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Injection Moulded Unupholstered Plastic Chair

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ABSTRACT

A moulded plastic seat (31, 61, 131, 161) for a chair (30, 60, 130, 160) is disclosed. The seat is provided with a pair of recesses (37, 38, 57, 58, 67, 68) or a coalesced pair of recesses (137, 138, 157, 158, 167, 168) which are spaced apart and sized to reduce, but not eliminate, pressure on the ischial tuberosities of a sitter. A range of spacing and sizing corresponding to the height range of the sitter is disclosed. The seat is relatively thin and has some “give” in use.

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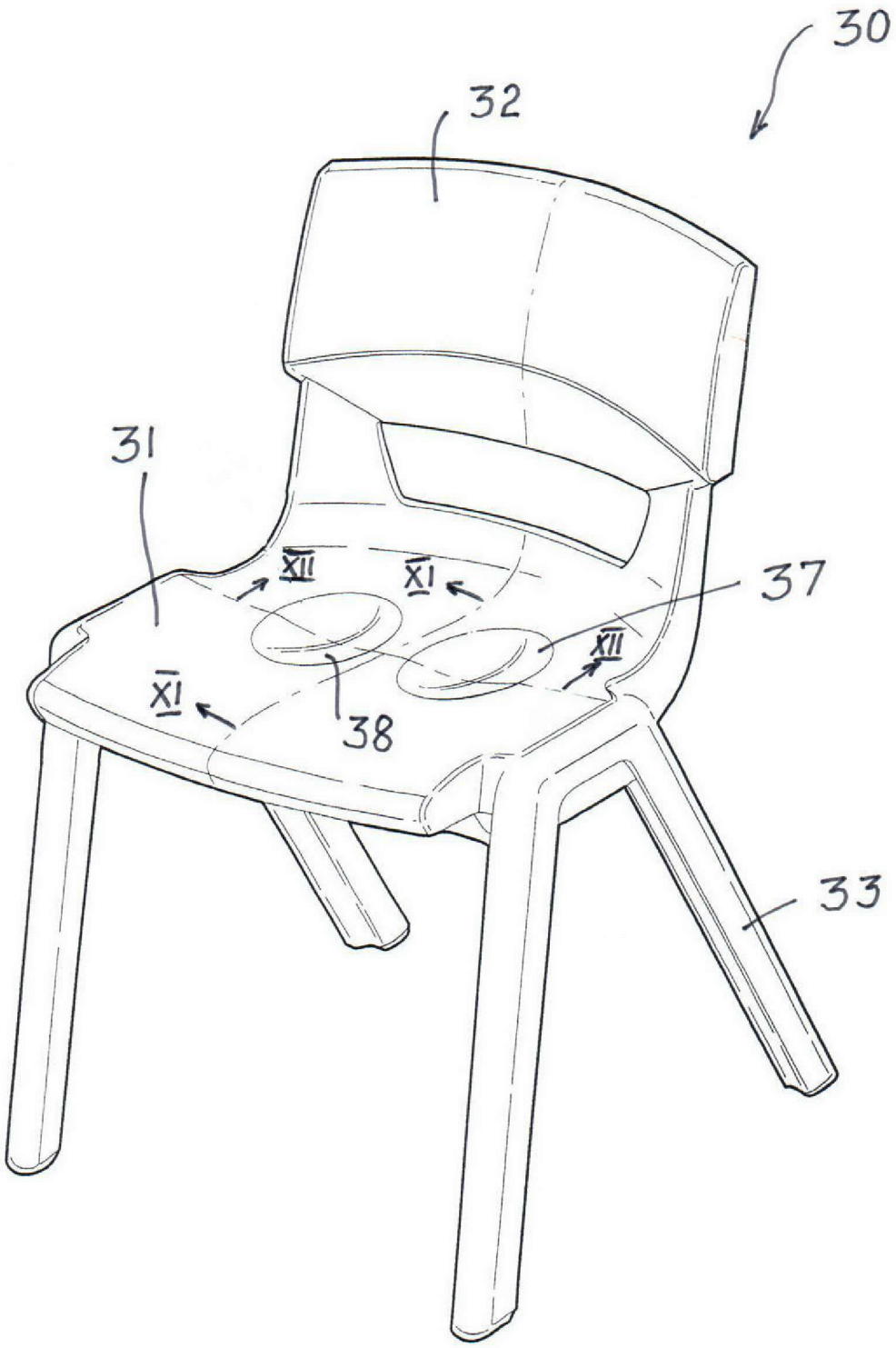

FIG. 4

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Injection Moulded Unupholstered Plastic Chair

Field of the Invention

The present invention relates to plastic seating and, in particular, to injection moulded plastic chairs.

Background Art

Injection moulded plastic chairs in which the entire chair is manufactured in a single operation have been known in some time and US Patents 4,341,419 (Wood) and 5,860,697 (Fewchuk) and both assigned to the present applicant, exemplify this art. Such chairs are widely used, are of relatively low cost to manufacture, typically having a production cost of in the vicinity of US$30, and the marketing of such chairs is extremely competitive. A particularly large market for such chairs is that formed by educational institutions and such chairs are often fabricated in different sizes to cater for students of different ages ranging from kindergarten students to adult university students.

Such chairs are normally fabricated from polypropylene, or a plastic which is substantially equivalent thereto, and accordingly, the seat whilst having some give or flexibility, is nevertheless relatively rigid. This rigidity becomes particularly noticeable when the chair is sat upon for long periods of time, such as a classroom session or lecture, eg 40 to 60 minutes.

Whilst it is known to upholster such plastic injection moulded chairs, or even provide them with a cushion, this adds considerably to the expense and inconvenience experienced by the owner of the chairs. This especially applies in relation to chairs which are required to be stacked between uses since such cushions or upholstery are liable to be damaged. Thus whilst a cushion may make a chair more comfortable for the user of the chair, a cushion is a very undesirable accessory as far as the owner and purchaser of the chair is concerned. Particularly in educational institutions, the owner or purchaser of the chair is a person different from the user of the chair.

The skeletal and anatomical portions of the human body involved in sitting are the pelvis, which is essentially a ring of bone which supports the backbone or spine, and the femurs of the upper legs or the thighs. The lowermost portions of the pelvis are two protrusions termed the ischial tuberosities. When sitting it is thought that the weight of the upper body is supported by, and this results in compression of, the flesh between the ischial tuberosities and the seat, whereas the weight of the thighs is supported by the flesh below the femurs.

After a person has been sitting still on a relatively rigid seat for some time, such as a seat injection moulded from polypropylene, the flesh below the ischial tuberosities has been compressed for that time and, as a consequence of this compression, the blood flow through the area adjacent the ischial tuberosities is reduced. This results in the first signs of restlessness, inattention, and "squirming" on the seat as the sitter attempts to adjust their position so as to change the distribution of pressure forces on their flesh.

In addition, a large percentage of the population using such chairs are not necessarily in peak physical condition. Many persons suffer from various kinds of back pain, such as lumbago. Also, prolonged sitting on hard surfaces can cause ischial bursitis, also known as Weaver's bottom (a term coined to describe the symptoms suffered by weavers who spent long hours sitting at a loom). As a consequence, an appreciable percentage of any audience or class will have a pre-existing medical condition which is likely to be aggravated by prolonged sitting.

Genesis of the Invention

The genesis of the present invention is a desire to provide a seat able to be used in the low cost injection moulding of plastic chairs and which avoids or ameliorates ischial bursitis and thereby promotes concentration and reduces inattentiveness amongst students, in particular.

Summary of the Invention

In accordance with a first aspect of the present invention there is disclosed a seat for use in relation to chairs for the avoidance or amelioration of ischial burstis, said seat being un-upholstered, not being provided with any cushion or padding, and being

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injected moulded from plastics material to form a seat surface, said seat having a rigidity when set equivalent to the rigidity of polypropylene, and said seat surface having a thin vertical extent, being spaced from any supporting frame by a distance sufficient to allow said seat surface to deflect and reduce said distance when a person sits on said seat, and having in the upper surface of said un-upholstered injection moulded seat a pair of spaced apart concavities which do not deform in use to any substantial extent, the spacing between said concavities corresponding to the spacing between the ischial tuberosities of a class of humans intended to sit on the seat.

In one embodiment, the above-mentioned pair of concavities are separate, whilst in another embodiment, the above-mentioned pair of concavities is coalesced.

Brief Description of the Drawings

Embodiments of the present invention will now be described, with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a prior art old fashioned tractor seat;

Fig. 2 is a perspective view of a prior art seat used for rowing sculls;

Fig. 3 is a perspective view of a prior art injection moulded contoured seat;

Fig. 4 is a front perspective view of the chair of a first embodiment of the present invention;

Fig. 5 is a rear perspective view of the chair of Fig. 4;

Fig. 6 is a front elevation of the chair of Fig. 4;

Fig. 7 is a rear elevation of the chair of Fig. 4;

Fig. 8 is a plan view of the chair of Fig. 4;

Fig. 9 is an inverted plan view of the chair of Fig. 4;

Fig. 10 is a left side elevation of the chair of Fig. 4, the right side elevation being a mirror image thereof;

Fig. 11 is a front to rear cross sectional view along the line XI-XI of Fig. 4;

Fig. 12 is a left to right cross sectional view along the line XII-XII of Fig. 4;

Fig. 13 is a perspective view of an armchair of a second embodiment;

Fig. 14 is a perspective view of a stadium seat of a third embodiment;

Fig. 15 is a perspective view of a stadium seat of Fig. 14 with its pivotable seat raised;

Fig. 16 is a front perspective view of a chair similar to that of Fig. 4 but having a seat of a second embodiment where the concavities are coalesced;

Fig. 17 is a plan view of the chair of Fig. 16;

Fig. 18 is a perspective view of an armchair having a seat with coalesced concavities;

Fig. 19 is a perspective view of a stadium seat with coalesced concavities;

Fig. 20 is a perspective view of the stadium seat of Fig. 19 with its pivotable seat raised,

Fig. 21 is a plan view of a pressure map created by a person sitting on a conventional injection moulded plastic seat of the type described in US Patent No 5, 860, 697 (Fewchuk),

Fig. 22 is a perspective view of the pressure map of Fig. 21,

Fig. 23 is a plan view of a pressure map created by the same person sitting on the chair of Fig. 4, and

Fig. 24 is a perspective view of the pressure map of Fig. 23.

Detailed Description

Turning now to the drawings, Fig. 1 illustrates an old fashioned tractor seat 1 which was pressed from metal. Such tractors were required to be worked for long periods of time, the seats were very poorly sprung and driver fatigue was a severe problem. The seats were provided with a large number of openings 2 primarily to enable rain water to drain from the seat since the tractors were without cabins and without any roof or other shelter. Such metal seats 1 were superseded by upholstered seats with the introduction of tractor cabins.

Turning now to Fig. 2, a conventional seat 10 for a rowing scull, as used for over 100 years, is illustrated in which two through apertures 12, 13 are provided. The spacing between the through apertures 12, 13 corresponds approximately to the spacing between the ischial tuberosities of an adult male. The seat 10 is specifically designed to cater for the front to rear swinging action of the spine of the rower during rowing and the holes or through apertures 12, 13 are designed to prevent the flesh under the ischial tuberosities being cyclically significantly compressed during the front to rear rocking motion undertaken whilst rowing.

Furthermore, the duration of a competitive rowing race is a relatively short time, for example, most rowers are capable of rowing 2,000 metres in less than 10 minutes. So the problem whilst rowing is one of comfort during relatively short bursts of high intensity activity rather than any lack of attention caused by listener inactivity during a long lecture.

Turning now to Fig. 3, in this prior art chair the seat 20 is moulded to the perceived shape of the buttocks and upper thighs of a user, the intention being to convey an impression of comfort to a would be purchaser or user. However, in fact the flesh of the sitter is compressed in the same way as when sitting on the chair 20 of Fig. 3 as in a conventional chair such as those disclosed in the two abovementioned US patents. That is, the contours of the seat 21 provide the optical illusion of comfort, but not the actual reality of comfort.

Prior art searches conducted after the conception of the present invention have revealed WO2006/040516 (Moule) which like the prior art of Fig. 3 discloses a hard and thick seat which is shaped overall to receive the buttocks. Thus the seat of this publication does not provide any resilience or "give" when the weight of the user's body is applied to the seat.

Also revealed was US Patent No. 4,529,247 (Stumpf et al), which discloses a one piece moulded seat and backrest with an opening 20 between the seat 14 and the backrest 16. Two front to rear elongated slits 19b and 21b enable the rear portion 14b of the seat to be supported in a cantilever fashion and thereby deform to reduce the pressure on the flesh between the rear portion of the seat 14b and the ischial tuberosities of the sitter. US Patent No. 4,418,958 (Watkin) discloses a similar arrangement in which the cantilevered portion is split into two by a further slot 42 thereby permitting one side of the seat to deform more than the other side of the seat, if the sitter shifts his weight from left to right or vice versa. A hole 48 in each portion 44 increases the softness of the portions 44 and also decreases the pressure in use on the ischial tuberosities of the sitter. A difficulty with both these prior art arrangements is that delinquent students may flex the portions which are supported in a cantilever fashion (14b in Stumpf and 44 in Watkin) thereby leading to permanent deformation and unsightly damage to the chairs.

