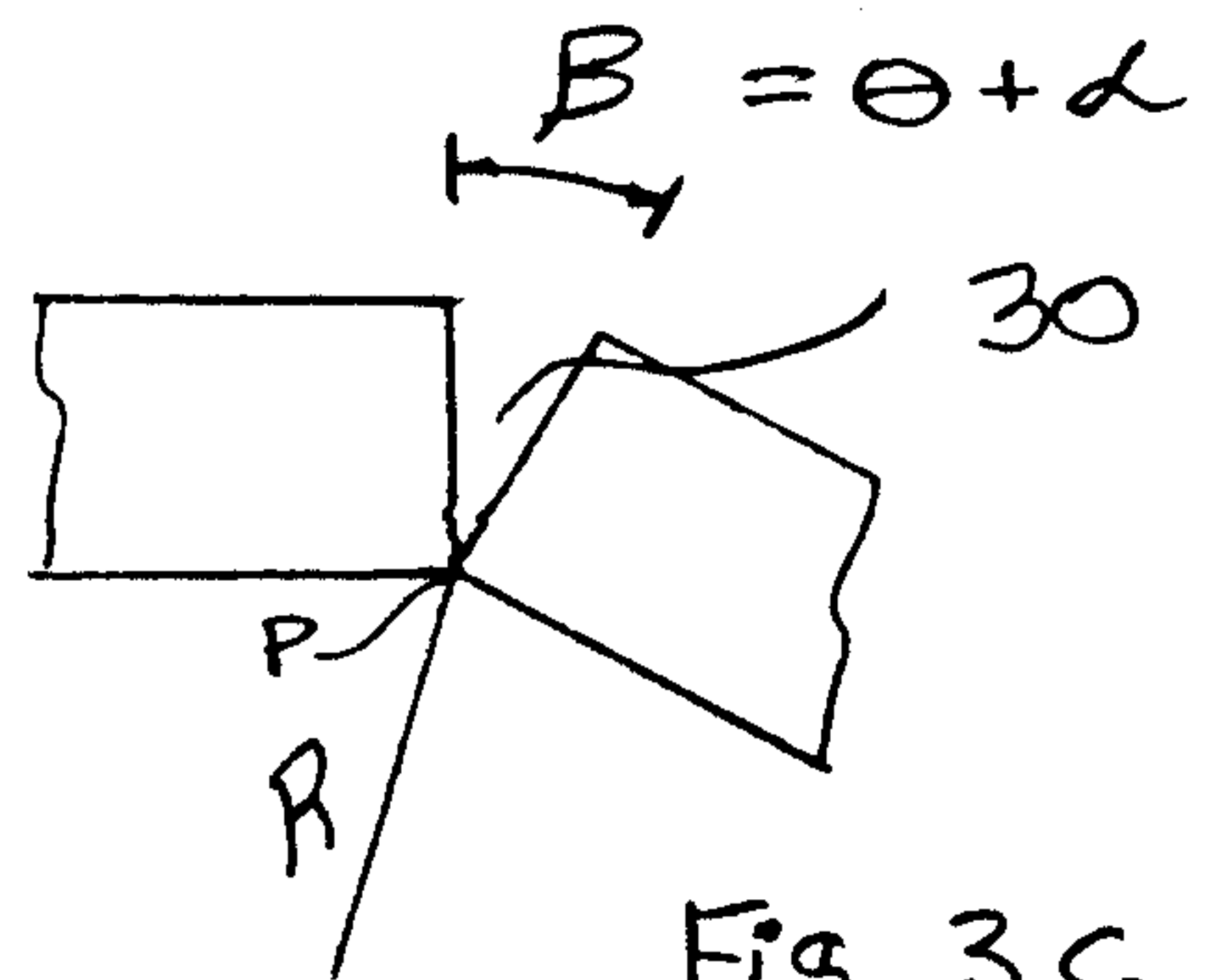


Fig. 3c

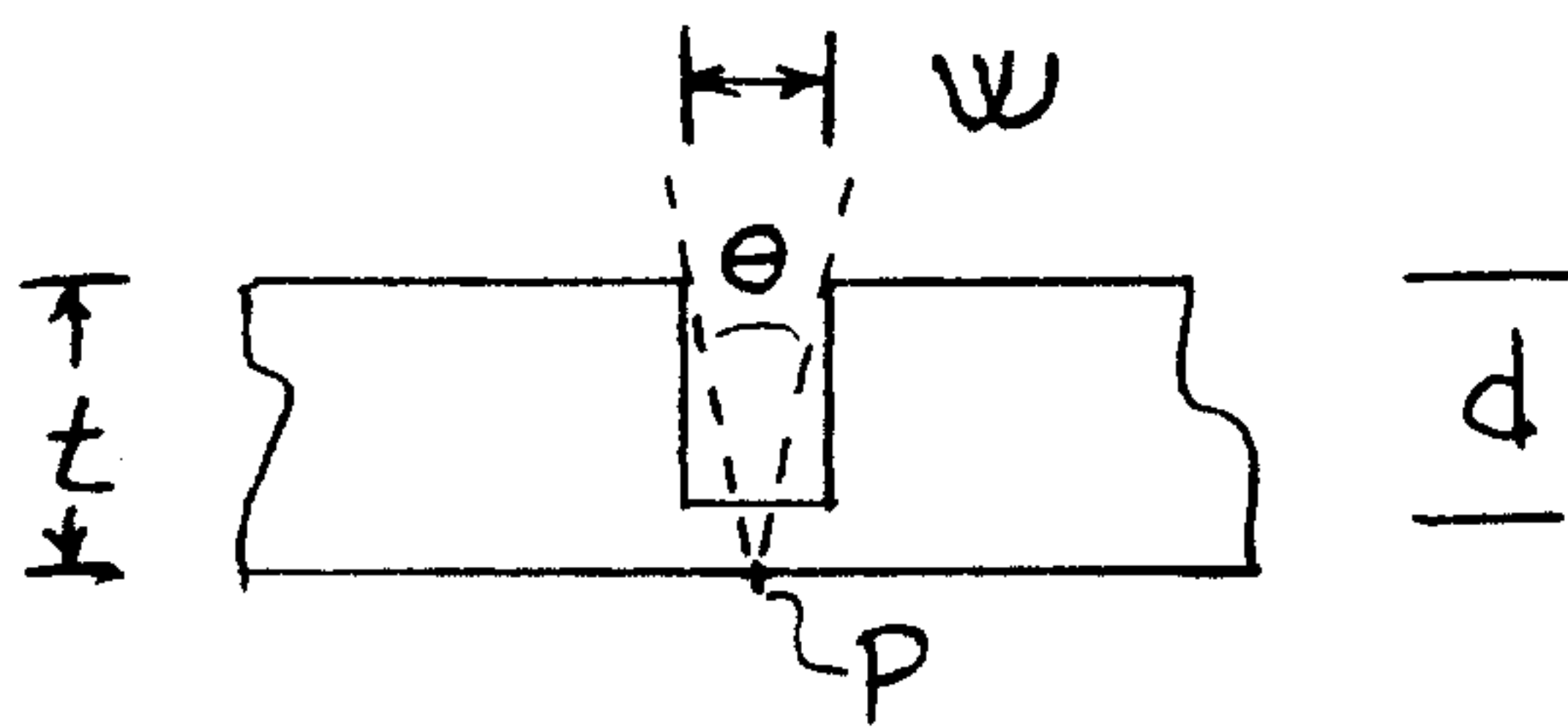


