July 26, 1966 S. P. CRANE 3,262,739

VENTILATING CUSHION

Filed May 15, 1964

Fig. 1

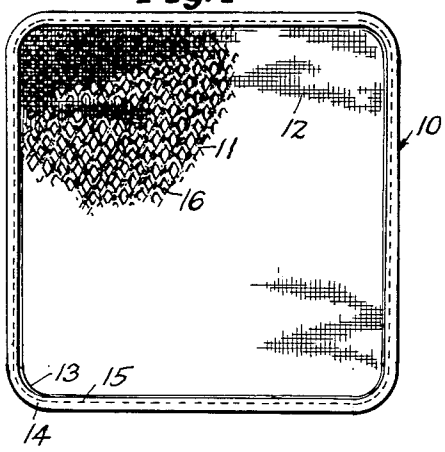


Fig. 2

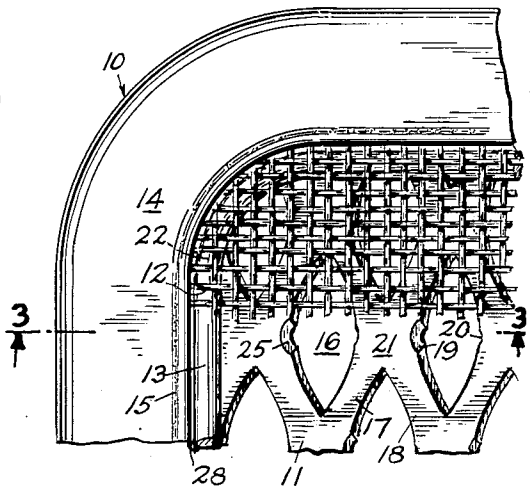


Fig. 4

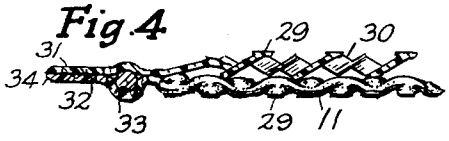


Fig. 3

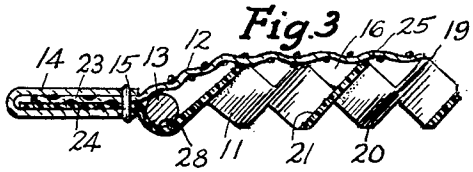


Fig. 5

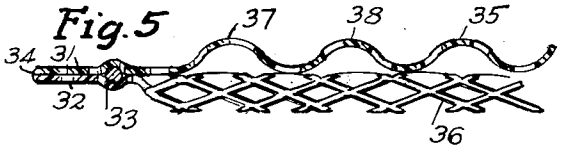


Fig. 6

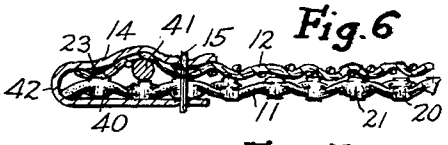


Fig. 9

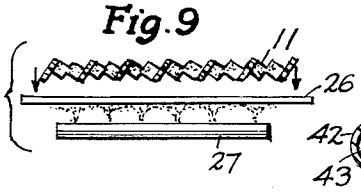


Fig. 7

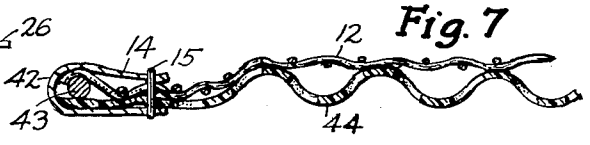
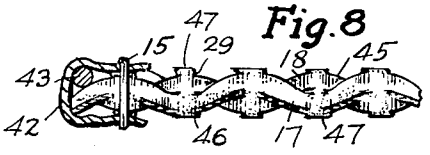


Fig. 8



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VENTILATING CUSHION

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9 Claims. (Cl. 297—453)

This invention relates to ventilating cushions of the type adapted to rest on a seat or to rest against a seat back and to so space the sitter from the seat as to permit the circulation of air therebetween for cooling purposes.