A further prior art proposal is that contained in published US Patent Application No. 2012/0119560 (Wu) in which a seat is formed from a bottom board and a top board which are joined together. The top board has a pair of recesses 3 over which a soft cushion (not illustrated in the patent specification) is placed, the soft cushion also having two recesses. This proposal suffers from the disadvantageous problems of cushions referred to above.

Turning now to Figs. 4 to 12, the chair 30 of the preferred embodiment of the present invention is illustrated. The chair 30 has a seat 31 and a backrest 32 and four legs 33. As best seen in Fig. 9, the upper portions of the legs 33 are joined by a cross brace 35 which is spaced from the underside of the seat 31. The entire chair 30 including seat 31, backrest 32, legs 33 and cross brace 35, is moulded in a single piece using injection moulding equipment.

As best seen in Fig. 4, two recesses 37, 38 are formed in the upper surface of the seat 31 and project downwardly from the lower surface of the seat 31 as best seen in Fig. 12.

The chair 30 is moulded from polypropylene which is sufficiently rigid for the legs 33, for example, to support the chair 30 without difficulty. However, the seat 31, being relatively thin, is provided with a little bit of give or flexibility. Thus, as seen in Fig. 11, the distance 36 between the lower surface of the seat 31 and the upper edge of the cross brace 35 is reduced when a person sits on the seat 31 in accordance with the disclosure of Australian Patent Application No 2010 246 557 (Attorney Ref. 3004DR-AU). In addition, the recesses 37, 38 ensure that the flesh below the ischial tuberosities is not compressed to the same extent as it would be if the recesses 37, 38 were absent, as in the prior art of US Patent No. 5,860,697 (Fewchuk), for example.

As best seen in Fig. 12, because the thickness of the seat 31 is maintained irrespective of the presence of the recesses 37, 38, so the strength of the seat 31 is not reduced by the presence of the recesses 37, 38.

Subjective tests conducted by employees of the applicant on prototype chairs 30 indicates that the period during which a sitter can sit comfortably on the chair and remain attentive, is considerably increased, typically by approximately 50%. Thus an employee who could sit for 20 minutes without experiencing any discomfort is now able to sit for 40 minutes without experiencing any discomfort.

Other types of chairs which include plastic injection moulded seats include armchairs and stadia seats. Fig. 13 illustrates an armchair 50 having a pair of ischial concavities 57, 58 whilst Figs. 14 and 15 illustrates a stadium seat 60 having a pivotable seat 61 with a pair of ischial concavities 67, 68.

The two separate concavities of Figs. 4-15 can, as indicated in Figs. 16-20, be coalesced so as to form a single recess which has two concavities. In the embodiments of Figs. 16-20 the designation numbers of like parts to those of the embodiments of Figs. 4-15 are increased by 100. Thus as seen in Figs. 16 and 17, a chair 130 has a backrest 132 and four legs 133. A single recess 136 having two coalesced concavities 137, 138 is formed in the upper surface of the seat 131.

The concavities 137, 138 function in the same way as the recesses 37, 38 and thus the flesh under the ischial tuberosities is similarly not compressed by the chair 130 relative to prior art arrangements.

Turning now to Fig. 17, it will be seen that the single recess 136 has a left to right dimension X which is the distance between the centres of the concavities 137, 138. Similar, there is a minimum front to rear dimension Y and a maximum front to rear dimension Z. In particular, students of different stature or height will require that the recess 136 has different dimensions. Set out in the table below are the preferred dimensions in mm for the indicated student heights, also in mm.

Student Height	1590 - 1880	1460 - 1765	1190 - 1590
X	160	140	130
Y	130	115	105
Z	170	150	140
Depth at centre of Y	3	2	1.5
Depth at extremities of X	8	6	5

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As mentioned above, other types of chairs including armchairs and stadia seats can have plastic injection moulded seats. Fig. 18 illustrates an armchair 150 having a pair of ischial concavities 157, 158 similar to the armchair 50 of Fig. 13. Similarly, Figs. 19 and 20 illustrate a stadium seat160 having a pivotable seat 161 with a pair of ischial concavities 167, 168. The stadium seat 160 is similar to the stadium seat 60 of Fig. 15.

Turning now to Figs. 21-24, a pressure pad apparatus used in medical research was used to determine the pressures experienced by a person sitting on the prior art seat of US Patent No 5, 860, 697 (Fewchuk) and the pressures experienced by the same person sitting on the seat of Fig. 4 of the present specification. The pressure pad was a thin flexible mat which was divided into a large number of individual cells each of small area and each of which contains a solid state sensor such as a piezo resisitive sensor. The pressure within each cell was able to be sensed and the results indicated by means of a program stored in a computer to which the pad was connected. The person sitting on both seats was the Research and Development Manager of the applicant corporation and the duration of each sitting session was approximately 30 minutes.

For the above-mentioned prior art seat, it will be seen from Figs. 21 and 22 that the pattern of pressure conforms generally to the shape of the buttocks and there are two pronounced pressure peaks spaced apart by a distance corresponding to the ischial tuberosities. The peak pressure in each of the peaks is in the range of 209-220 mmHg and the area covered by pressures in excess of 88 mmHg is quite extensive.

However, for the seat of Fig. 4, although the pattern of pressure again conforms generally to the shape of the buttocks, and again there are two pronounced pressure peaks spaced apart by a distance corresponding to the ischial tuberosities, the shape and intensity of these peaks is substantially different. In particular, the peak pressure is less than 88 mmHg, a reduction in the order of 60%. In addition, although the areas of peak pressure in Figs. 23-24 have a similar shape to the areas of peak pressure in Figs. 21-22, the pressure in the former Figs is much more diffuse and less intense than in the latter Figs. As a consequence, a person sitting on the seat of Fig. 4 is able to sit with comfort for longer, is less likely to move or otherwise “squirm”, and is generally

able to maintain concentration for longer periods. These attributes of the seat of Fig. 4 represent a substantial advance over the prior art.

In addition, whilst the magnitude of the pressure is important, so too isthe gradient of change between the various zones of equal pressure. The steeper this gradient, the more the "shear pressure" which surrounds each ischial tuberosity. The gradient also contributes to the intensity of the pain with the steeper the gradient the more intense the pain. Furthermore, in those seats which are used in aged care seating, where the same person remained seated in the same seat for long periods of time, a steep pressure gradient in the vicinity of the ischial tuberosities contributes to decubitus ulcers or bed sores. So the lower gradients illustrated in Figs. 23-24 also make a substantial contribution in the area of aged care seating.

The foregoing describes only some embodiments of the present invention and modifications, obvious to those skilled in the plastic injection moulding arts, can be made thereto without departing from the scope of the present invention.

The term "comprising" (and its grammatical variations) as used herein is used in the inclusive sense of "including" or "having" and not in the exclusive sense of "consisting only of".

CLAIMS

The claims defining the invention are as follows:

1. A seat for use in relation to chairs for the avoidance or amelioration of ischial burstis, said seat being un-upholstered, not being provided with any cushion or padding, and being injected moulded from plastics material to form a seat surface, said seat having a rigidity when set equivalent to the rigidity of polypropylene, and said seat surface having a thin vertical extent, being spaced from any supporting frame by a distance sufficient to allow said seat surface to deflect and reduce said distance when a person sits on said seat, and having in the upper surface of said un-upholstered injection moulded seat a pair of spaced apart concavities which do not deform in use to any substantial extent, the spacing between said concavities corresponding to the spacing between the ischial tuberosities of a class of humans intended to sit on the seat.
2. The seat as claimed in claim 1 wherein the distance between the centres of said concavities is in the range of from 130mm to 160mm.
3. The seat as claimed in claim 1 or 2 wherein the front to rear dimension of each said concavity is in the range of from 140 to 170mm.
4. The seat as claimed in any one of claims 1-3 wherein the depth of said concavities is in the range of from 5mm to 8mm.
5. The seat as claimed in any one of claims 1 - 4 wherein said concavities are identical.
6. The seat as claimed in any one of claims 1 - 4 wherein said concavities are coalesced.
7. The seat as claimed in any one of claims 1 - 6 and forming part of an integrally formed injection moulded plastic chair.
8. The set as claimed in any one of claims 1 - 6 and forming part of an armchair.
9. The seat as claimed in any one of claims 1 - 6 and forming part of a stadium seat.
10. The seat as claimed in claim 9 and being pivotable between a raised standby position and a substantially horizontal use position.
11. The seat as claimed in any one of claims 1 - 10 wherein said class of humans is selected from the group consisting of adults, teenagers, primary schoolchildren and kindergarten students.

12. The seat as claimed in any one of claims 1 - 11 and injection moulded from polypropylene.

Dated this 6th day of April 2021

SEBEL FURNITURE LTD

By

FRASER OLD & SOHN
Patent Attorneys for the Applicants

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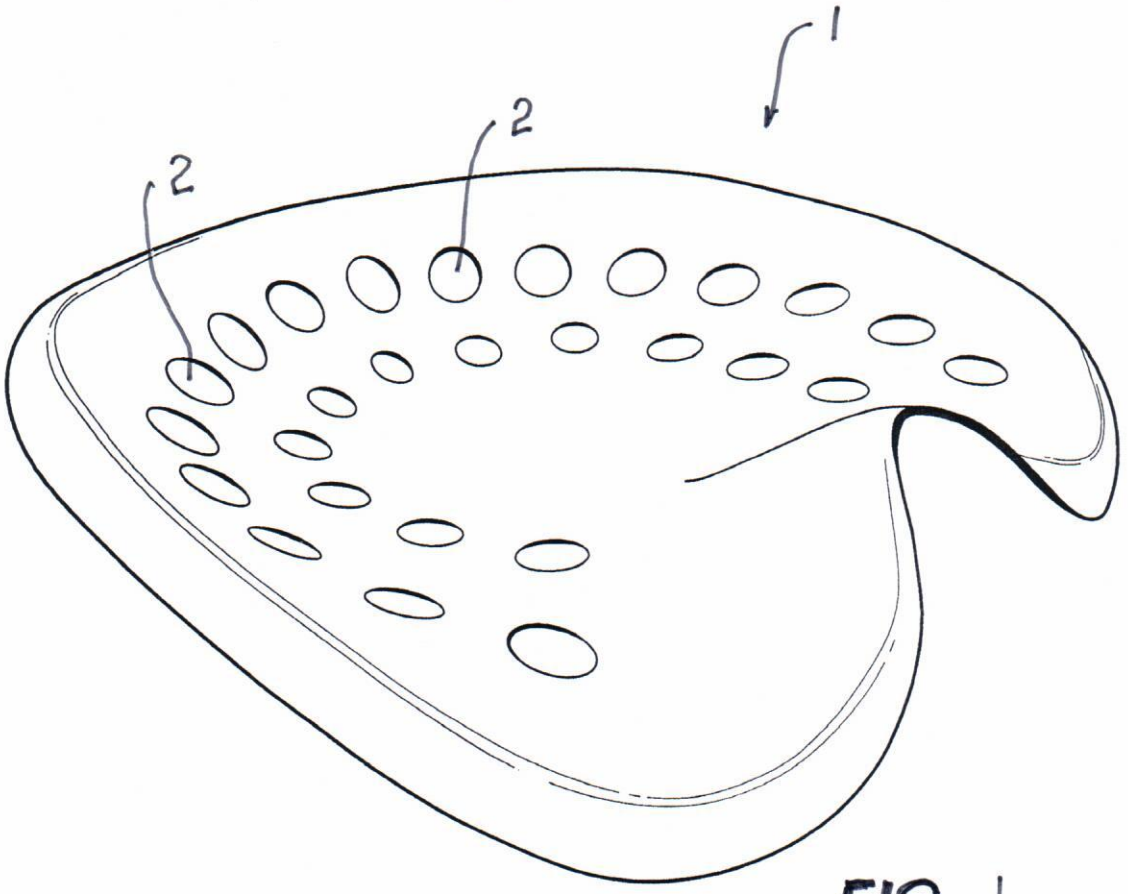

FIG. 1
(PRIOR ART)

