March 5, 1940. L. A. DUNAJEFF 2,192,573

RESILIENT SHEET

Original Filed July 21, 1938 2 Sheets-Sheet 1

Fig. 1

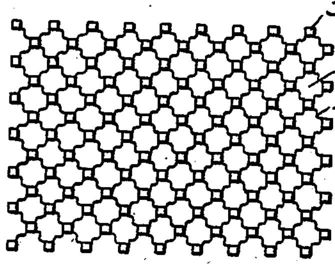

Fig. 2

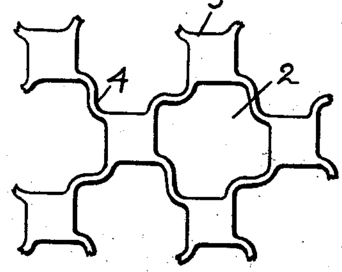

Fig. 3

Fig. 4

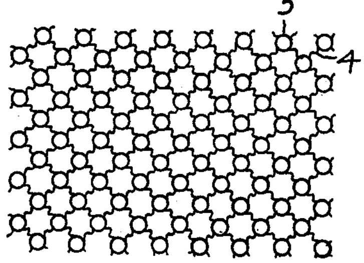

Fig. 5

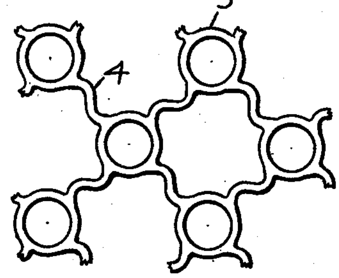

Fig. 6

Fig. 7

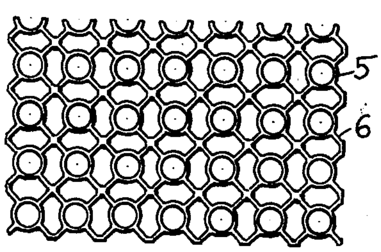

Fig. 8

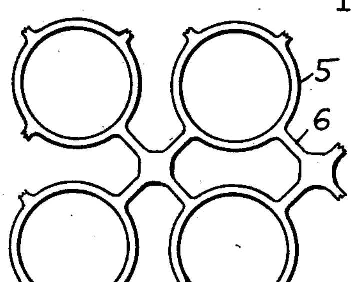

Fig. 9

Fig. 10

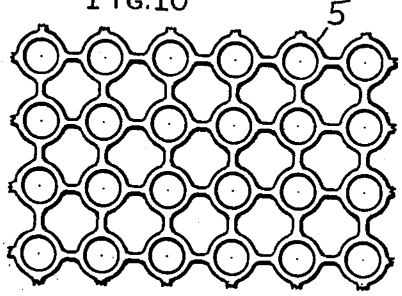

Fig. 11

Fig. 12

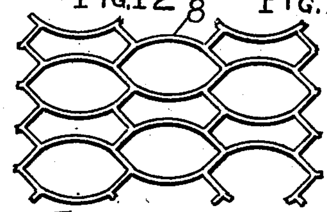

Fig. 13

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RESILIENT SHEET

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Fig. 14

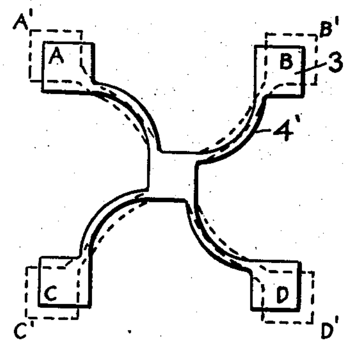


Fig. 15

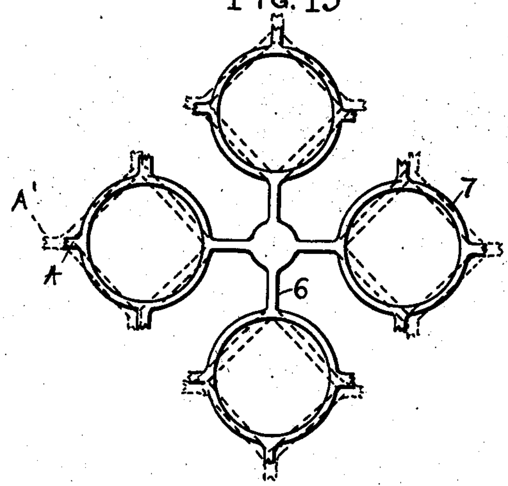


Fig. 16

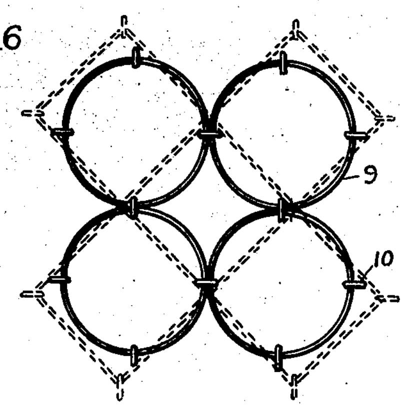


Fig. 17

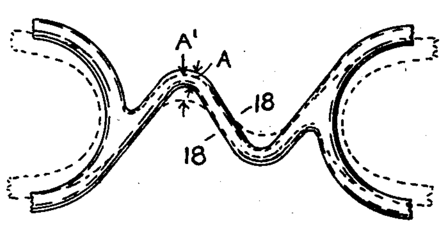
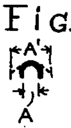