The coiled wire inner unit frequently used for cushions of this type, while efficient for its intended purpose, is relatively expensive when made of good quality materials and workmanship. Previous plastic inner units have proven to be insufficiently heat conductive and lack strength unless made of relatively thick and higher cost material and have small and comparatively few air channels or perforations for the circulation of air. The thinner and more economical plastic inner units provide inadequate space for ventilation and are not dimensionally stable, beside tending to warp and stretch in an unsightly manner after a relatively short period of use. Attempts have been made to use expanded metal sheet for ordinary resilient cushions not intended for ventilation. Such attempts have not been commercially successful even though such expanded sheet, if properly made and dimensioned, provides adequate ventilating space.

The present invention takes advantage of the peculiar characteristics of slitted and expanded plastic material to utilize such material for the spacing unit of ventilating cushions by dimensioning the thickness, slit length, longitudinal and transverse distances between slits and the amount that the slits are widened when the sheet is expanded and thereby to impart the requisite strength to the unit while retaining and producing ventilating openings of the proper sizes.

The present invention therefore is directed to the provision of a ventilating cushion having as its primary element a plastic member of a single sheet of relatively thin material but expanded in the general manner in which expanded metal has been expanded in the past to serve the function of the spacer of the ventilating cushion, while retaining sufficient flexibility to conform to the shape of the sitter and the shape of the supporting seat or back, and maintaining substantially constant the overall thickness of the sheet so that it does not flatten or collapse under load to the initial plane of the sheet from which it has been expanded.

The invention is further directed to the provision of a ventilating cushion wherein the expanded plastic spacing member is treated to increase the normal bearing or supporting area on which the sitter or leaner rests, the treatment comprising providing an enlarged area at the crests of the undulating strips of the spacer member by flattening the crests, or turning the edge portions inwardly.

The invention is further directed to the provision of an optional mesh or net-like cover for the expanded sheet to bridge the wider openings in the sheet thereby to insure comfort to the user, and the finishing of the marginal portions of the sheet and cover with binding tape and stitching in such a manner that the border wire is adequately retained in place.

The invention is further directed to the provision of a relatively inexpensive non-rusting but heat conducting plastic ventilating cushion adapted for quantity production, assuring an adequate volume of ventilating space and providing sufficient bearing surface for user comfort.

The various objects of the invention will be clear from the description which follows and from the drawings, in which

FIG. 1 is a fragmentary elevational view of a ventilating cushion to which the invention has been applied, showing

parts of the expanded sheet spacing member and part of the mesh cover.

FIG. 2 is a similar view on an enlarged scale of a corner of the same, showing also the border wire and wide transverse spacing between slits of the expanded sheet to obtain united imperforate areas of considerable width.

FIG. 3 is a vertical sectional view taken on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary vertical sectional view of a modified form of the invention wherein two expanded sheets with the rows of perforations thereof arranged respectively to extend in different directions, are secured together in face to face relation with the border wire arranged in a groove in the marginal portions of the sheets.

FIG. 5 is a similar view of another modified form of the invention, showing two expanded sheets corrugated and secured together.

FIG. 6 is a similar view of still another modified form of the invention showing an expanded sheet and a mesh cover similar to FIG. 3, but showing a different arrangement of the border wire.

FIG. 7 is a similar view of a still further modified form of the invention wherein an expanded sheet is corrugated and covered with a mesh cover with the border wire arranged in the fold of the edge binding tape.

FIG. 8 is a similar view of another modified form of the invention wherein a single expanded sheet with relatively wide undulating strips and having flattened crests and troughs is finished with a border wire and binding tape.

FIG. 9 is a diagrammatical view of a heated plate by means of which the crests of the undulating strips of the expanded sheet may be softened and flattened to enlarge the bearing areas thereof.