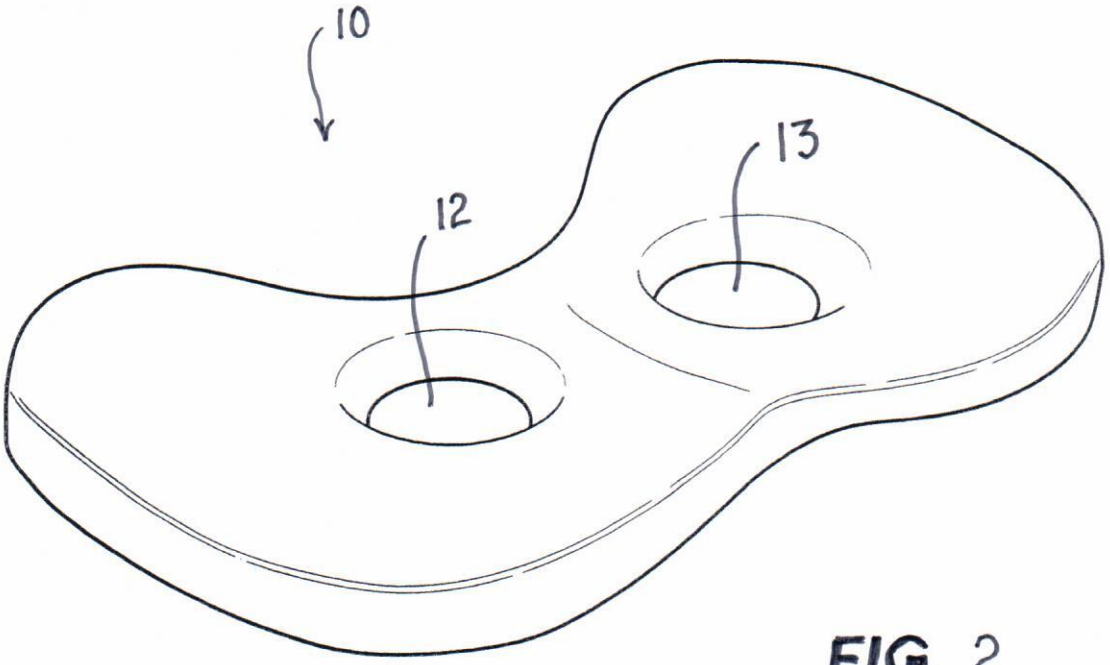

FIG. 2
(PRIOR ART)

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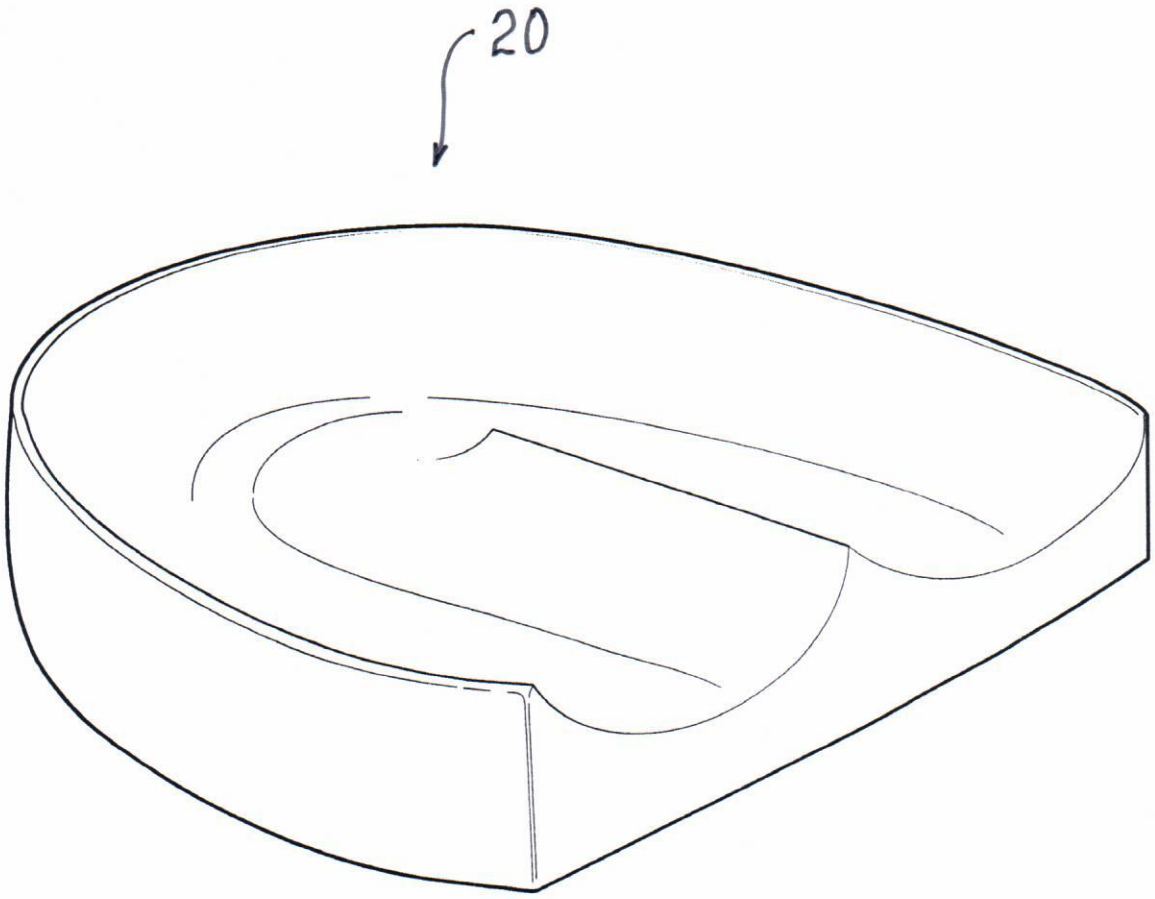

FIG. 3
(PRIOR ART)

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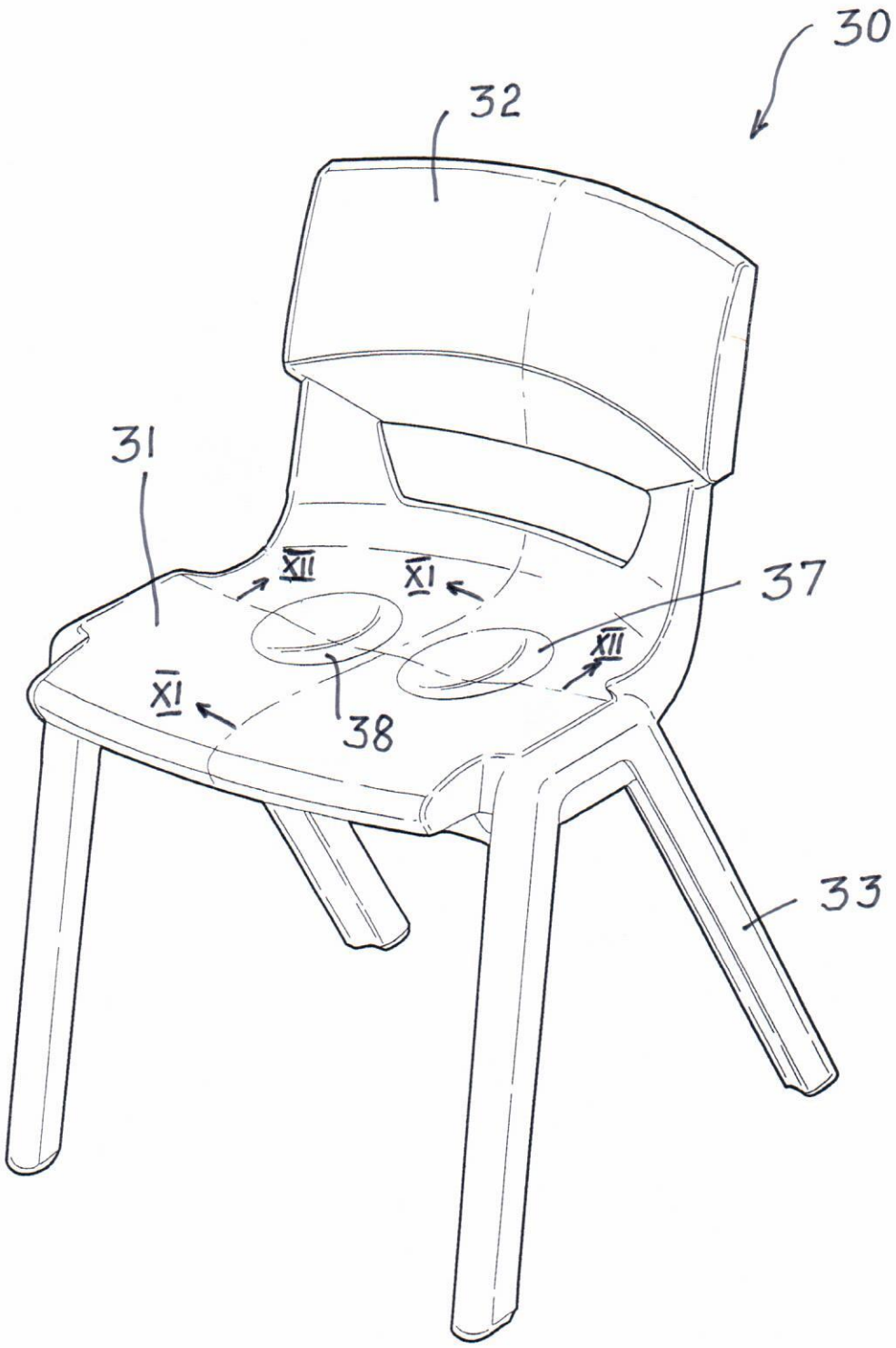

FIG. 4

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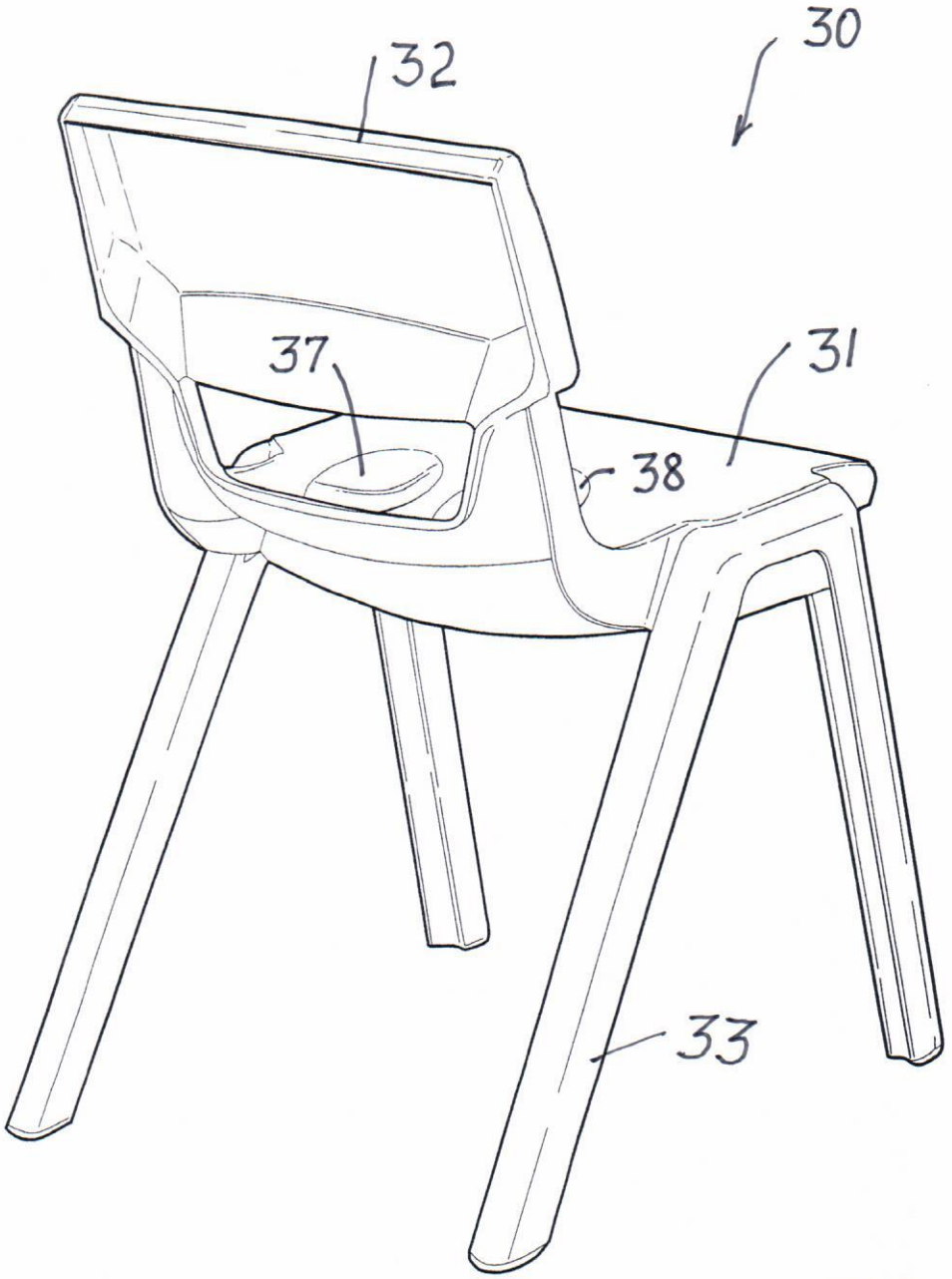

