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NON-WOVEN FABRICS AND METHOD OF MANUFACTURE

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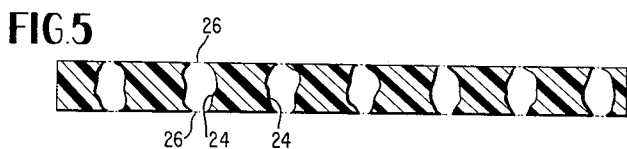
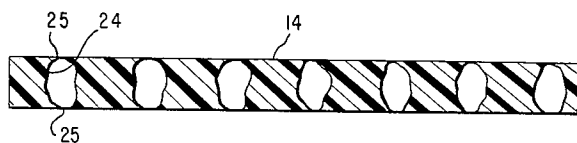
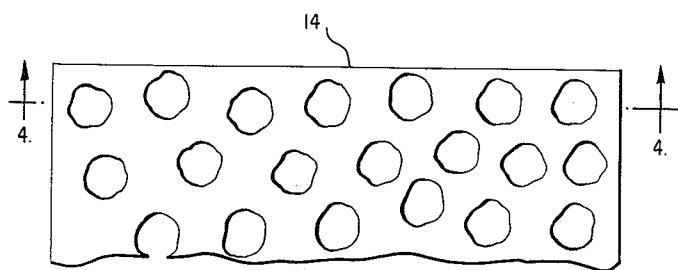
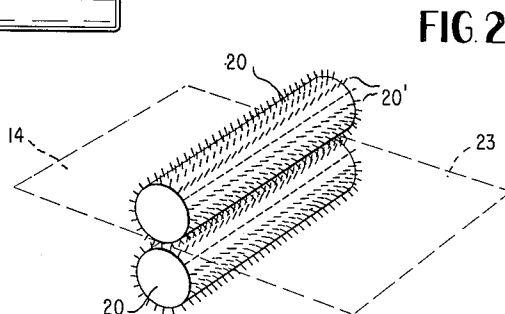
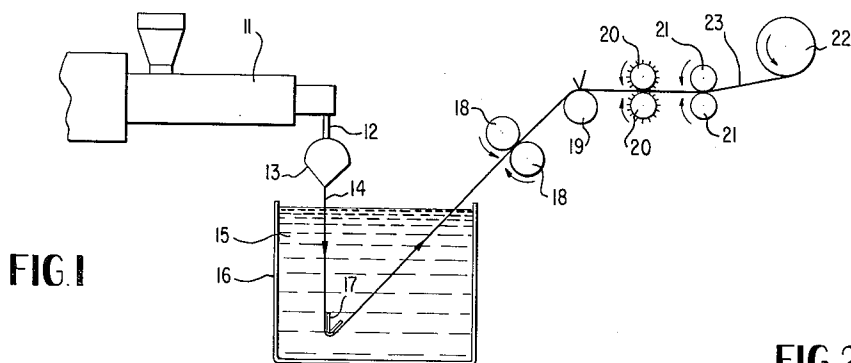


FIG. 4

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1957. This application Mar. 10, 1961, Ser. No. 94,940
10 Claims. (Cl. 161—109)

This invention relates to a new article of manufacture, namely, a non-woven cloth or fabric and, more particularly to a non-woven cloth or fabric made from a sheet of foam material substantially of single bubble thickness, wherein the interrelated side walls of the bubbles provide the non-woven fabric. This application is a continuation of application Serial No. 643,299, filed March 1, 1957, now abandoned.

Cloth has been manufactured for centuries by known processes, such as weaving, wherein warp and filling yarns are interlaced on a loom, or such as knitting wherein a single yarn or thread is interlaced into a series of connected loops. While yarns such as cotton, linen, wool, etc., were used at first, synthetic yarns, such as nylon, rayon, etc., are now quite commonly used in the manufacture of woven or knitted fabrics.

The present invention relates to a new way of forming cloth directly from the raw material (nylon, rayon, etc.), thus obviating the need to first form the strands or yarns and then weaving or knitting these into cloth. The basic idea of this invention is that the non-woven cloth or fabric is provided by and consists of the interrelated side walls of the bubbles of a sheet of plastic foam material of single bubble thickness.

This invention differs from any present use of plastic foam in several respects. The two primary differences are: (1) The thickness of the foam is limited to one or a few bubbles, whereas other uses of foams involve foams many bubbles thick; (2) some or all of the end walls of the bubbles may be absent or punctured. It is the intercell walls which constitute the cloth structure.

The presence, partial or complete absence of end walls will be determined by the final properties desired. For a given high polymeric foam the porosity, transparency, stretchability, etc., will be varied as extent of end wall elimination is changed.