Fig. 3d

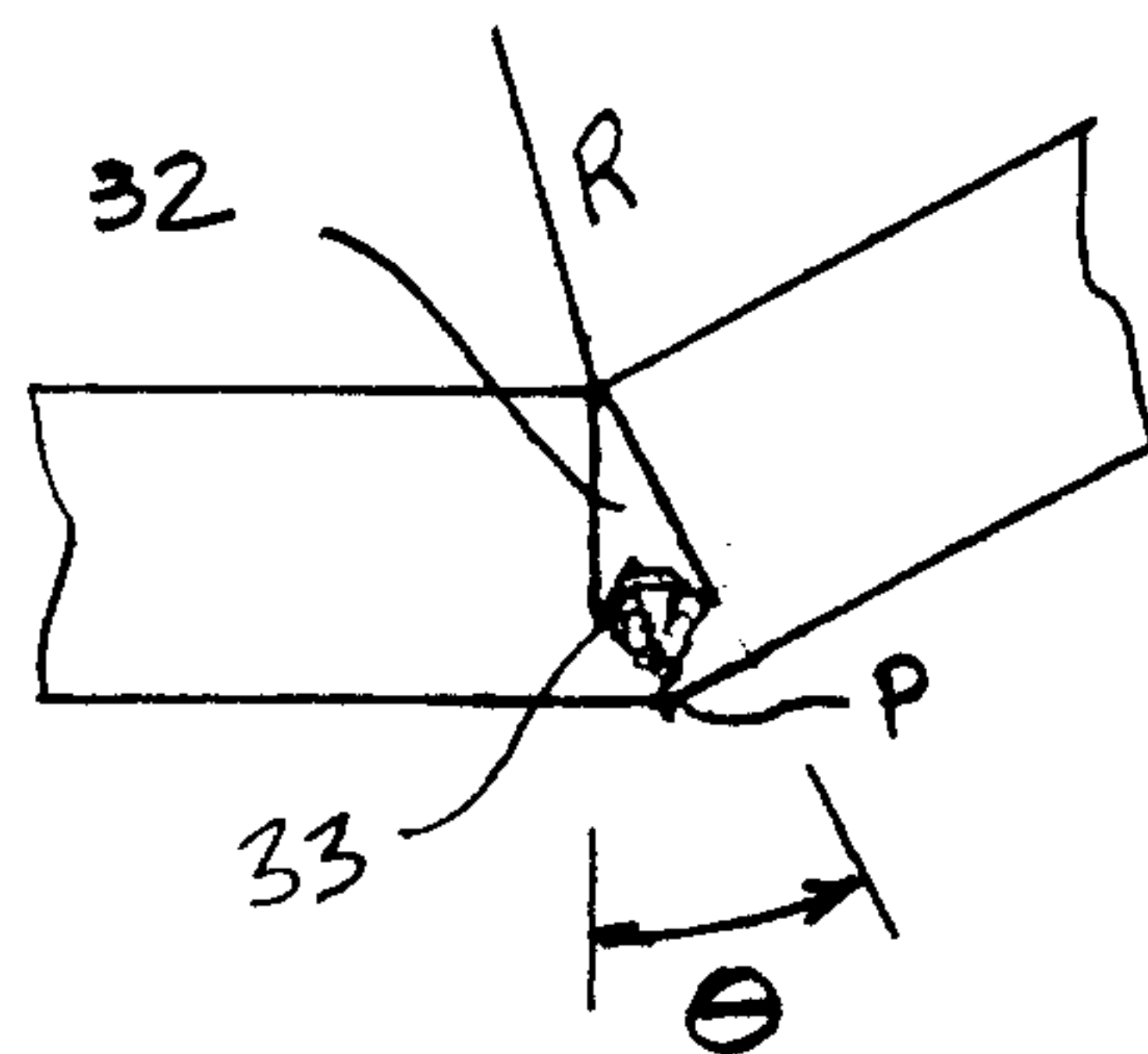


Fig. 3e

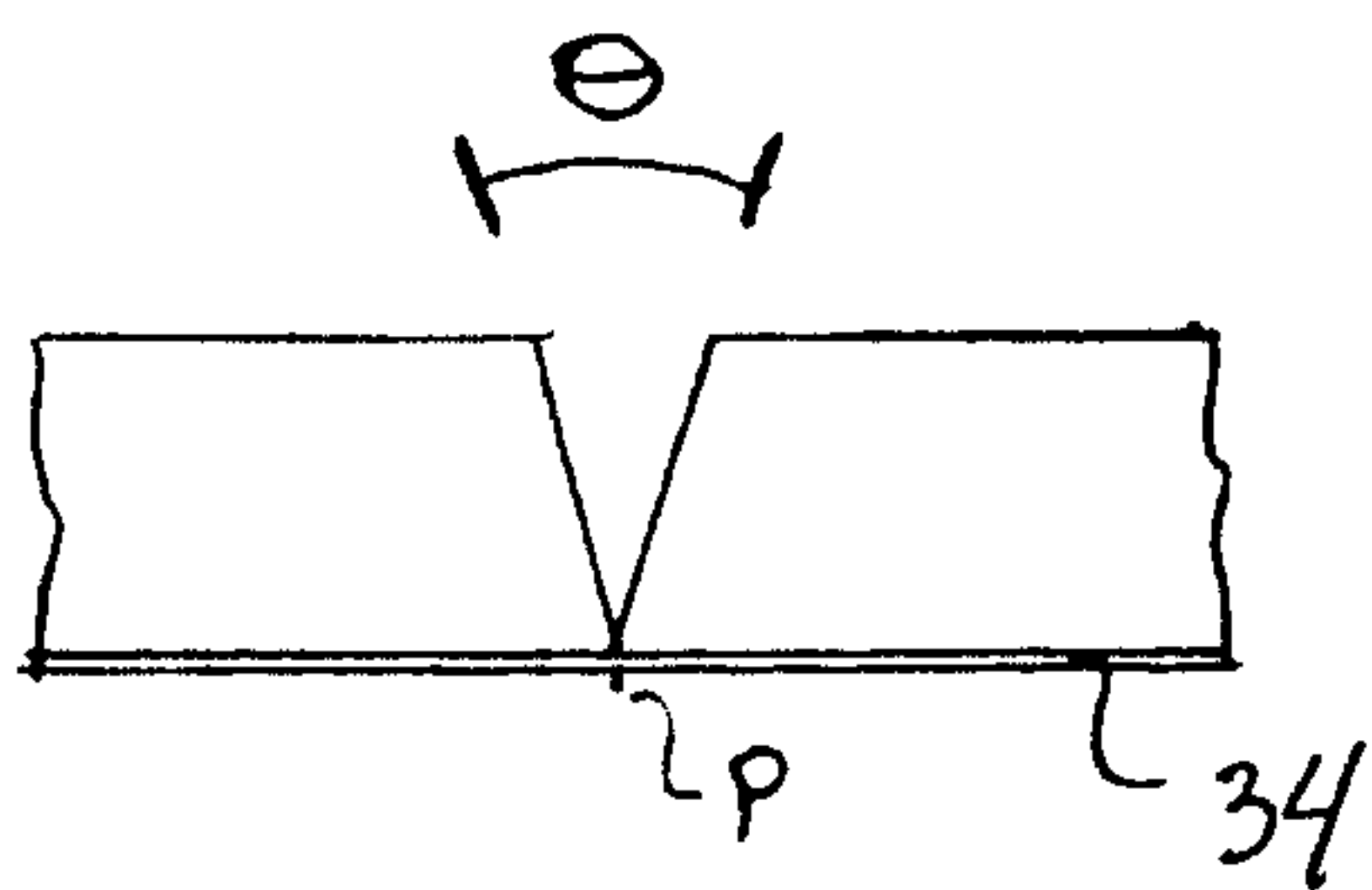