FIG. 5

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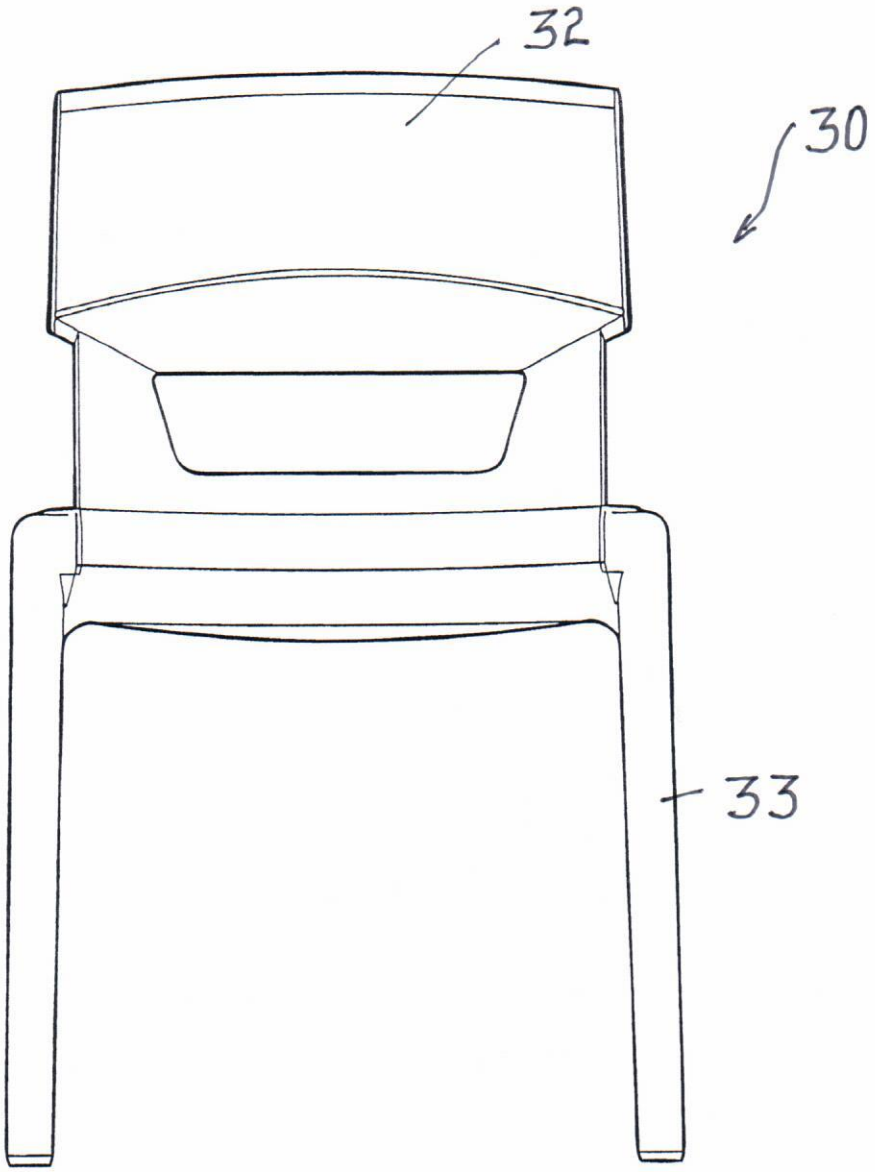

FIG. 6

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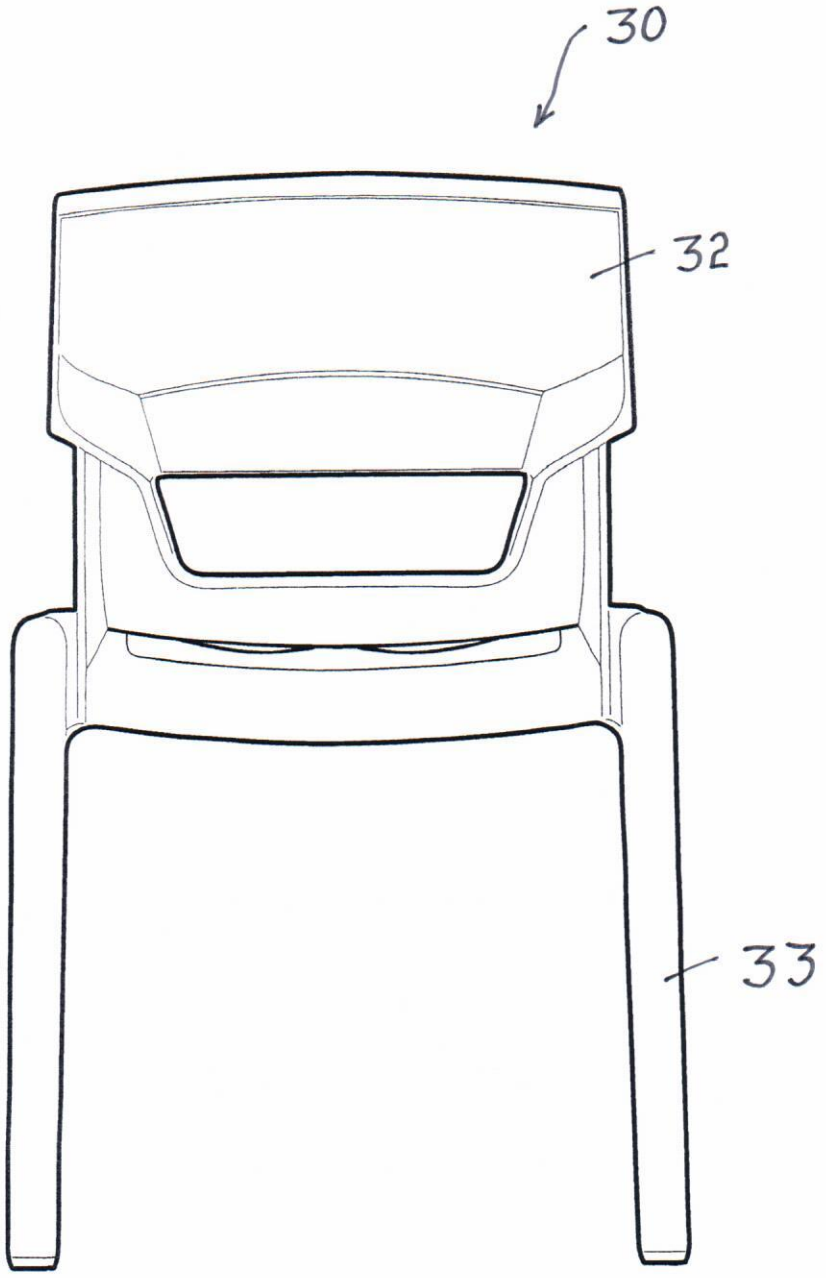

FIG. 7

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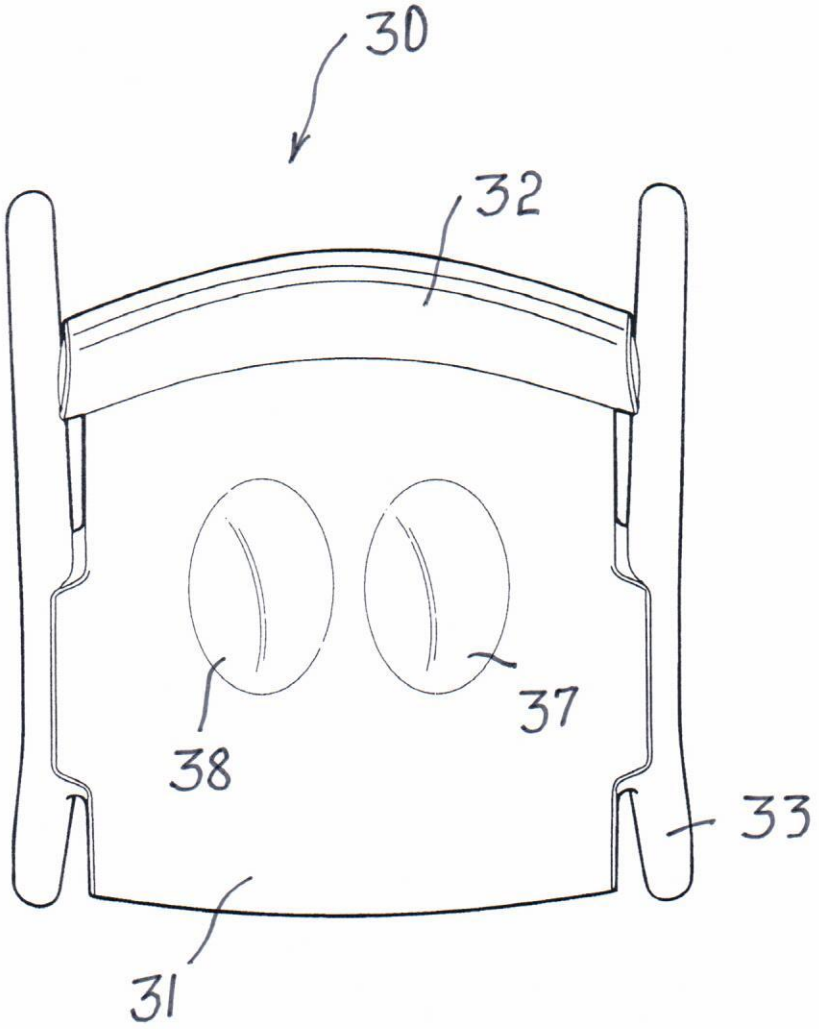

FIG. 8

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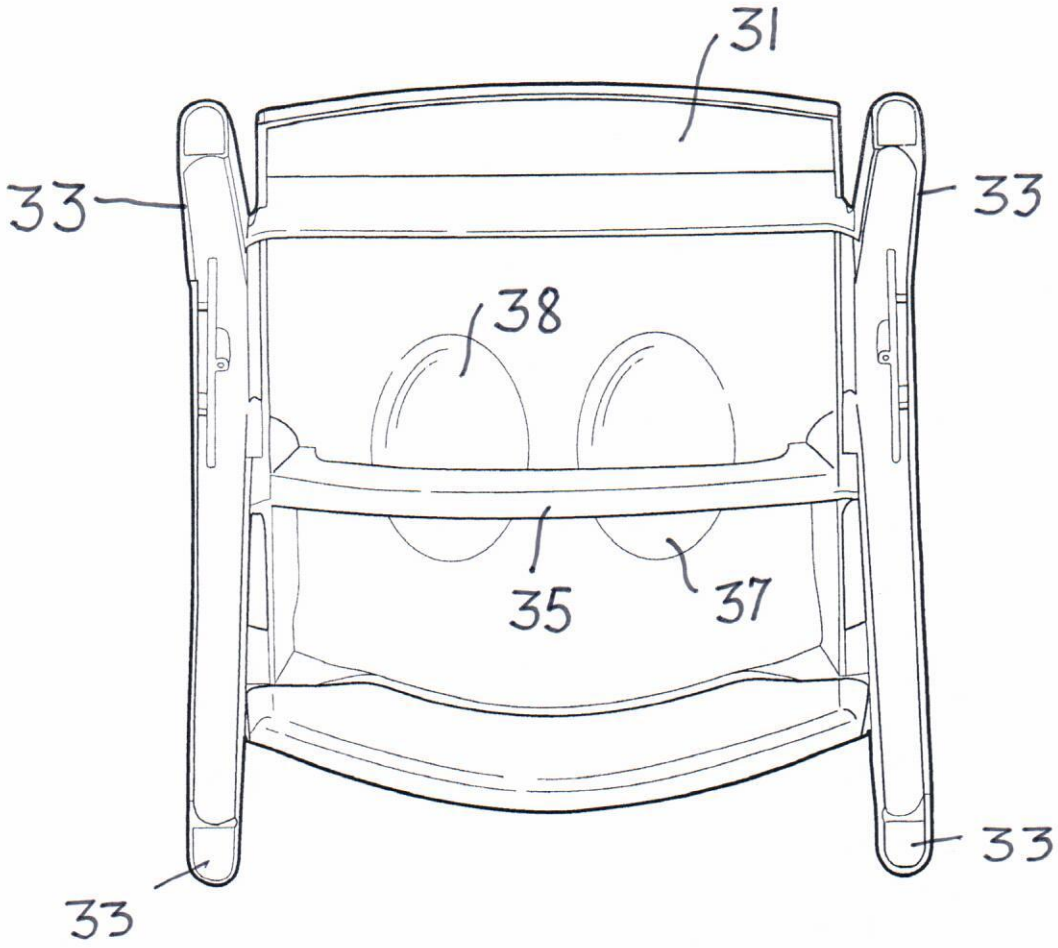