Accordingly, it is an object of this invention to provide, as an article of manufacture, a strip of material, originally a foam substantially of single bubble thickness, some of the opposing end walls of the bubbles thereof being substantially absent, and with the interrelated side walls of said bubbles providing a non-woven fabric, with the height of the bubbles corresponding in general to the thickness of the strip, the cross-section of individual bubble openings being substantially symmetric between opposite sides of the strip.

It is a further object of the present invention to produce the strip of plastic foam material by molding, extruding, or spraying.

It is a further object of this invention to provide a thin sheet of plastic foam having a limited number of bubble layers, with the material taken from a group of foamable plastic substances, such as nylon, Dacron, Acrilan, the ethylenes, urethanes, styrenes, plastic resins or dispersions of foam rubber.

These and other objects will be seen from the following specification and claims in conjunction with the appended drawing in which:

FIG. 1 is a diagrammatic view illustrating one form of apparatus used to form the non-woven material of the invention;

FIG. 2 is a perspective view of the pair of opposed material piercing rollers shown in FIG. 1, but on an enlarged scale;

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FIG. 3 is a plan view of a fragment of the strip of plastic foam material;

FIG. 4 is a section taken on line 4—4 of FIG. 3; and

FIG. 5 is a section taken on line 4—4 of FIG. 3 but illustrates the construction of the strip after piercing, or breaking of the bubble end walls.

It will be understood that the above drawing illustrates merely one preferred form of the present article of manufacture and one form of apparatus employed in the manufacturing process. Other apparatus and other embodiments of the invention are contemplated within the scope of the claims hereafter set forth.

Referring to the drawing, FIG. 1 diagrammatically illustrates one form of apparatus employed in producing the present article of manufacture wherein the strip of plastic foam material is produced in an extruding process. It is contemplated that other means may be employed for producing films or relatively thin strips of plastic foam material, such as by spraying or molding.

In FIG. 1 an extruding device is generally indicated at 11 from which the foam plastic material is delivered through outlet 12 into the laterally elongated forming die 13 which forms the plastic foam material into a thin elongated strip.

The initially formed strip 14 is then cooled either by moving it over a cooling roller (not shown) or, as illustrated in FIG. 1, by moving the strip 14 through fluid 15, such as water, in cooling tank 16. The strip moves around guide 17 within said tank and is drawn upwardly by the pair of opposed preferably rubber pull rolls 18 driven by suitable power means.

The strip of foam plastic material then moves over a suitable edge trimming roll 19 for shearing the opposed marginal edges of the strip to a predetermined material width. The strip may be directly wound on roll 22 after passing through tension rolls 21. In the strip of material, one or a few bubbles thick, the interrelated side walls of the bubbles form a non-woven fabric. The presence, partial or complete absence of the bubble end walls will determine the final properties of the cloth or fabric. If the end walls of the bubbles are to be removed after trimming, the properly sized strip of material may then be advanced through a pair of power driven opposed puncturing rolls 20. Projected from their cylindrical surfaces in accordance with a predetermined pattern are a series of sharpened elements or pins 20', which are adapted for piercing some of the opposed end walls of the bubbles. The apertured strip then passes through tension rollers 21 and in its final form as at 23 is wound upon a suitable roll 22 completing the manufacturing cycle.

FIG. 2 on an enlarged scale shows the strip 14 of plastic foam material as it passes through the puncturing rolls 20. In this connection other apparatus may be employed for eliminating the end walls of the individual bubbles defined by the plastic material. The flexibility and porosity of the finished strip will depend upon the number of piercing elements 20' per unit area.

FIGS. 3 and 4 illustrate fragmentarily the structure of the strip of plastic foam material 14 which has not passed through the piercing rollers 20. The size and uniformity of the bubbles is determined in the manufacturing process. The bubbles may be extremely small corresponding to finely woven fabric or large like the texture of a minnow net.

Here the respective bubbles are shown diagrammatically and with the strip one bubble thick, for illustration. The side walls of said bubbles are indicated at 24 interrelated with corresponding other bubble side walls. The respective unbroken end walls of the individual bubbles are designated at 25.

After the foam material 14 has passed through the piercing rollers 20 as shown in FIG. 2, the cross sectional structure of the strip will appear as shown diagrammatically in FIG. 5. The end walls 25 have been eliminated and are replaced by the openings 26 at the opposite ends of the bubbles. Thus there remains merely the interconnected or interrelated side walls of the individual bubbles which provide the non-woven fabric.

The nature of the fabric produced may be varied by controlling the material which is employed in the strip forming process. As is well known in the art various thermoplastics have already been formed into strips or films of solid material as by an extrusion process as diagrammatically illustrated in the drawing. The present strip or film of foam material may be formed by extruding, molding or by spraying.

Regardless of the particular process used, the nature of the material is controllable by regulating the bubble size, viscosity, etc. Likewise, the thickness of the foam layer is controlled at one bubble layer, two or three bubble layers, or at least a limited number of bubble layers, determined by the intended use of the fabric.