Fig. 3f

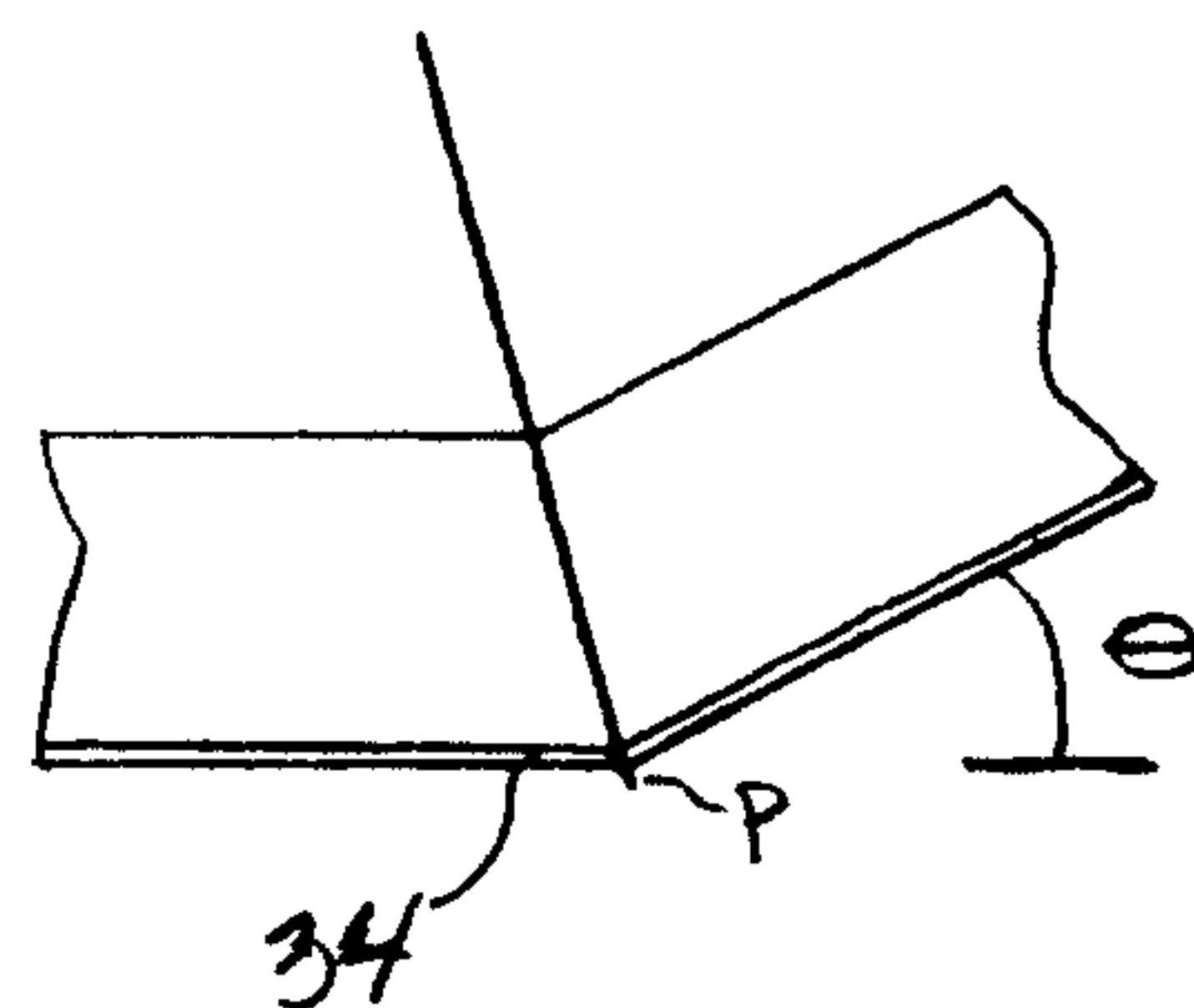


Fig. 3g

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