FIG. 9

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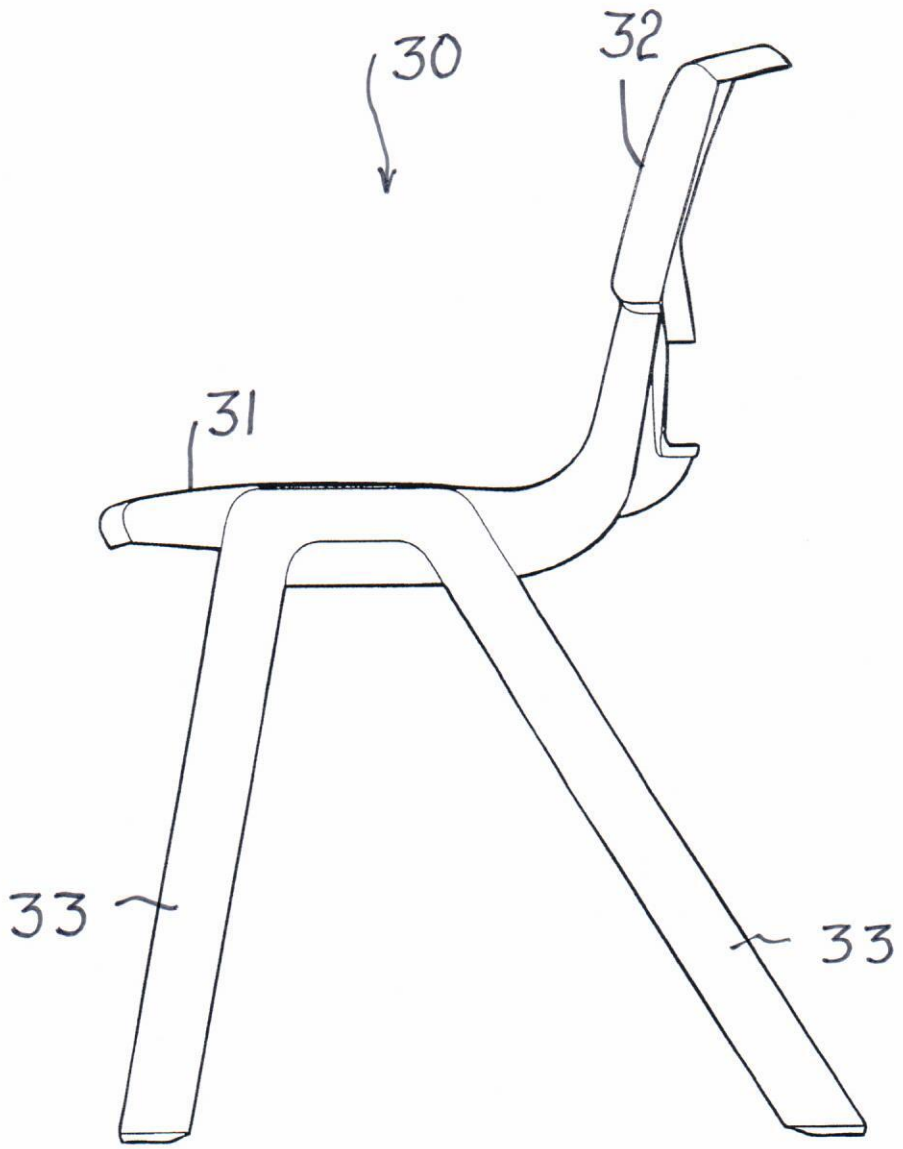

FIG. 10

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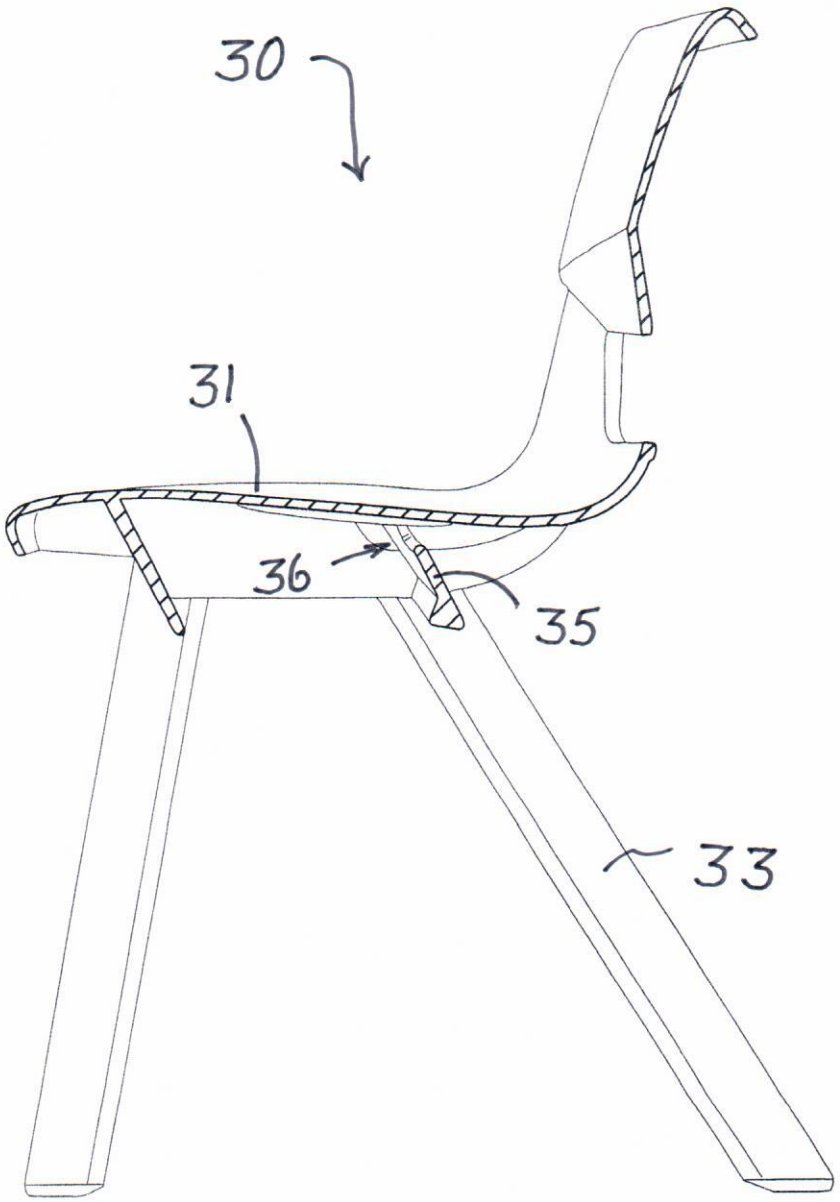

FIG. 11

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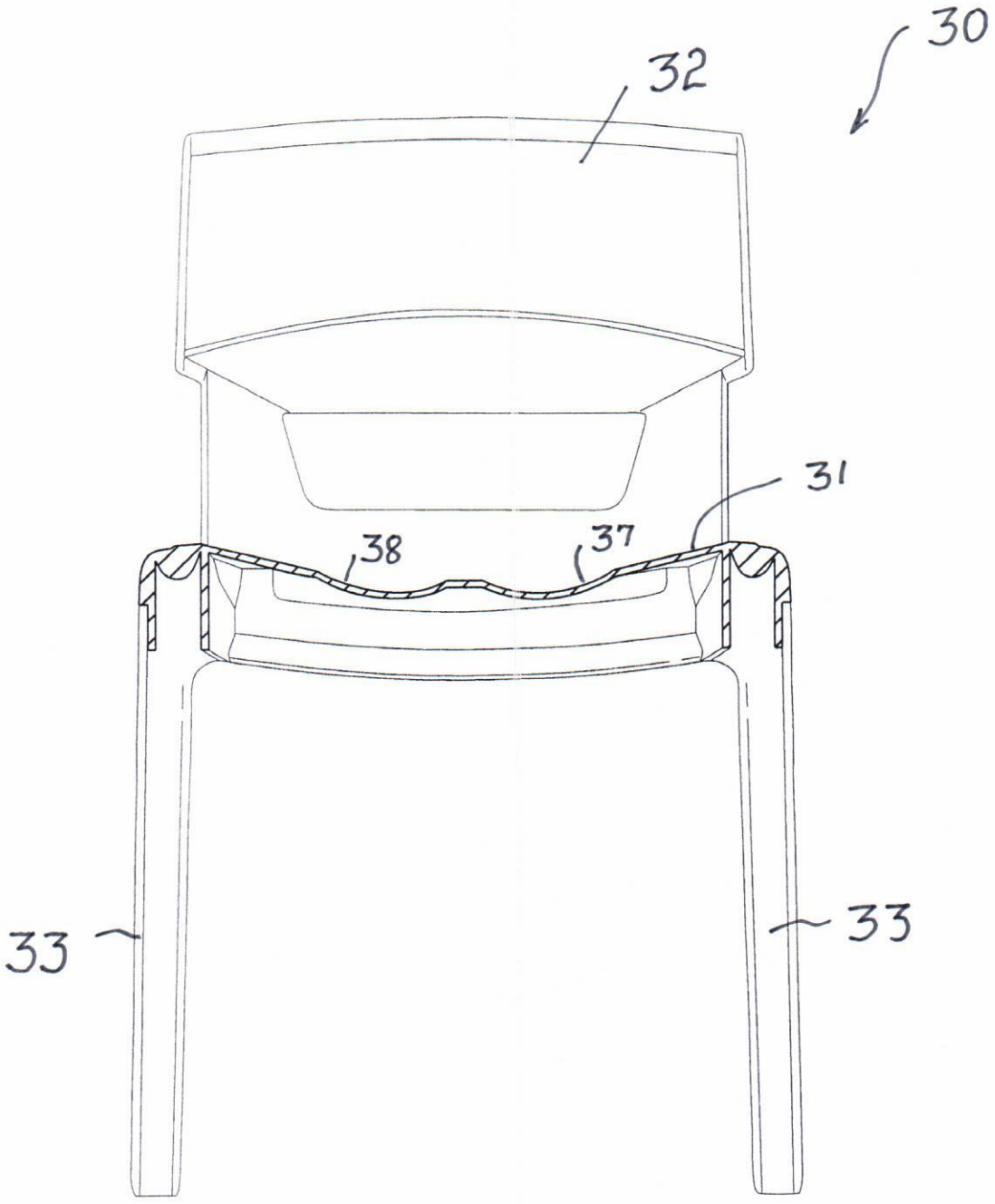

FIG. 12

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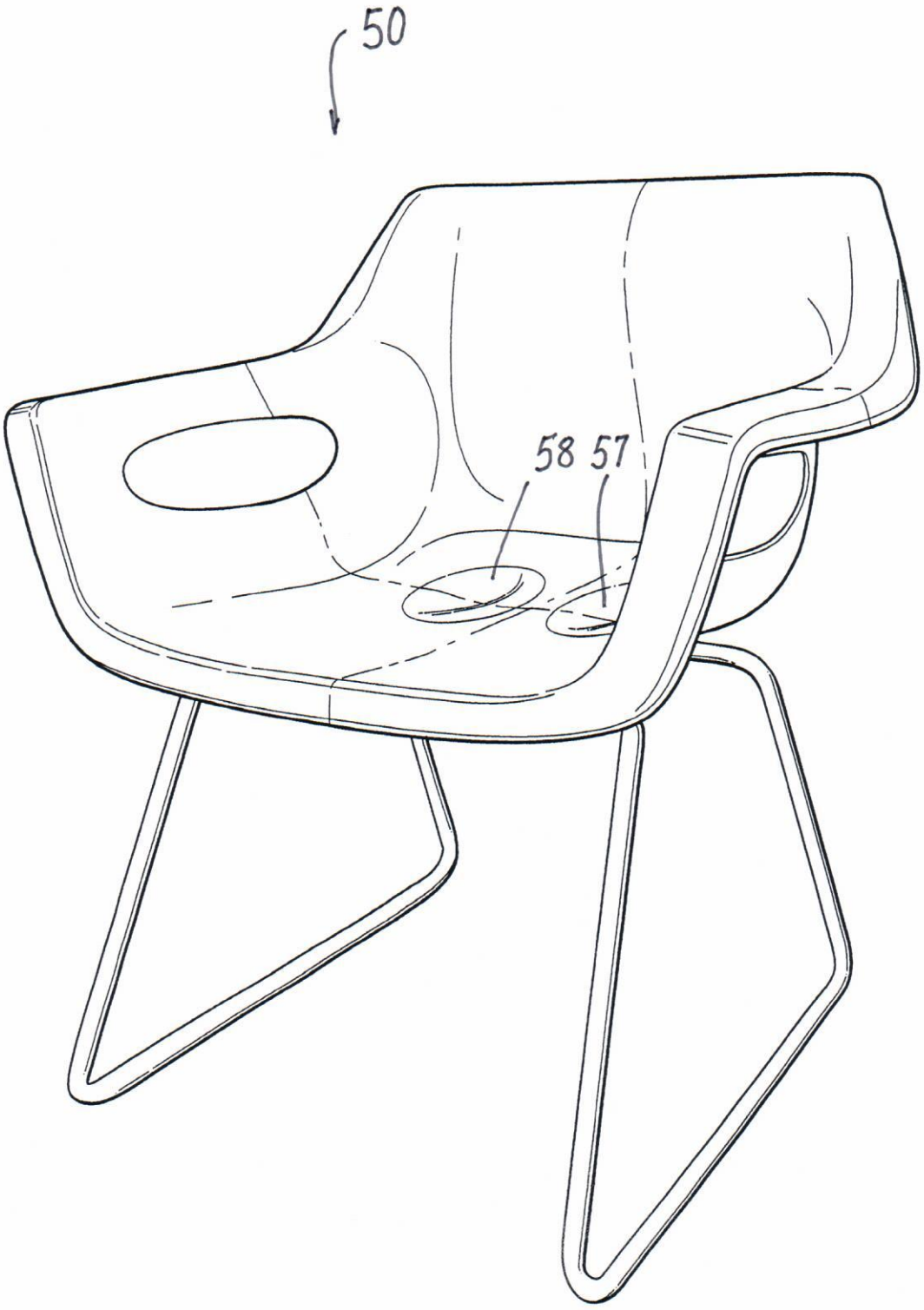