In that form of the invention shown in FIGS. 1–3, the cushion **10** comprises the expanded sheet **11**, the mesh cover **12** of net-like material, the border wire **13**, the edge binding tape **14** and the stitching **15**. The expanded sheet **11** is made of a sheet of suitable plastic material such as polyethylene, polypropylene or the like of such thickness that when the sheet is slitted and expanded, and the transverse and longitudinal spacings of the slits are properly selected the sheet is dimensionally stable but is sufficiently flexible to conform to the shape of the supporting surface under the load, namely, the weight or pressure of the user. The supporting surface, as usual, is the seat or back or both, of an automobile or article of furniture such as a chair, sofa or the like. The sheet is expanded to provide the generally diamond shaped perforations or openings **16** between adjacent ribs or continuous strips **17**, the openings being arranged in rows so that the long or longitudinal axes of the openings are aligned with each other. However, since the slits forming the openings of adjacent rows overlap, the adjacent rows of openings are not transversely aligned, but the openings of one row alternate with the openings of the adjacent rows.

A peculiar feature of such expanded material which heretofore has been deemed to be objectionable for most uses, has been found to be advantageous for the purpose for which expanded sheets are used in the present invention. Said feature or characteristic is the twisting and undulating of the continuous ribs or strips **17** and **18** of substantially uniform cross section, as the sheet is expanded to enlarge the slits and to form crests as **19** and valleys or troughs **20** at the uppermost and lowermost points respectively of the undulations of the adjacent strips and of the thickness of the sheet material. Said strips are imperforate or united between the ends of each two adjacent perforations **16** in each row to form the highly twisted area **21**. When properly dimensioned for

the load it is to support and which normally tends to compress and flatten the strips and areas **21** into the initial plane of the sheet, said areas stand out from the support for the cushion at a considerable angle and act akin to beams having a depth greater than the thickness thereof. Consequently, the areas **21** offer such resistance to compression that the amount of flattening which takes place under the usually distributed load is insignificant in practice. This is especially so because the expanded plastic is resilient enough to return to its expanded shape and dimensions when the load thereon is released.

Because of the undulations in the strips **17**, **18**, only the extreme uppermost points of the areas **21** come into contact with the load and only the extreme lowermost points of said areas contact the supporting surface for the cushion, such as the seat or back. Consequently, air circulation completely around all the remaining parts of the strips **17**, **18** is unrestricted by anything in the cushion or by the user or the supporting surface.

In FIGS. 1–3, the amount of expansion, the thickness of the material and the spacing of the slits have been selected to provide an overall height of at least a half inch in the expanded sheet, such height providing an ample volume of air space between a plane tangent to the crests of the sheet and a plane tangent to the troughs. Since the openings or perforations **16** are relatively large, it is advisable to bridge them for better comfort to the user. This is done by the use of the mesh or net-like cover **12** having openings **22** of lesser width and length than those of the perforations **16**.

The cushion edges are finished by enclosing the marginal portions of the sheet and cover in the folded binding tape **14** and stitching the inner edges of the tape together, after the border wire **13** has been arranged in position, by means of the stitching **15** passing through the upper and lower parts of the tape and through the marginal portions **23** of the cover and **24** of the sheet. Said marginal portion **24** of the sheet is shown flattened as by means of heat and pressure to reduce the bulk of the margins of the cushion, but as shown in FIGS. 6 and 8 the margins need not necessarily be flattened. The stitching **15** also serves the purpose of maintaining the border wire in the proper position thereof, preventing said wire from any substantial movement in the general plane of the cushion.

When the thickness of the expanded sheet is such that the crests **19** of the undulations position relatively sharp edges at the uppermost points of the expanded sheet, it becomes advisable for comfort to render said edges harmless. This is done by cutting off enough of the crests to enlarge the "bearing area" of the sheet, the cuts being parallel to the general plane of the sheet and the resulting flattened areas **25** being coplanar and wider than the thickness of the sheet material. It will be understood that by "bearing area" is meant the area of the sheet which tends to press on or into the sitter. The bearing area may also be enlarged by heat-softening the crests and turning them inwardly or outwardly.

Alternately, the bearing area may be enlarged, as shown in FIG. 9, by pressing the sheet **11** down on to the upper surface of a heated plate as **26**, heated in any suitable manner, as by the burners **27**. The hot plate softens the plastic crests flattening them to increase the areas thereof as shown, for example, in FIGS. 4, 6 and 8.