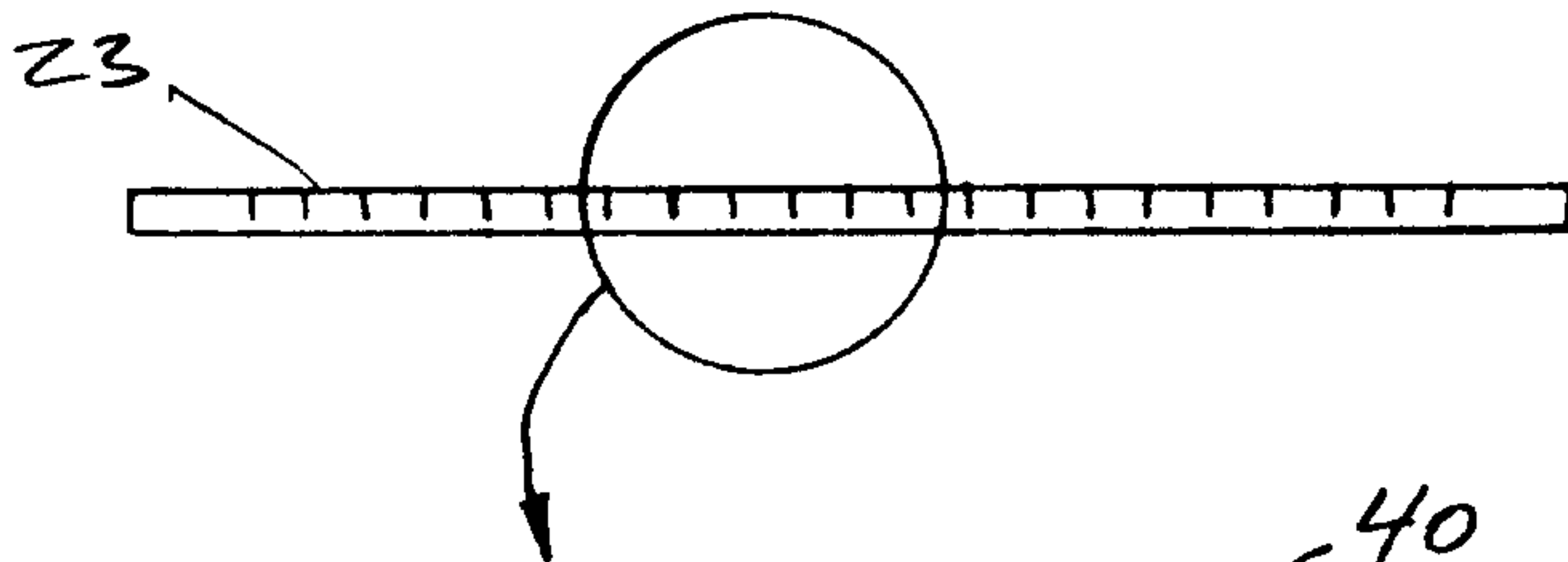
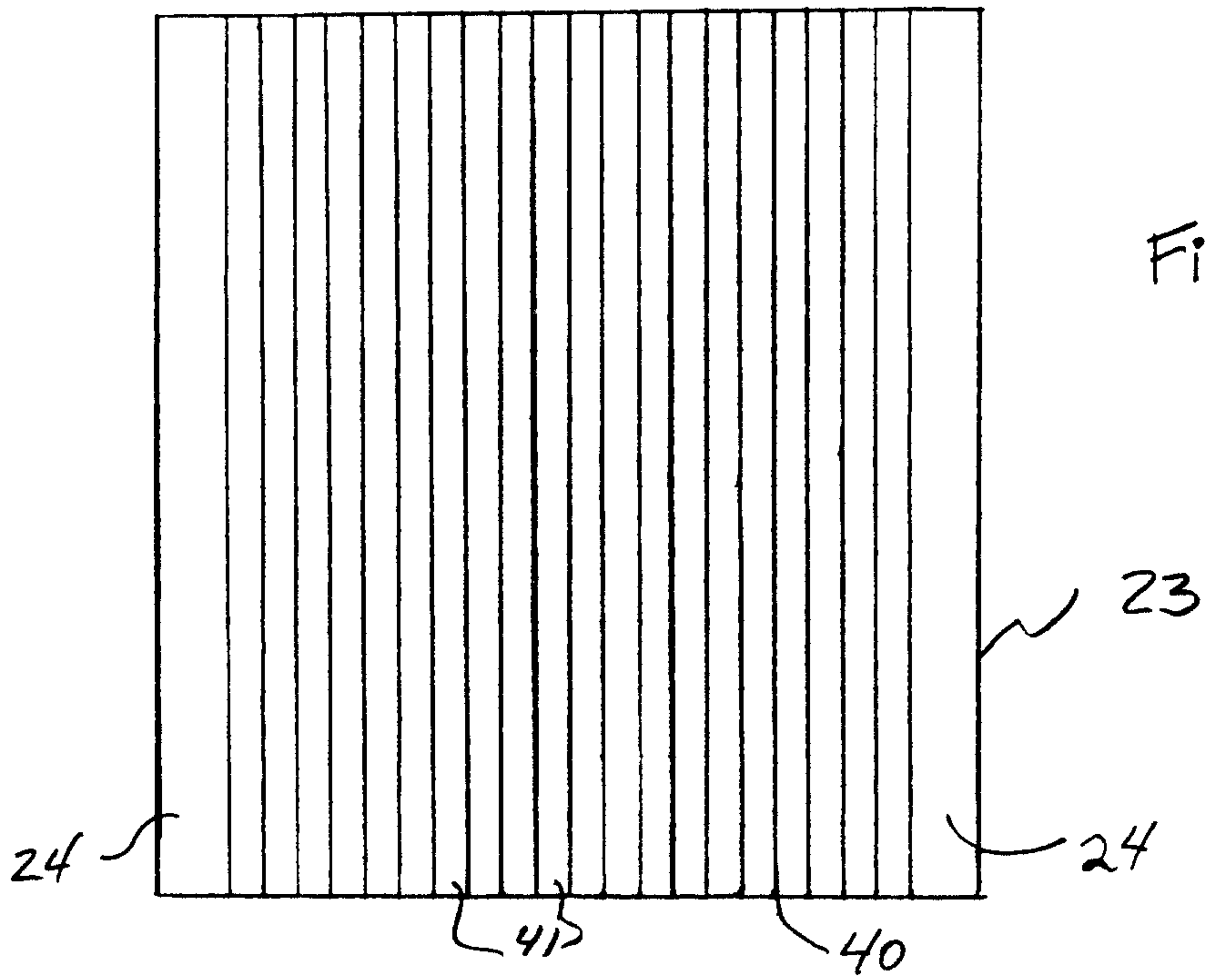