FIG. 13

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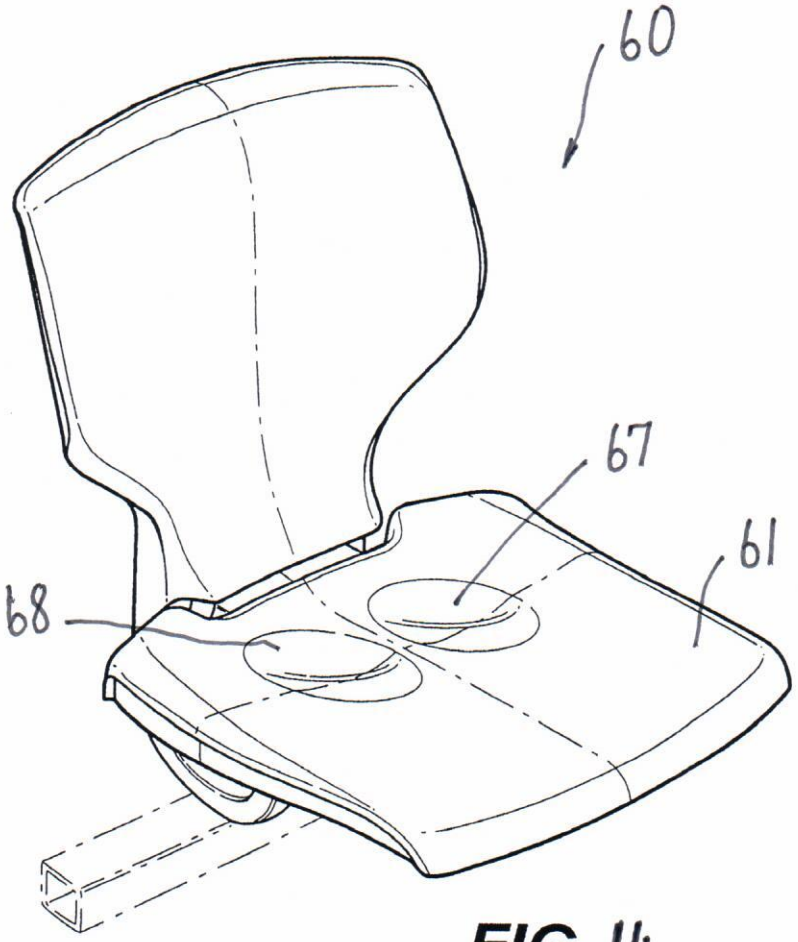

FIG. 14

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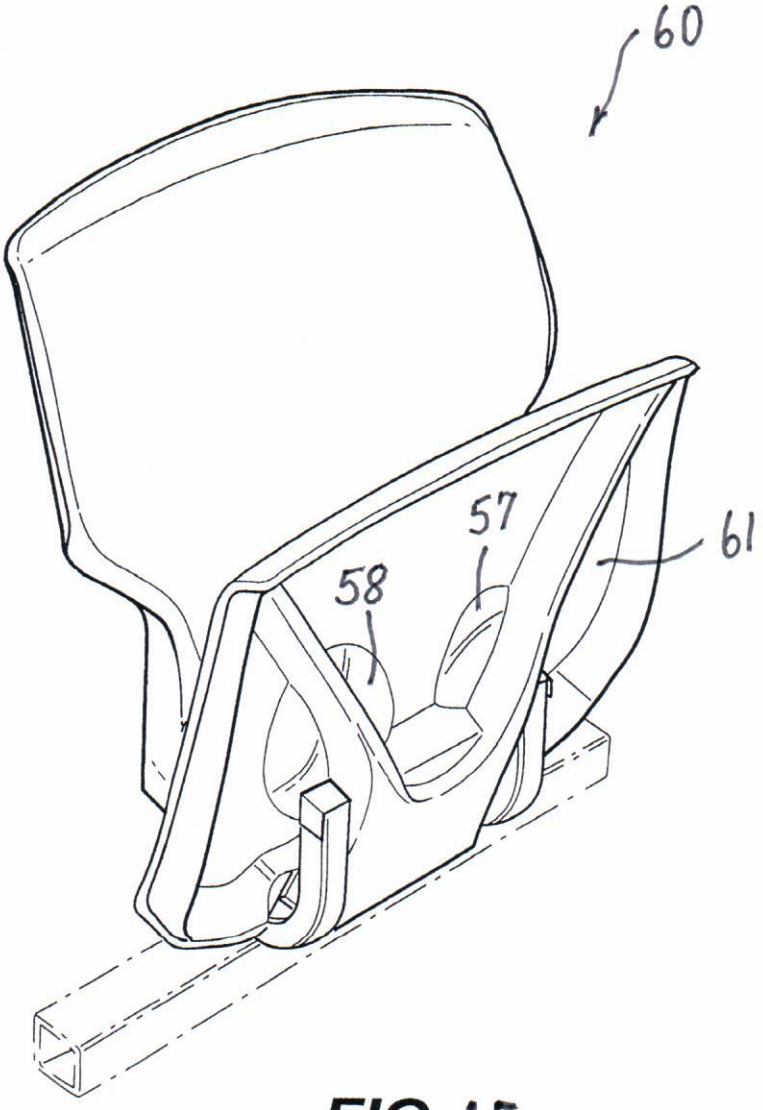

FIG. 15

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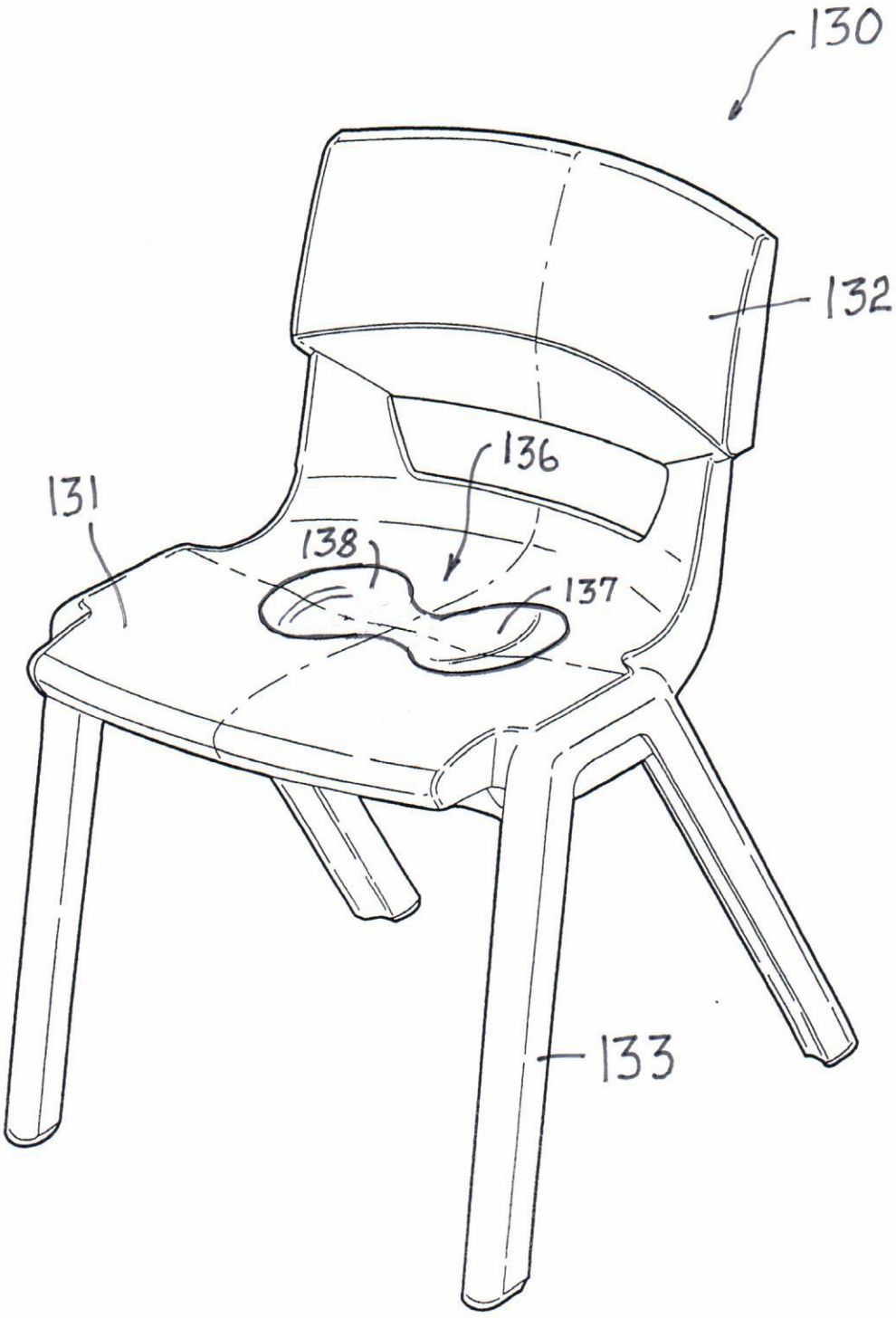

FIG. 16

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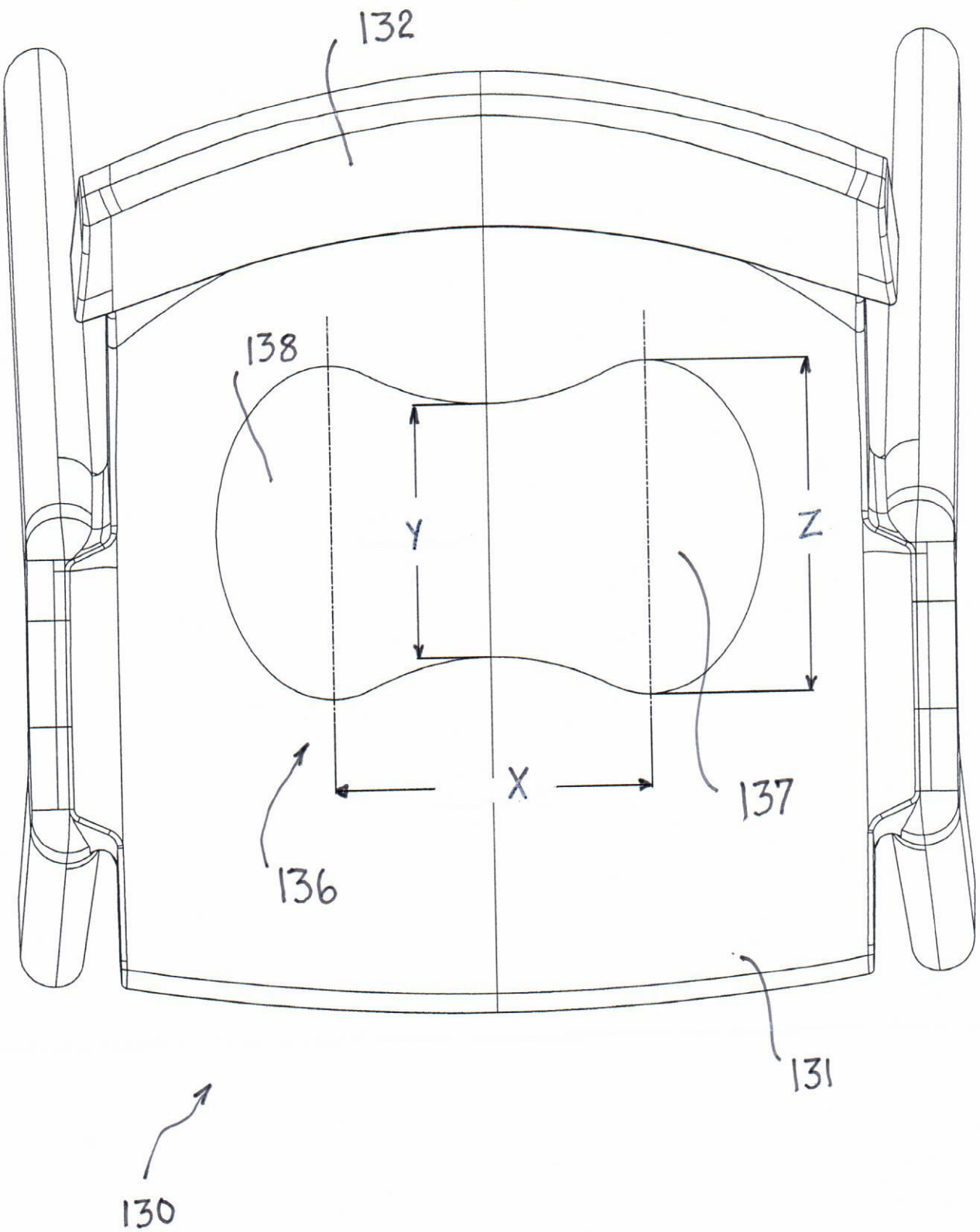