It will be understood that the adjacent undulating strips **17** and **18** of the expanded sheet undulate not only up and down but also from side to side because of the twist imparted to the strips during expansion of the sheet; also that the amount of twist and the angle which the united areas **21** make with the general plane of the sheet is largely determined by the width of the perforations **16** and the width of the united areas and that the resistance of the strips to flattening under compression back to the initial plane of the sheet is dependent, among other things, on the angle above mentioned. It will further be understood that the border wire is prevented from moving

in any direction within its own general plane by the stitching **15** adjacent thereto which confines the wire within the polygon formed by the line of stitching.

To aid in retaining the wire against displacement under load, a recess **28** is optionally made in the sheet inwardly of the stitching **15** as best seen in FIG. 3. Such recess is formed simultaneously with the flattening of the marginal portion **24** of the sheet by suitably shaped heated dies, or if said portions are not flattened out, the recess is made by heating the wire and pressing it into the sheet at the proper place thereby to soften and shape that part of the sheet which is in contact with the wire to form a sort of nest therefor.

In that form of the invention shown in FIGS. 4 and 5, the mesh cover **12** is replaced by another expanded sheet **30** of FIG. 4 which may have perforations, undulations and united areas of different and preferably, though not necessarily, smaller dimensions than those of the under sheet **11** for bridging the spaces between crests **19** of said under sheet. However, for maximum supporting effect, the expanded sheets are disposed angularly to each other, meaning that the longitudinal axes of the rows of perforations in the respective sheets extend in different directions.

The marginal portions **31** and **32** of both sheets are preferably flattened and the recess **33** for the reception of the border wire formed in one or both sheets as desired. At the same time, the peripheral edges of the sheets are preferably rounded to form the rounded edge **34** on the cushion, and the marginal portions **31** and **32** are heat sealed to secure the sheets together and to confine the border wire in its recesses.

If the cushion is to be reversible so that either of the sheets becomes the upper one, then the crests of the undulating strips of both sheets are flattened as at **29**, FIG. 4.

Additionally, in the form of FIG. 5, both sheets **35** and **36** are corrugated to a suitable "wave length" or distance between the crests **37**, **38** of the corrugations, not only to increase the overall height of the assembled sheets, but to increase the resistance thereof to compression and also to permit the use of thin plastic sheet material and relatively narrow perforations and undulations therein. It will be understood that the crests of the corrugations need not be and usually are not the same crests as on the undulating strips of the expanded sheet.

As shown in FIG. 6, the binding tape **14** encloses the marginal portion **23** of the mesh cover **12** as well as the unflattened marginal portion **40** of the expanded sheet **11** and the border wire **41**. However, said wire is arranged between and is confined by the stitching **15** and the fold **42** which forms the peripheral edge of the cushion. The wire may tend to spread apart the cover and the sheet to a slight extent, but such spread is not objectionable because the margin of the cushion is rarely used for seating purposes.

In FIG. 7, the border wire **43** is set quite closely to the fold **42** of the edge binding tape **14** and is confined by the fold shown against movement to the left. Movement toward the right is prevented by the opposite side of the polygonal border wire coming into contact with the fold of the tape on the right hand edge of the cushion. The expanded sheet **44** is illustrated as corrugated in the manner of the sheets **35** and **36** of FIG. 5 to attain the desired overall thickness of the cushion. That form of the invention shown in FIG. 8 omits the mesh cover of FIGS. 1–3, 6 and 7 and depends on a properly dimensioned expanded sheet as **45** for the spacing and supporting member, the crests **29** and the troughs **46** of the undulating strips **17** and **18** being flattened in any suitable manner as at **47** to provide the desirable coplanar bearing areas. The border wire **43** is shown as arranged at the fold **42** of the edge binding tape.

In all the forms of the invention, the expanded sheet, may if desired, be treated for heat conductivity so as to dissipate the body heat imparted thereto. Metallizing the

sheet by coating it inexpensively with a thin coat of a suitable metal such as copper in a manner which is well understood and needs no further description, is an example of such treatment.