Fig. 4b

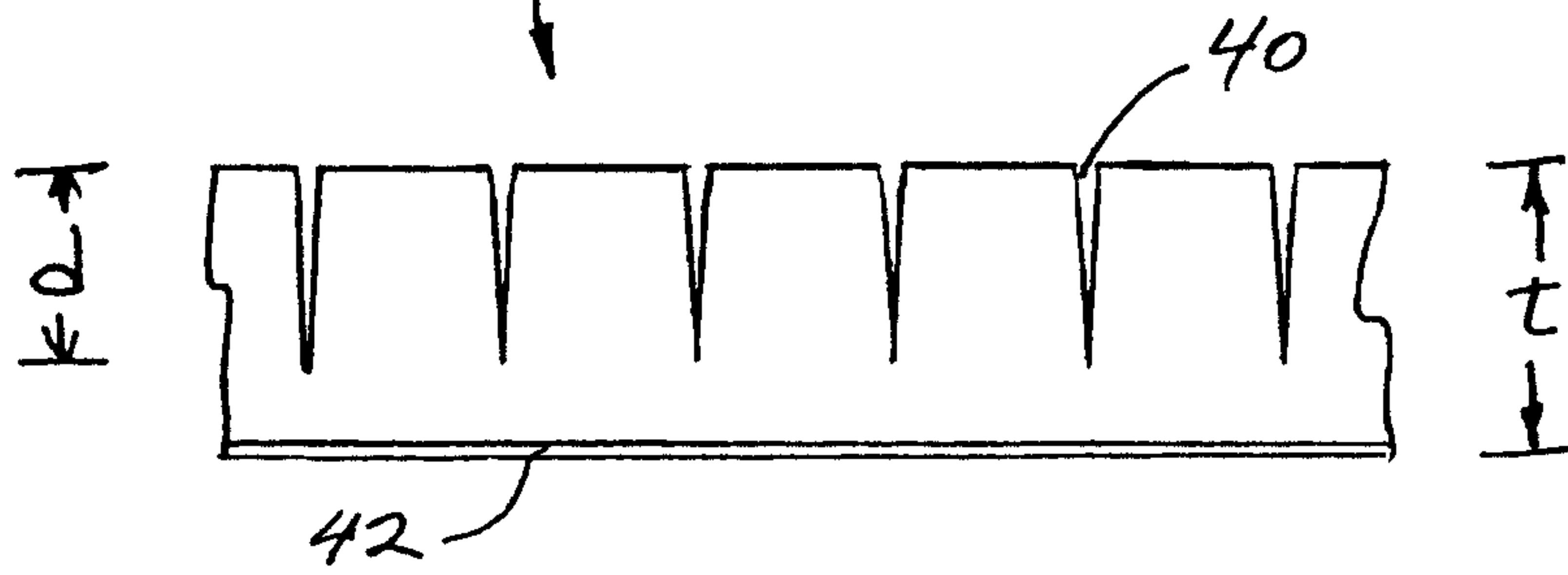


Fig. 4c

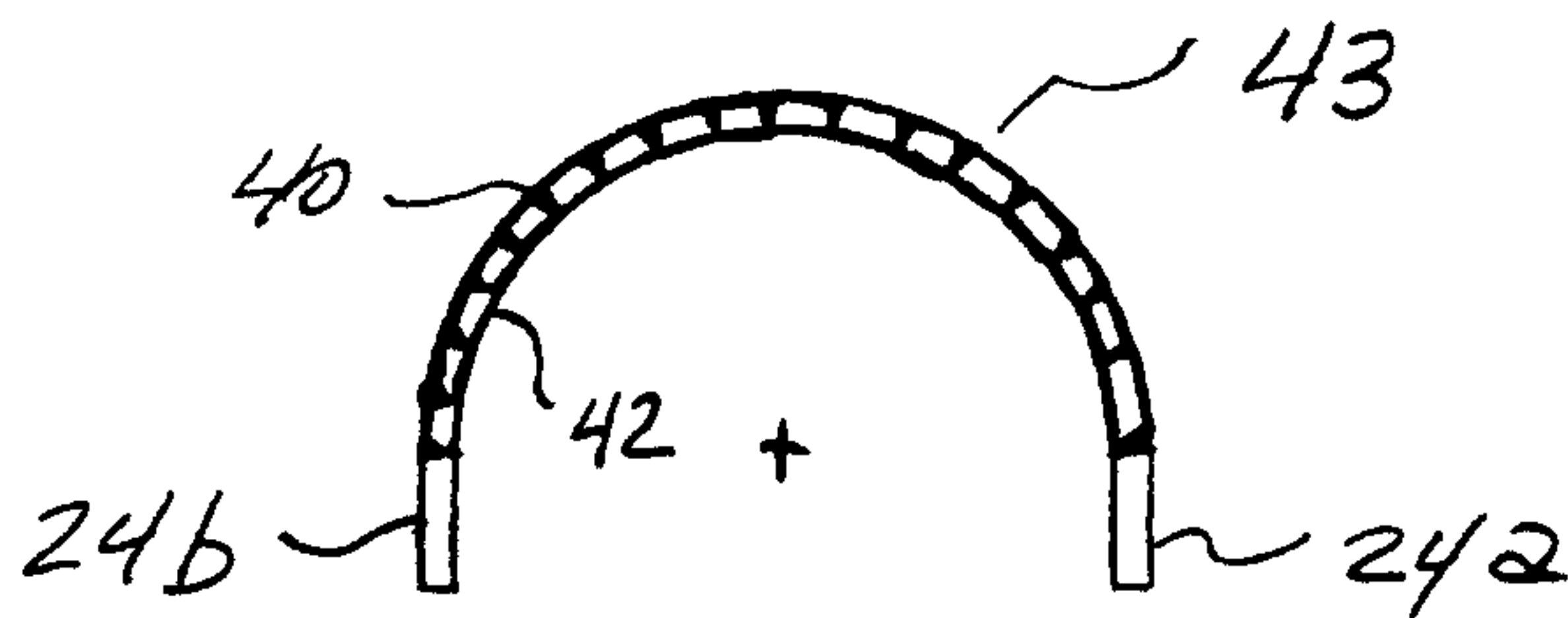