FIG. 17

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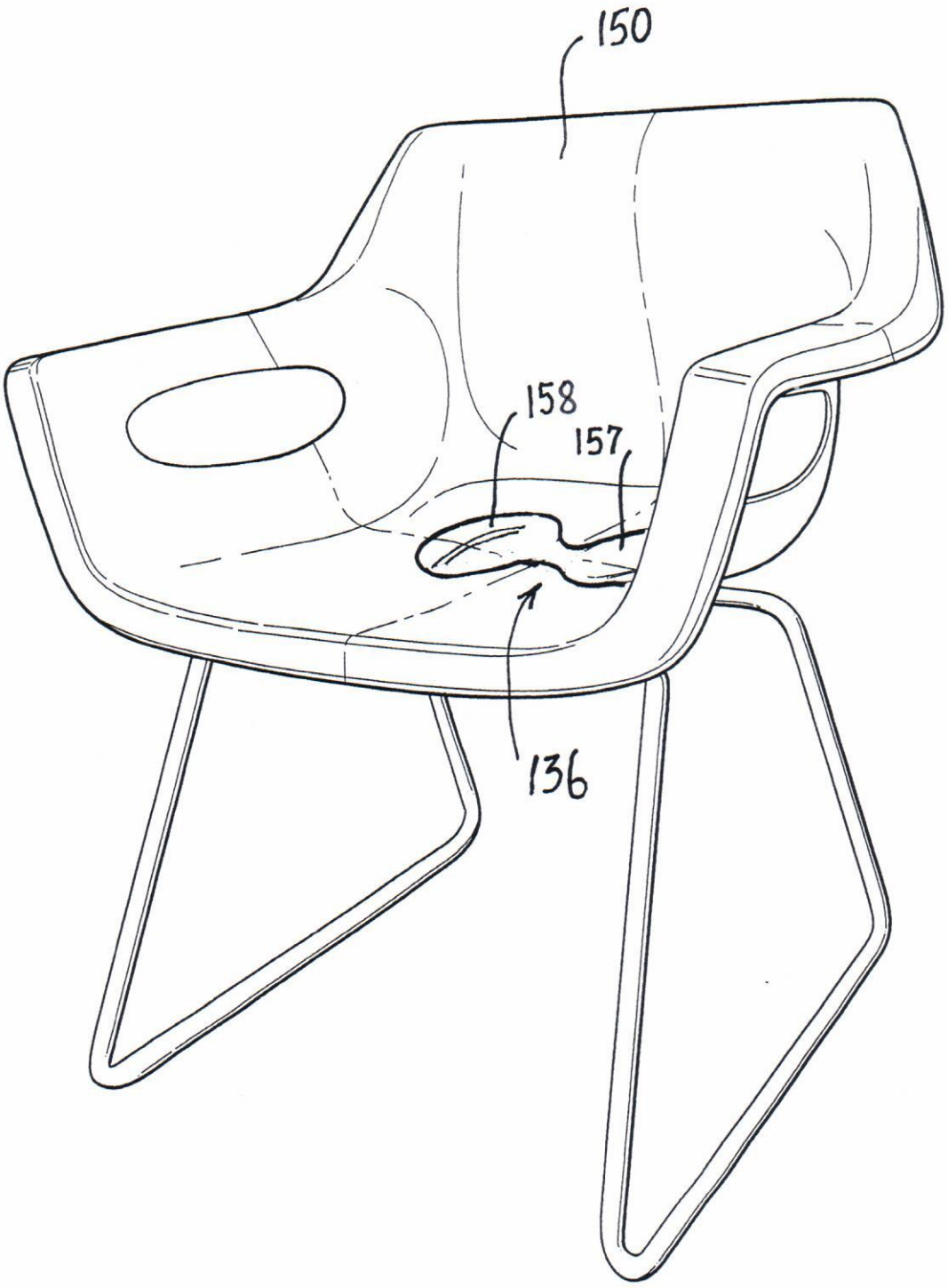

FIG. 18

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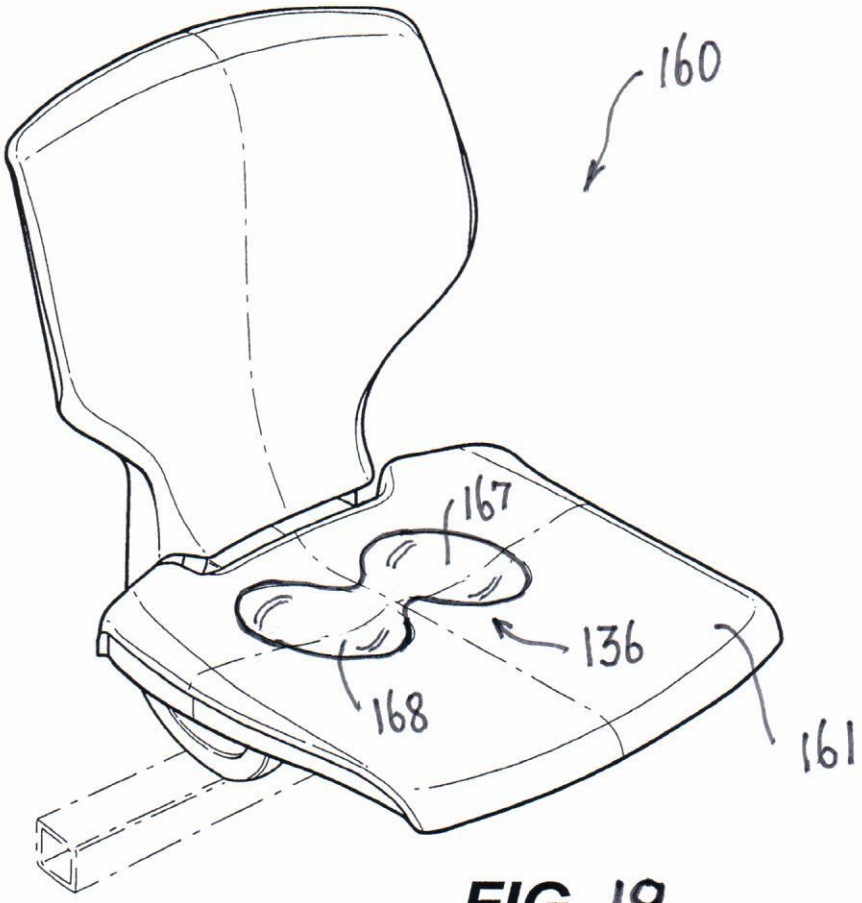

FIG. 19

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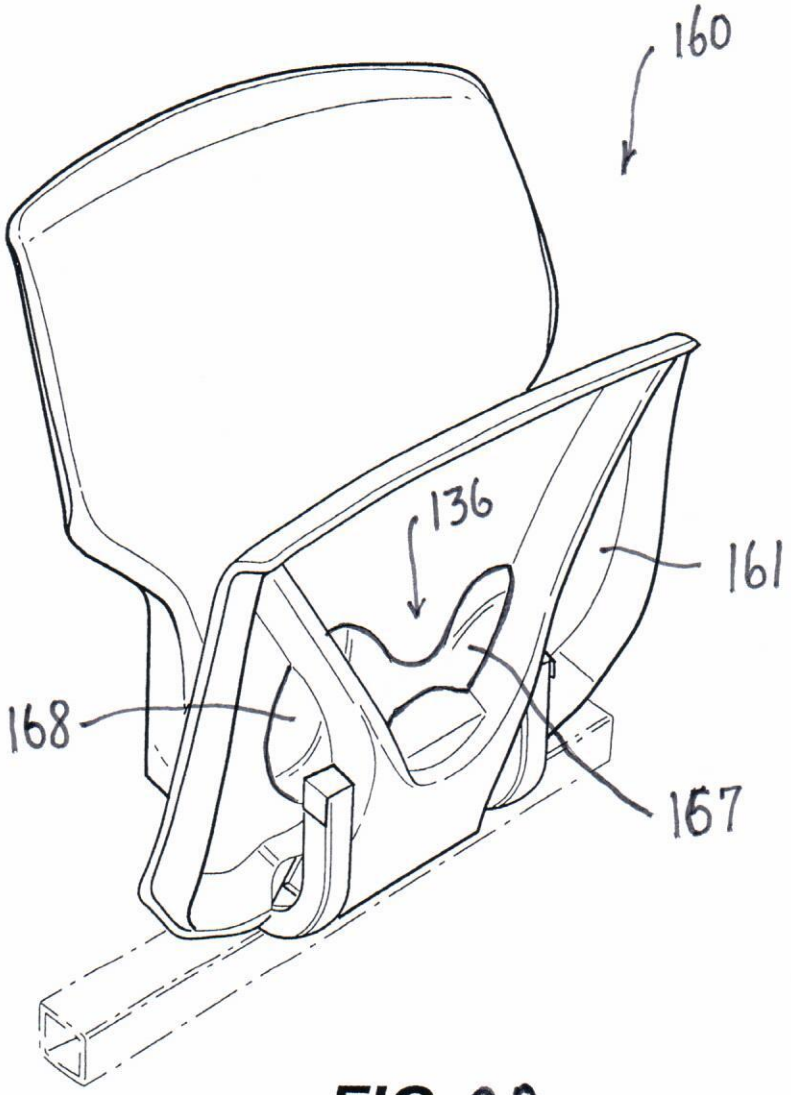

FIG. 20

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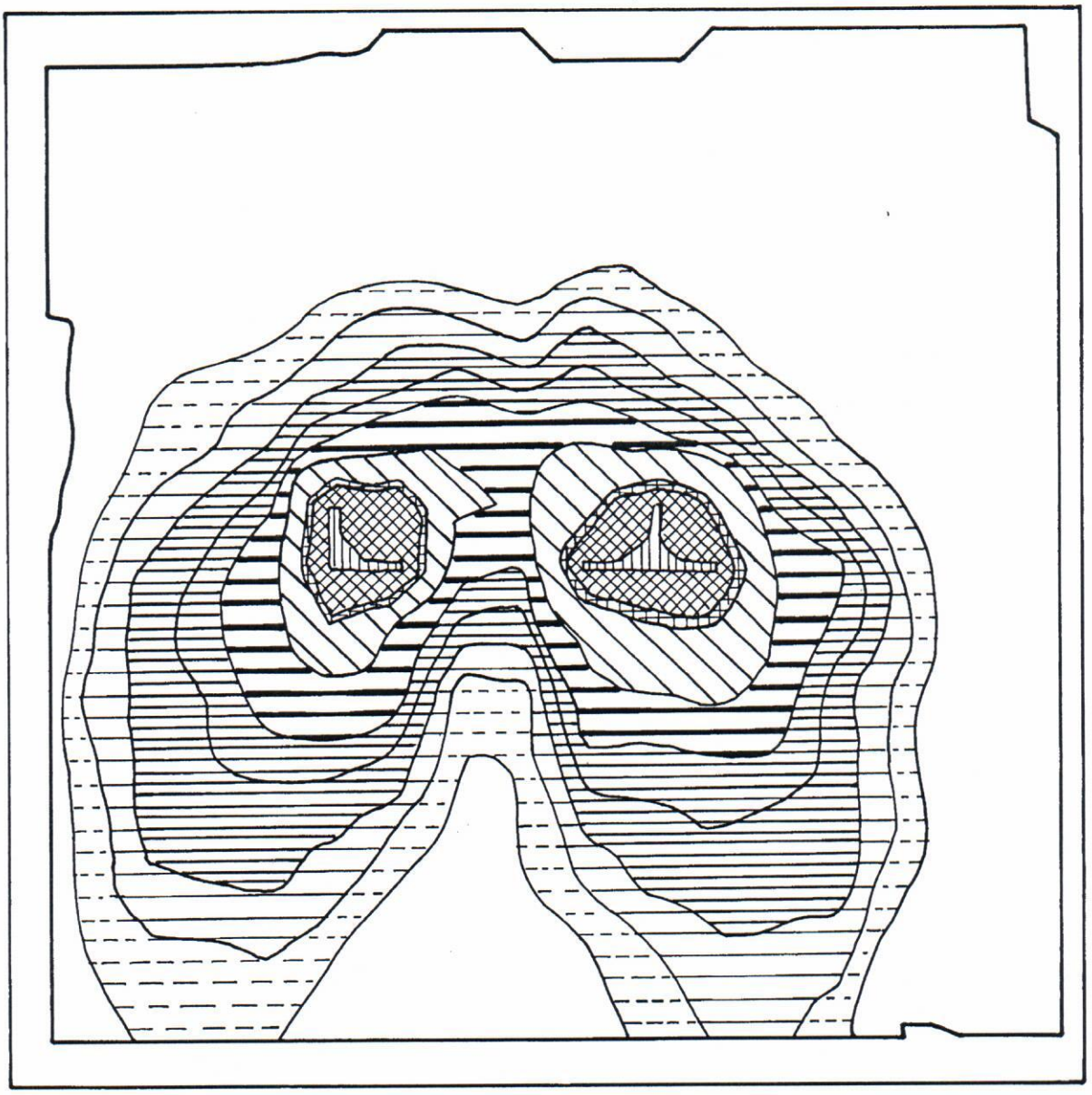