It will now be seen that a properly proportioned slitted and expanded plastic sheet, corrugated or not, or covered with another plastic sheet or with a mesh or net-like cover and having a border wire retained against displacement by an edge binding tape and stitching or by heat sealing or a groove in the expanded sheet and having the crests thereof flattened if needed constitutes an efficient and inexpensive ventilated cushion in which spacing member is said expanded sheet or sheets, and that by coating the sheet with a suitable metallic coat, the sheet is made adequately heat conductive, and that the various objects of the invention have been effectively attained.

I claim:

1. A ventilating cushion comprising a dimensionally stable sheet of flexible slitted and expanded plastic material having rows of perforations, each perforation tapering to a point at the opposite ends thereof, the perforations being separated by continuous undulating strips of rectangular cross section having uniform width and thickness and sharp corner edges, the crests of each strip being integral with the respective adjacent troughs of an adjacent strip to form imperforate areas each of twice the width of the remaining parts of the strip, the tops of the crests and the bottoms of the troughs being adapted directly to contact the load on the cushion and the supporting surface for the cushion respectively and to maintain the remaining parts of the strips out of contact with said load and said supporting surface when the cushion is in use, an edge finishing tape folded in half around and in contact with both faces of the sheet at the marginal portion of the sheet, stitching passing through and securing the inner edge portions of the tape together and to the sheet, and margin-stiffening means for the sheet consisting of a border wire arranged within the tape outwardly of the stitching and held in position on a face of the sheet solely by said tape and stitching.

2. In a ventilating cushion, a flexible and dimensionally stable spacing, ventilating, load-bearing and load-transmitting member comprising a slitted and expanded sheet of relatively thin plastic material, said sheet having transversely spaced apart rows of substantially rhombic perforations pointed at opposite ends thereof and widest at the mid-points thereof, the sheet consisting only of integrally joined strips each having sinuous undulations throughout the entire length thereof, there being one such strip on each side of each row of perforations, each of the strips being of substantially uniform width throughout the entire length thereof, the undulations having crests alternately with troughs, the crests on one side of each row being integral with the respective adjacent troughs on the opposite side of each row at the widest points of the perforations to form imperforate united portions of substantially twice the width of the remaining parts of the strips, said united portions and the remainder of the undulations being twisted and thereby arranged at an angle to the general plane of the sheet, and presenting sharp edges at the intersections of the opposite faces of the sheet with the surfaces formed by the slits in the sheet, said united portions resisting deformation under the weight of the user and returning to the initial size and shape thereof when deformed by said weight after the weight is removed therefrom while permitting the sheet to flex as a whole under said weight, only the uppermost points of said crests being adapted to receive said weight and only the lowermost points of the troughs being adapted to transmit said weight to a supporting surface, the remaining portions of the strips being spaced away from the supporting surface and from the user sufficiently to permit the circulation of air completely through the perforations and undulations when the sheet is in use, completely around all said remaining portions of the strips, an edge finishing tape folded around the marginal portions of the sheet, stitching passing through the sheet and the inner edge portions of the tape and a border wire at the marginal portions of the sheet, the stitching cooperating with said marginal portions for maintaining the border wire against significant displacement relatively to and in the generally plane of the sheet.