Fig. 4d

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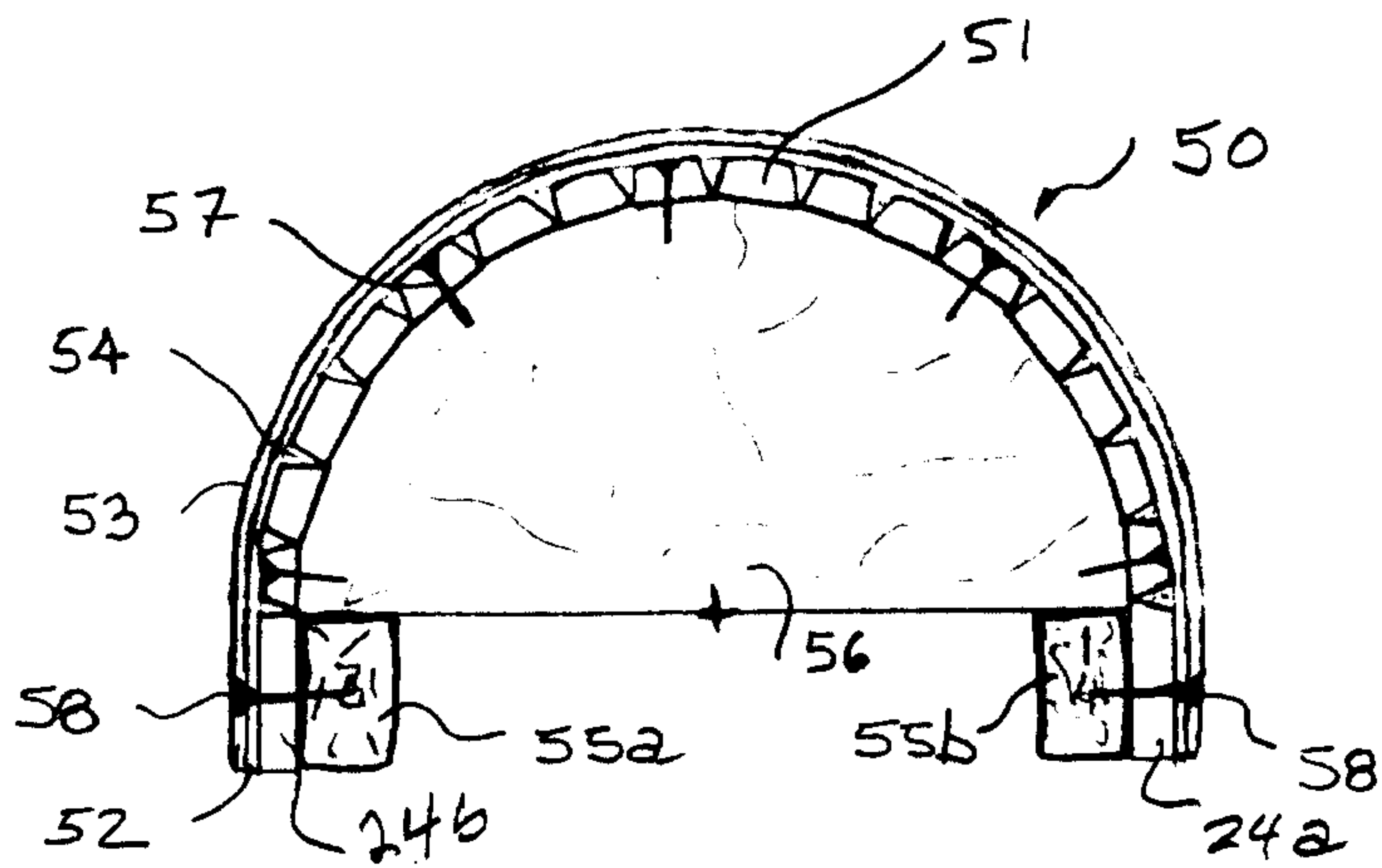