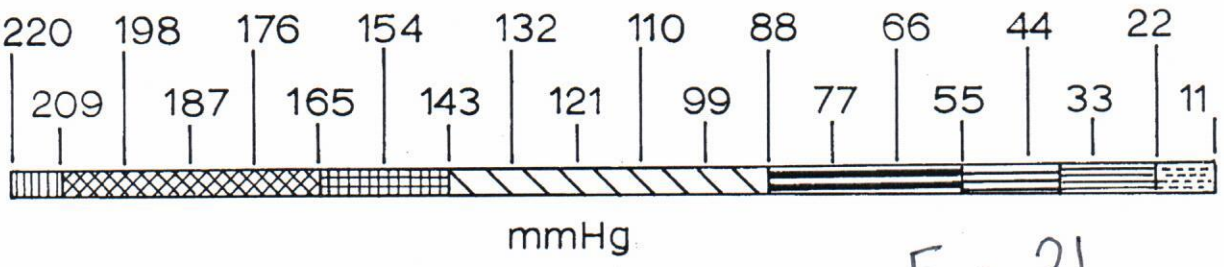

FIG. 21

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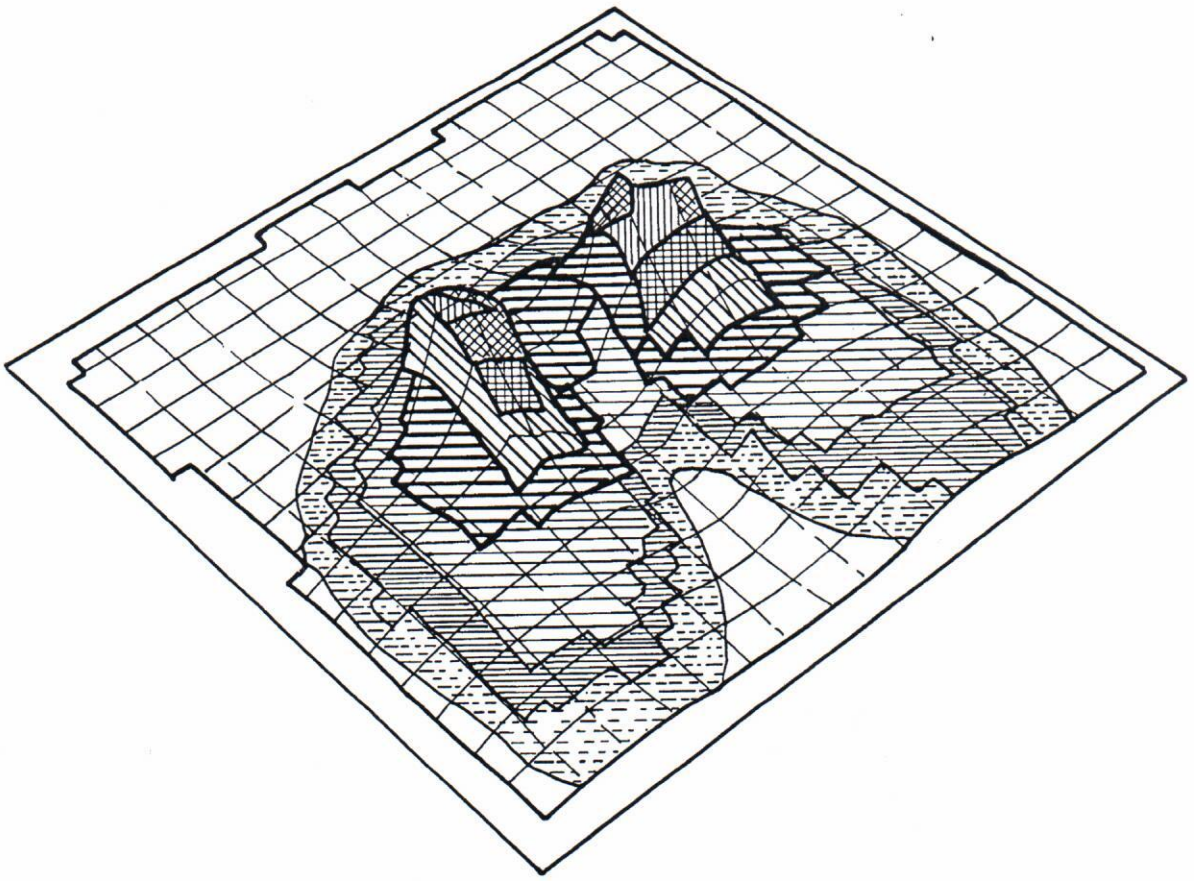

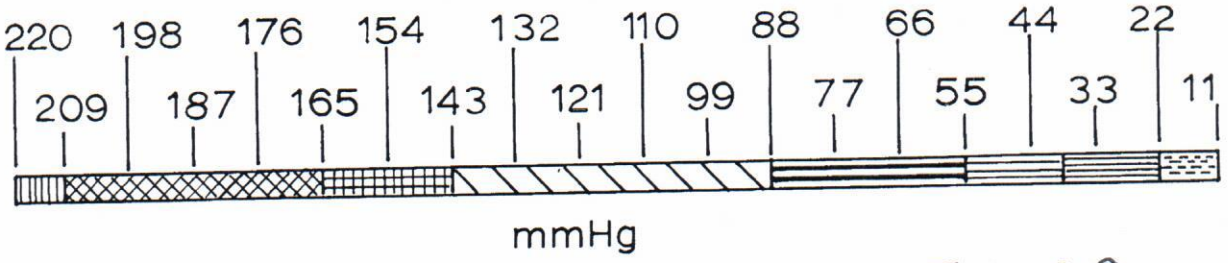

FIG. 22

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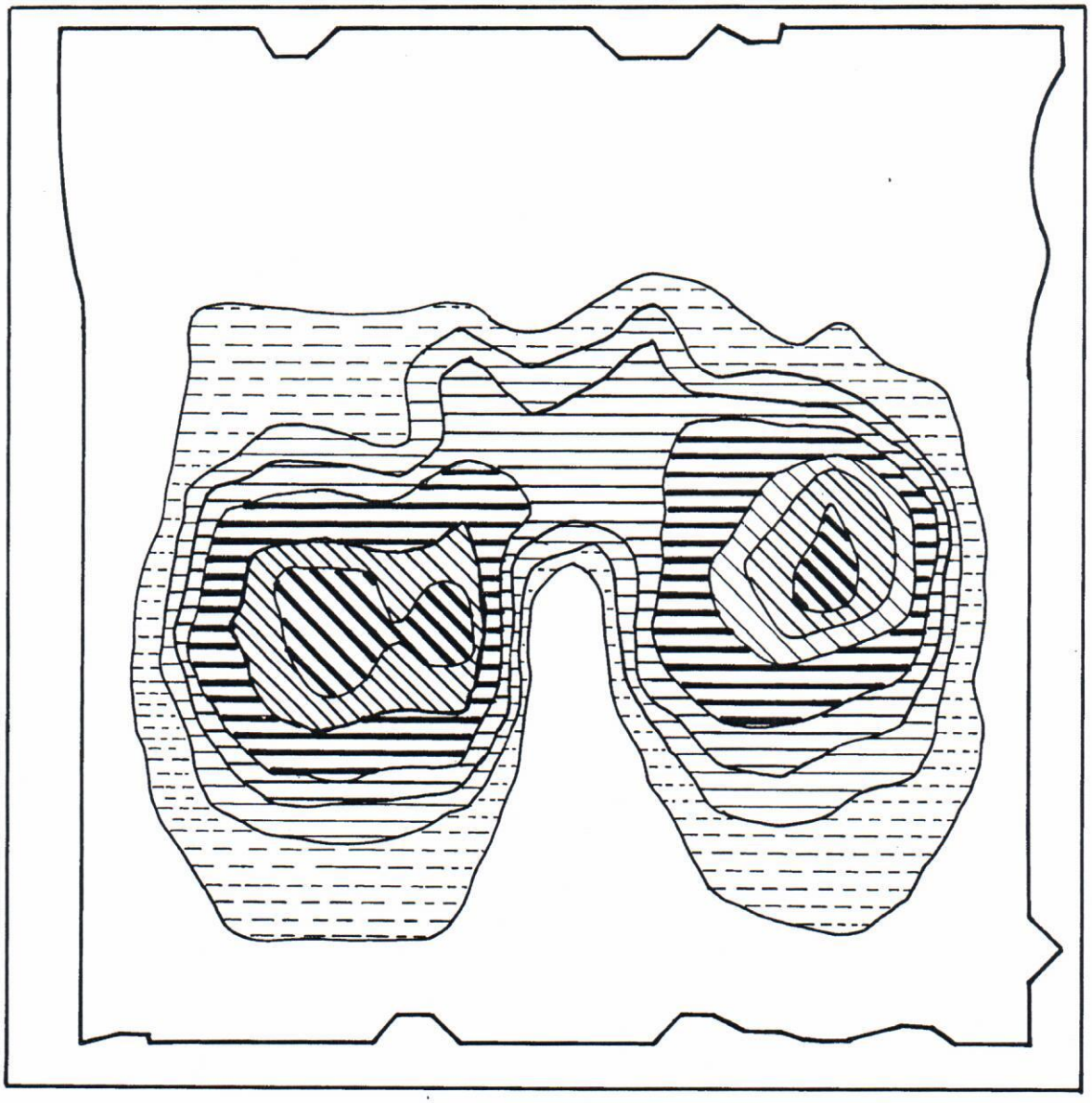

FIG. 23

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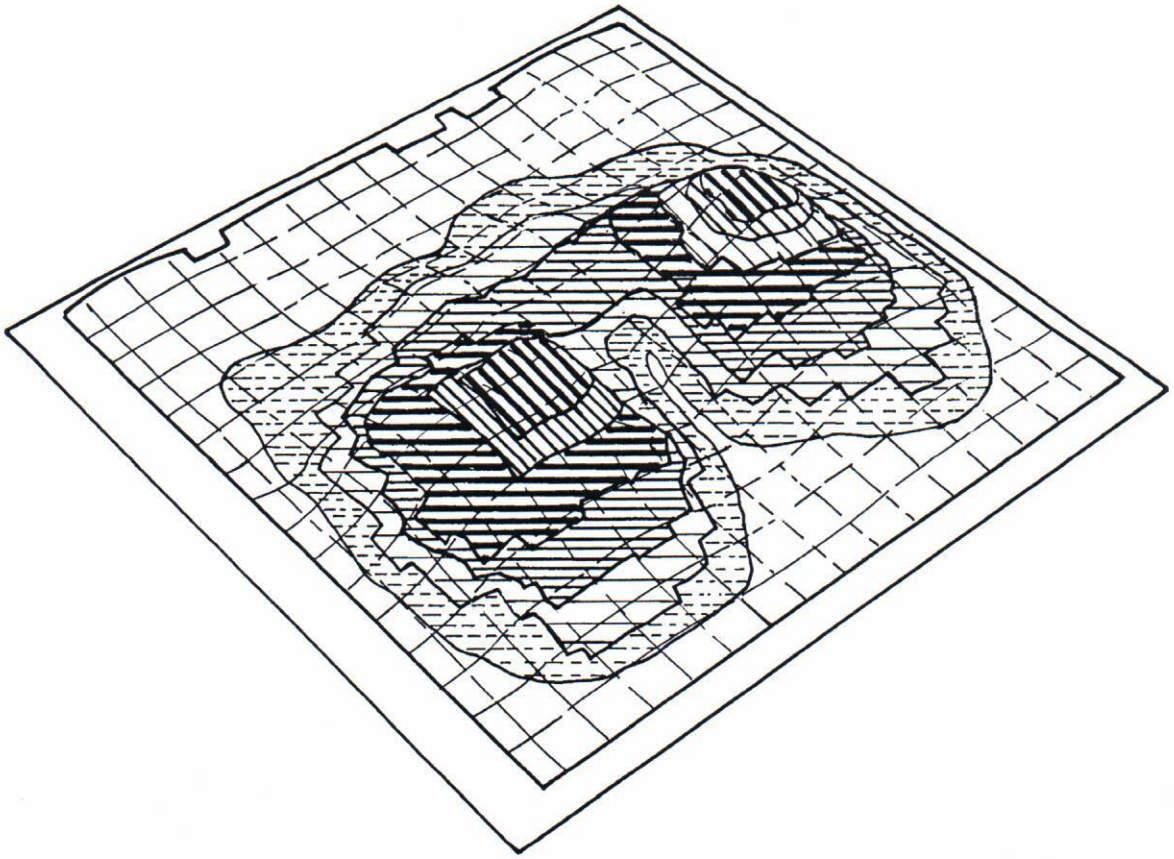

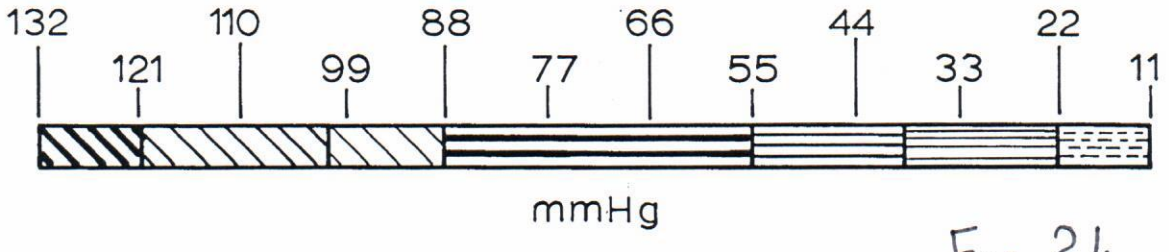

FIG. 24