Fig. 18



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Patented Mar. 5, 1940

2,192,573

UNITED STATES PATENT OFFICE

2,192,573

RESILIENT SHEET

Leonid A. Dunajeff, New York, N. Y., assignor to Commercial Ingredients Corporation, New York, N. Y.

Application July 21, 1938, Serial No. 220,489
Renewed December 28, 1939

5 Claims. (Cl. 29—180)

My invention relates to resilient sheets and has particular reference to sheets resiliently expansive in lateral directions.

My invention has for its object to provide a sheet with a desired degree of lateral stretchability under action of applied forces acting in the plane of the sheet or transversely thereto, in the latter case the sheet being adapted to resiliently buckle if held by its edges. For this purpose I use a sheet preferably made of an inherently resilient or elastic material, such as steel or other suitable metal, Celluloid, fiber, rubber of a desired degree of hardness, molded composition, etc., and further increase the lateral flexibility or stretchability of the sheet by perforating it in such manner that portions between the perforations form zig-zag shaped or curved bridges. The size and curvature of these bridges is arranged so that the bridges can be deflected or resiliently straightened out by the action of applied forces, and they may be considered as corrugations in the plane of the sheet. The pattern of the perforations may be made uniform throughout the sheet in order to obtain uniform flexibility or resiliency in all its points, or the pattern may vary if it is desired to vary the resiliency at certain points of the sheet. The bridges are preferably made to extend in different directions in order to render the sheet laterally expansive in all directions. Such a sheet is characterized by its ability to stretch in all directions, increasing its area when so stretched.

When secured by its edges in a frame, the sheet will resiliently stretch under action of forces transverse to the plane of the sheet, the elongation being obtained from the straightening of the curves of the bridges.

My sheet can be made sufficiently elastic so that it can be used for chair seats, mattresses, backs of seats, etc., and for other purposes where resilient flexibility and stretchability may be required.

The corrugated bridges, to be resiliently flexible, must be narrow, their width being comparable or corresponding to the thickness of the material. The flexibility of the wide bridges can be increased by transversely curving the edges of the bridges so as to form the bridges into channels open at one side of the sheet.

Certain typical forms and embodiments of my invention are described in the accompanying specification, from which full understanding of my invention and its operation can be had, and the invention is further disclosed in the accompanying drawings in which—

Fig. 1 is a plan view of my sheet with elements connected by curved bridges.

Fig. 2 is an enlarged detail view of the same.

Fig. 3 is a side view of the same.

Fig. 4 is a plan view of a modified sheet with ring-shaped elements or portions connected by curved bridges.

Fig. 5 is an enlarged detail view of the same.

Fig. 6 is an end view of the same.

Fig. 7 is a plan view of another modification showing rings connected by bridges.

Fig. 8 is a detail view of the same.

Fig. 9 is an end view of the same.

Fig. 10 is another modification of ring-shaped elements connected by bridges.

Fig. 11 is an end view of the same.

Fig. 12 is a plan view of a sheet having elongated rings.

Fig. 13 is an end view of the same.

Fig. 14 is a diagrammatic view showing stretching of a sheet similar to the sheet shown in Fig. 1.

Fig. 15 is a diagrammatic view showing stretching of a sheet similar to the sheet shown in Fig. 7.

Fig. 16 is a diagrammatic view showing stretching of a sheet formed of wire rings.

Fig. 17 is a fractional detail view of ring-shaped portions and curved bridges curved into open channels.

Fig. 18 is a sectional view taken on the line 18—18 of Fig. 17.

My resilient sheet can be made in a variety of different forms, all these forms being characterized by separate pieces or elements connected together, preferably integrally, by bridges, the pieces and the bridges being, for instance, formed or stamped out, their contours being defined by perforations. The sheet can be made of metal, fibrous or cellulose material, in which case the perforations may be stamped out in suitable dies; or, if made of a suitable metal, alloy or composition, the whole sheet may be cast or pressed out between rolls. If made of a composition, the sheet may be formed in hot or cold dies. The resilient lateral flexibility or stretchability is obtained by giving the bridges a curved or zig-zag shape, or by making the elements or pieces themselves in the form of flexible rings. One example of such a sheet is shown in Figs. 1, 2 and 3, Figs. 2 and 3 representing detail view of the sheet on an enlarged scale. The sheet 1 is provided with perforations 2 of such a shape that square pieces 3 are formed connected together at their corners by bridges 4. The bridges are curved in the plane of the sheet as shown and can, therefore, resiliently stretch or straighten out when a force or forces are applied to the sheet. The material of the sheet must, of course, be resiliently flexible. The curvature must be sufficient to bring the middle portion of the bridge entirely outside of a straight line passing through its ends; in other words, there should not be any uninterrupted straight line of material between the ends of the bridge.