Fig. 5a

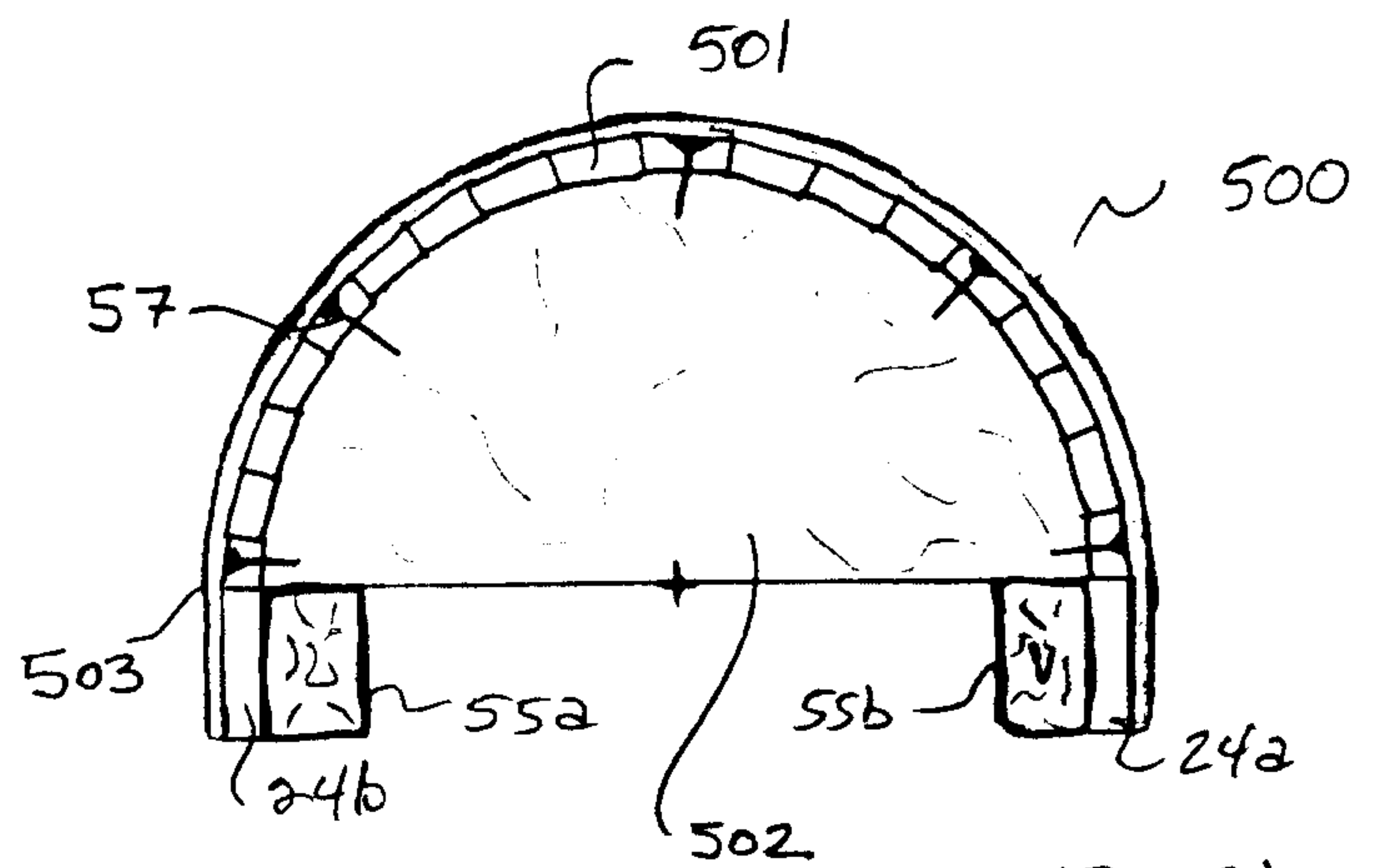


Fig. 5b

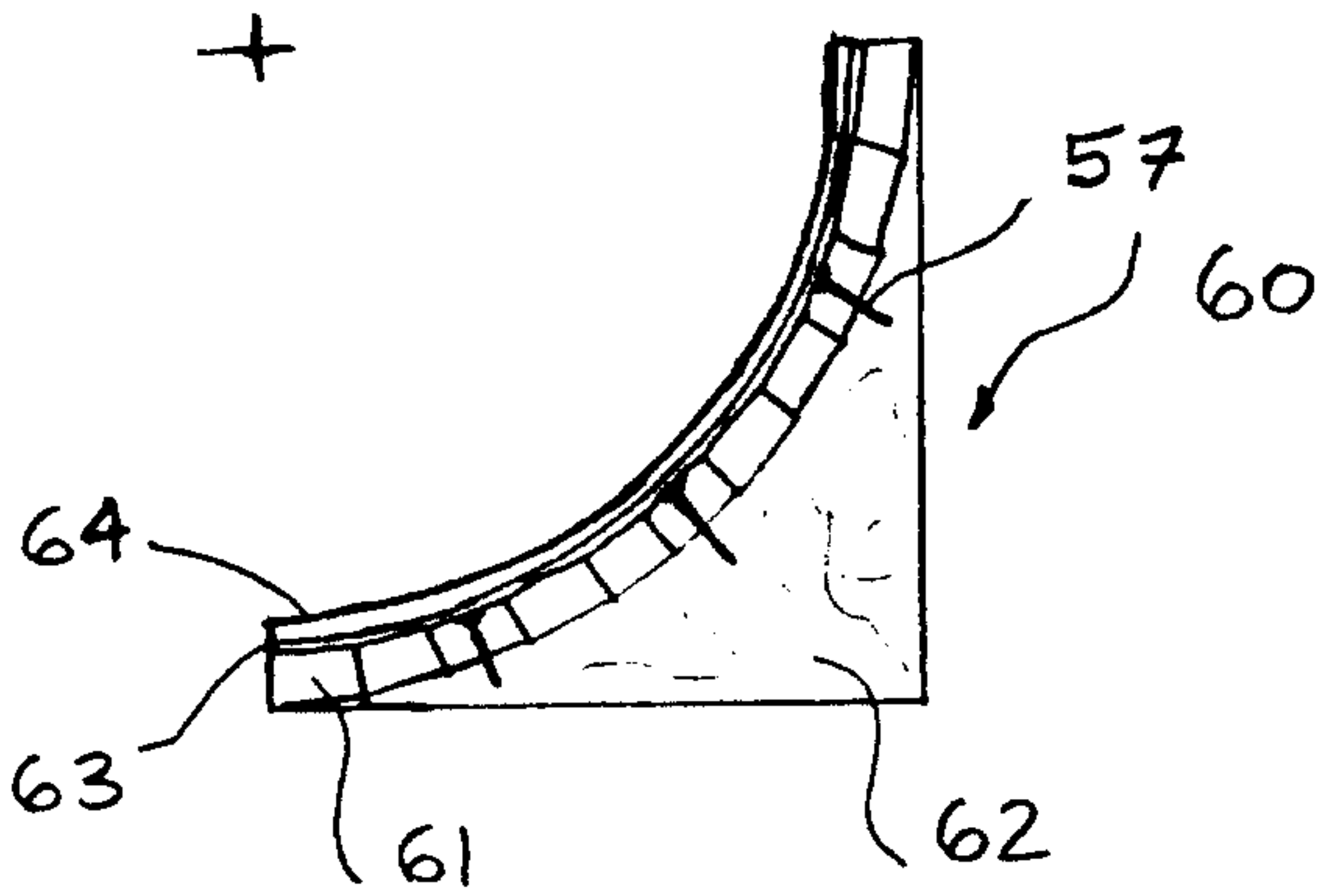