3. In a ventilating cushion, a flexible and dimensionally stable spacing member of an initially flat sheet of relatively thin plastic material, said plastic material, being characterized by the tendency thereof, after deformation under a load out of the initial size and shape thereof, to return to said initial size and shape after the load thereon is removed, said initially flat sheet having parallel rows of parallel slits completely therethrough, the slits in each row being in longitudinal spaced relation to each other and being in longitudinal alignment and being staggered relatively to the slits in the adjacent rows, said initially flat sheet being expanded in a direction substantially perpendicular to the rows to widen said slits into rows of tapering perforations each at least twice as wide at the midpoints thereof where the slits are widest, than the distance between rows of slits in the initially flat sheet, thereby to increase the overall initial dimension of the sheet measured in a direction perpendicular to the rows to a dimensionally stable final dimension greater than said initial dimension and to increase the greatest overall thickness of the sheet to an amount approximating twice the initial distance between the rows of slits, said sheet having a sinuously undulating strip on each side of each row of perforations thereby to provide alternating crests and troughs in each strip on each side of each row of perforations, each strip being of substantially uniform rectangular cross section having relatively sharp corner edges, the crests on the strip on one side of each row of perforations being united with the respective troughs of the strip on the other side of the row, the united portions determining the overall maximum thickness of the sheet and being twisted at a substantial angle to the general plane of the sheet to arrange one of the sharp edges of each of the strips at the crest of the strip and to arrange another of the sharp edges at the trough of the strip, said angle being sufficient to maintain substantially constant the overall amplitude of the crests and troughs while permitting the sheet to flex as a whole under the weight of the user, the united areas acting akin to beams under said weight, the uppermost points of the crests being adapted to receive said weight and the lowermost points of the troughs being adapted to transmit said weight to a supporting surface, the remaining portions of the sheet when in use being spaced away from the supporting surface and from the user thereby to permit circulation of air in all directions between the crests, between the troughs, past and completely around all points of the strips and through the sheet except at the uppermost points of the crests and the lowermost points of the troughs when the spacer is sandwiched between the body of the user at one face of the spacer and an air-impervious support at the other face thereof, an edge finishing tape folded around the marginal portions of the sheet, stitching passing through the sheet and the inner edge portions of the tape, and a border wire at the marginal portions of the sheet, the stitching cooperating with said marginal portions for maintaining said border wire in place.

4. In a ventilating spacer, the combination with a net-like slitted and expanded net-like sheet of the type resulting from the expansion transversely of a flexible sheet having transversely spaced apart overlapping rows of longitudinally spaced apart slits, the expanded sheet having rows of perforations lined by integrally joined relatively narrow undulating strips twisted out of the material of, and out of the general plane of the sheet, each strip having longitudinally spaced apart crests alternating with troughs, the troughs being spaced vertically and transversely from the crests, each of said crests having an upwardly convex sharp corner edge and each of the troughs having

a downwardly convex sharp corner edge, the material of each strip below the crest thereof being integrally united to the material above the adjacent trough of the adjacent strip, of

a border wire around the marginal portion of the expanded sheet,

an edge finishing tape folded around said marginal portion with at least the under flap thereof with the under face of the expanded sheet, and

stitching passing through the inner edges of the tape and through the sheet closely enough to the border wire to hold said wire against significant movement in all directions within the plane of the sheet, the perforations and undulations of the strips permitting air to circulate vertically and in all other directions through and around the strips except at the uppermost points of the crests and the lowermost points of the troughs when the spacer is sandwiched in use between the body of the user at one face of the spacer and an air-impervious support at the opposite face of the spacer.

5. The ventilating spacer of claim **4**, the uppermost points of the otherwise sharp edges of the crests and the lowermost points of the otherwise sharp edges of the troughs being interrupted and enlarged to increase the bearing area at said points.

6. The ventilating spacer claim **4**, a flexible foraminous cover for the sheet, the upper flap of the tape lying on the upper face of the cover, the marginal portion of the sheet just inwardly of the stitching being downwardly recessed to fit the border wire and receiving said wire therein.

7. The ventilating spacer of claim **6**, the uppermost points of the crests being flattened into coplanar areas

to increase the bearing area of the spacer and to interrupt the uppermost sharp edge of each strip at said crests.

8. The ventilating spacer of claim **4**, the crests being adapted to receive directly the load on the spacer, the upper flap of the tape being in direct contact with the upper face of the sheet, the border wire being between a flap of the tape and a face of the marginal part of the sheet and slightly outwardly of the stitching;

the tape, stitching, border wire and sheet being the only elements forming the spacer, and the tape, stitching and sheet being the only elements maintaining the border wire against significant displacement relatively to the sheet.

9. The ventilating spacer of claim **8**, the uppermost points of the crests being widened to extend transversely beyond the sharp edges of the remainders of the crests to increase the bearing area of the expanded sheet at the crests of the strips.

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