The effect of lateral forces on a sheet of a pattern somewhat similar to the pattern of the sheet 1 is shown in Fig. 14. The bridges 4' can be stretched by straightening out their curvature as shown in dotted lines, with the result that the elements A, B, C and D will move outwardly in different directions into new positions A', B', C' and D'. The area ABCD will then expand into the area A'B'C'D'.

Pieces or elements between the bridges can be also made resiliently yieldable by forming them in the shape of flexible rings 5 as shown in Figs. 4, 5 and 6, Figs. 5 and 6 being detail view of the elements and bridges. With a sheet formed as shown, not only the bridges 4 will resiliently stretch under action of applied forces, but the rings themselves will be resiliently deformed, the curved sides being straightened out in direction of stresses produced by the forces.

Modified forms of my sheet with bridged flexible rings are shown in Figs. 7, 8, 9, 10 and 15, Figs. 8, 9, 10 and 15 representing enlarged detail views of the bridged elements. Such a sheet can be stretched in all directions or, if fastened rigidly at its edges in a frame, can be resiliently depressed by the application of a force transverse to the plane of the sheet. The arcuate portions 7 between the bridges will be straightened out, tending to form straight lines, so that the rings will tend to be stretched out into squares or rectangles, as shown in dotted lines in Fig. 15.

The sheet as shown in Fig. 15 will expand in all directions, enlarging its area, when the points A will move outwardly into new positions A'. This effect is also shown diagrammatically in Fig. 16 where wire rings 9 are joined by clips 10. The rings when subjected to the stretching action, will tend to become straightened out so as to form squares as shown in dotted lines.

The elements between the bridges may be made elongated as shown in Figs. 12 and 13, the sheet in this case being formed of a plurality of elongated rings 8 joined together at their outer end portions.

In order to impart greater flexibility to any of the described forms of elements and bridges, the sides of the rings and the bridges may be modified by bending their edges into channels, for instance, of a U-shaped section. A detail view of such a modification is shown in Figs. 17 and 18. The expanded structure is shown in dotted lines, the U-shaped bridge expanding in certain portions, particularly at the bends, and collapsing at other portions, especially between the bends. The width A expands into A'.

Other similar modifications can be formed with my invention, the only necessary requirement being that the sheet should be of an inherently resilient or elastic material and the perforations should be made so that the sheet should have a plurality of curved or zig-zag shaped bridges or ring-shaped portions, extending in different directions so that they can resiliently expand or deform under action of applied forces.

I claim as my invention:

1. A resilient sheet made of a resilient material having elements separated by perforations, the elements being of a relatively narrow width comparable to the thickness of the sheet and curved edgewise in the plane of the sheet, the curvature being wholly imparted by the perforations and being such as to bring the middle portion of each element entirely outside of any straight line passing through its ends, the element being thereby adapted to substantially straighten out under stress and to increase the distance between its ends, the elements extending in different directions thereby rendering the sheet expansive simultaneously in all directions.

2. A resilient sheet made of a resilient material having elements of an approximately arcuate shape of a narrow width comparable to the thickness of the sheet, the elements being wholly formed by perforations and having curvature in the plane of the sheet, the middle portion of each element extending wholly outside of any straight line passing through its ends, the element being thereby adapted to straighten out its curvature under stress and to increase the distance between its ends, the elements thereby rendering the sheet laterally expansive simultaneously in all directions.

3. A resilient sheet made of a hard resilient material and so perforated as to form portions connected together by relatively narrow bridges curved edgewise in the plane of the sheet, the middle portion of each element extending wholly outside of any straight line passing through its ends, the element being thereby adapted to substantially straighten out under stress and to increase the distance between its ends, the elements extending in different directions thereby rendering the sheet expansive simultaneously in all directions.

4. A resilient sheet made of a resilient material so perforated as to form ring-shaped elements connected by bridges, the arcuate portions between the bridges being relatively narrow in comparison to their width and being curved entirely in the plane of the sheet, the inner edge of the arcuate portion extending entirely outside of any straight line passing through the ends of the portion, the portion being thereby adapted to substantially straighten out under stress and to increase the distance between its ends, the elements extending in different directions thereby rendering the sheet expansive simultaneously in all directions.

5. A resilient sheet made of a resilient material so perforated as to form ring-shaped elements connected together at different points, portions of rings between the points of connection forming arc-shaped bridges curved in the plane of the sheet, the middle portion of each bridge extending outside of any straight line passing through the ends of the bridge, the bridge being thereby adapted to straighten out and to lengthen between the end points, the sheet being thereby rendered stretchable simultaneously in all directions.

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