Fig. 6a

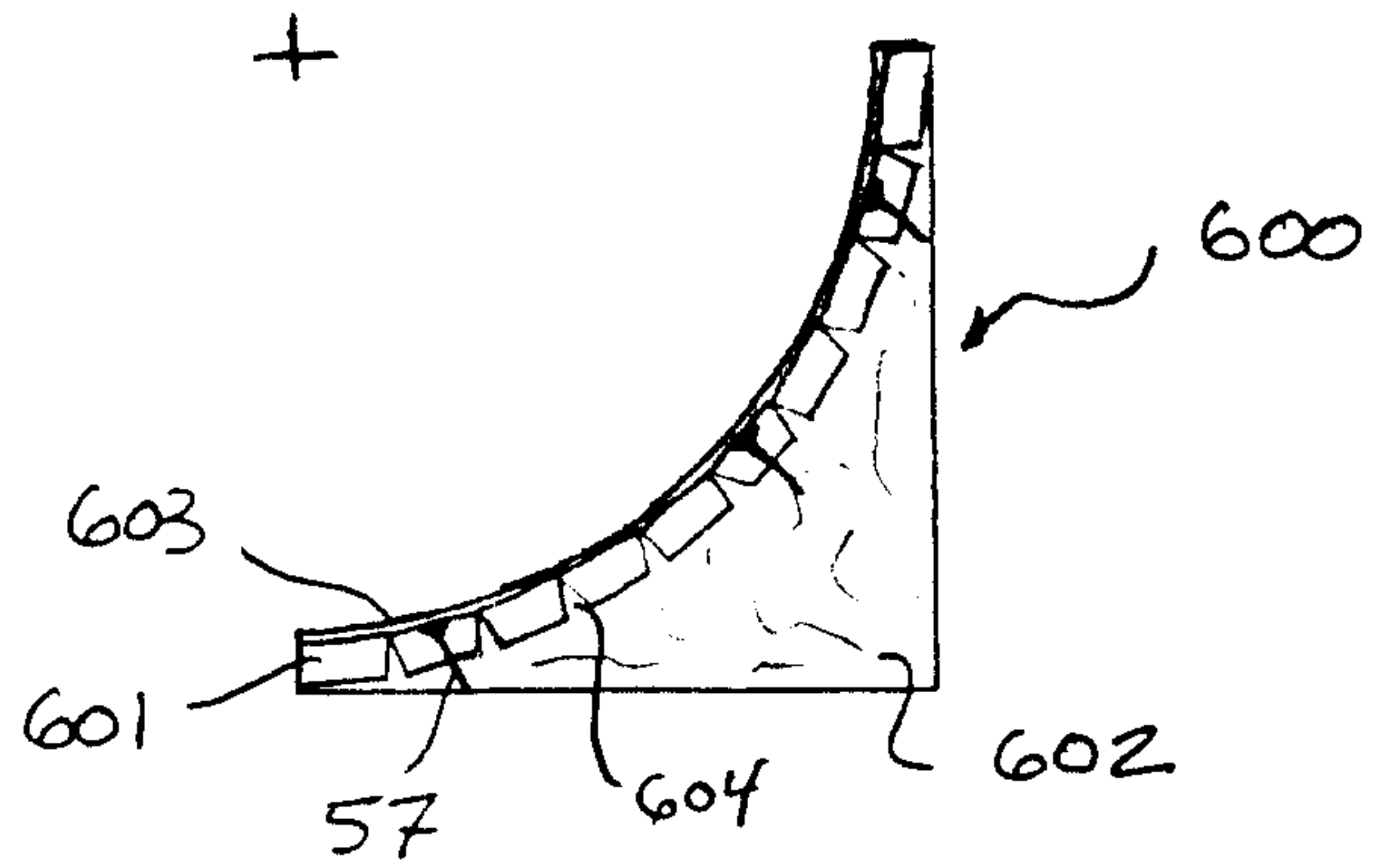


Fig. 6b

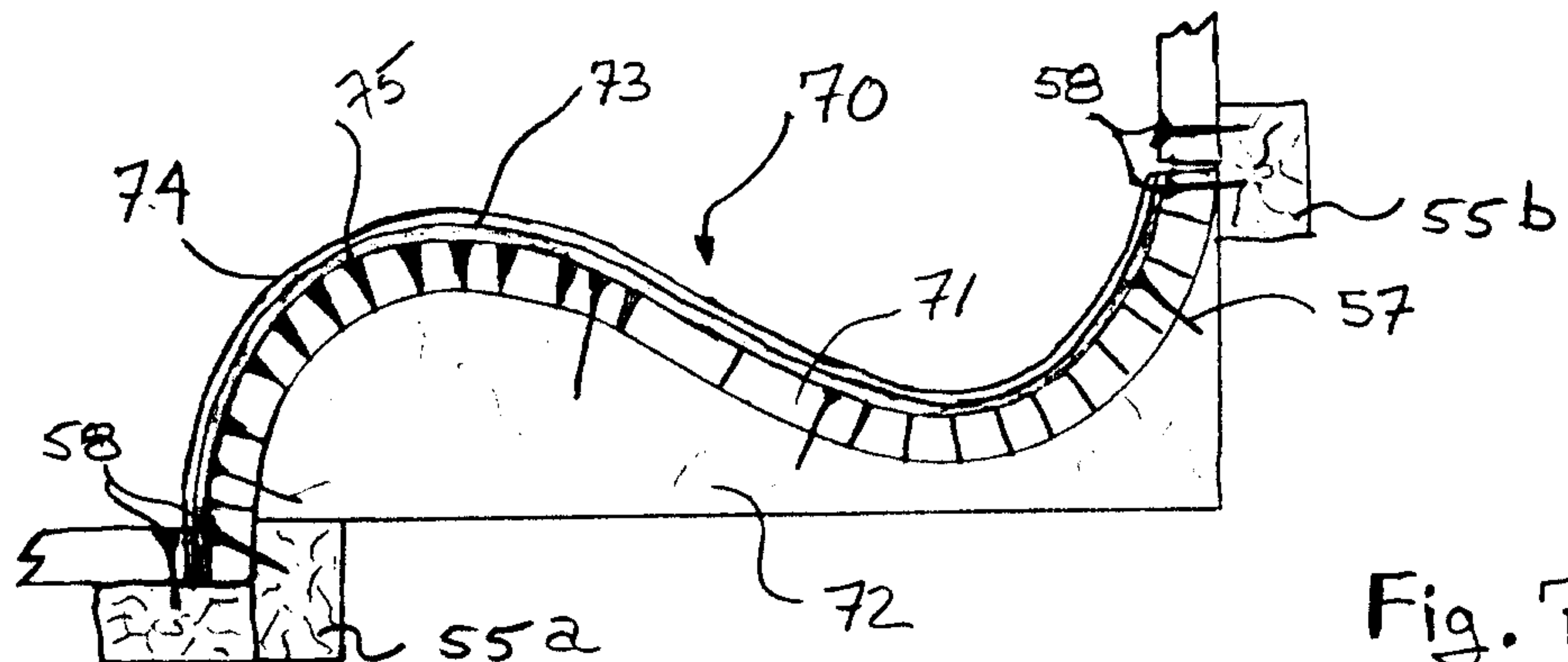


Fig. 7