For illustration, a bubble having a spherical radius of 2 mm., can be deformed to a maximum thickness of 1/4 mm., resulting in a "looser weave." A tighter weave effect may be produced using a bubble structure of 1 mm. radius. The degree of porosity, and for certain materials, the degree of fabric "deformability or stretchability" may be varied by the percent and arrangement of broken bubble surfaces. In other words, the manufacturing process may be such that only some of the bubble end walls are broken in accordance with a predetermined regular pattern, or a random pattern.

It is contemplated in the formation of the present fabric material that the same can be preformed by molding a thin foam shape which might be one or a few bubbles thick, and thereafter breaking the end surfaces of the walls defining such bubbles in accordance with a predetermined or random pattern. Such process is particularly useful in the textile field and wherein articles such as stockings can be molded to fit.

It is also contemplated as a part of the present invention that instead of actually breaking the end walls of the bubble defining material merely the side walls of the bubbles be formed in the manufacturing process of the strip to thus eliminate the breaking and puncturing step, nevertheless forming a non-woven fabric.

The present invention contemplates the provision of a "honeycomb" form of thin flat foam wherein the walls between bubbles becomes one of the dimensional elements of the non-woven fabric.

There are a large number of materials which have heretofore been employed or which may be employed in producing foam plastic strip material.

For example: said material may be taken from a group of solid foamable substances or thermoplastics such as the ethylenes, styrenes, urethanes, plastic resins, or dispersions of natural or artificial foam rubber. An alkyd resin when mixed with polyisocyanate is known to produce a foam or cellular structure. It is contemplated that others of the thermo-setting resins may be employed.

The desired amount of tensile strength for the cloth or fabric may require the use of certain other materials in the manufacture of the foam plastic strip, such as nylon, Acrilan, Dacron or other fibre forming linear copolymers.

One method of strengthening the fibres is by stretching the same at appropriate temperatures for aligning the molecules of the "mono-bubblular foam."

Aeration of an aqueous latex dispersion may be used in producing a latex foam strip of controlled bubble size and thickness.

Granules of partially expanded foam plastic such as polystyrene at temperatures of between 350 to 500° F. within suitable dies and for limited periods, have been

employed for producing strips of plastic foam material and wherein the thickness may be determined by the spaced relation between the dies and wherein the bubble size may be determined by the heat and time factors.

Another method of producing a porous plastic strip includes the formation of a non-porous plastic strip which contains therein a homogeneous dispersion of dissolvable substance, like salt, which is removed in a manufacturing process, leaving a porous plastic strip of material. Thus, the present invention may be described in terms of a strip of material formed from a two-phase dispersion (continuous and discontinuous) with the thickness of the strip being substantially that of an element of the discontinuous phase, such as the bubbles, the salt, etc., referred to above. The finished strip consists of the remaining interrelated side walls of the continuous phase with some, most, or all of the opposing end walls being substantially absent.

As an important part of the present disclosure, it is contemplated that as few or as many of the end walls of the respective bubbles per unit area may be pierced or otherwise broken depending upon the desired porosity of the finished fabric, or the end walls may remain intact.

Having fully described the invention, what is being claimed is:

1. As an article of manufacture, a strip of plastic material, originally a foam substantially of single bubble thickness, most of the opposing end walls of the bubbles thereof being absent, and with the interrelated side walls of said bubbles providing a non-woven fabric, with the height of the bubbles corresponding in general to the thickness of the strip, the cross section of individual bubble openings being substantially symmetric between opposite sides of the strip.

2. As an article of manufacture, a strip of plastic material, originally a foam substantially of single bubble thickness, some of the opposing end walls of the bubbles thereof being substantially absent, and with the interrelated side walls of said bubbles providing a non-woven fabric, the cross section of individual bubble openings being substantially symmetric between bubble ends.

3. As an article of manufacture, a thin sheet of plastic material originally a foam substantially of single bubble thickness, consisting of a series of laterally and longitudinally contiguous bubbles, the opposed end walls of some of said bubbles being substantially absent, the interconnected side walls thereof extending substantially at right angles to the plane of the sheet providing a non-woven fabric, the cross section of the individual openings being substantially symmetric between opposite sides of the sheet.

4. As an article of manufacture, a strip of plastic copolymer material originally a foam substantially of single bubble thickness, consisting of a series of laterally and longitudinally contiguous bubbles, the opposed end walls of some of said bubbles being substantially absent in accordance with a definite pattern, the interconnected side walls thereof extending substantially at right angles to the plane of the strip providing a non-woven fabric, the cross section of the individual openings being substantially symmetric between opposite sides of the strip.

5. The article of manufacture of claim 1, said material being any foamable thermoplastic copolymer.

6. As an article of manufacture, a strip of material originally a foam substantially of single bubble thickness, most of the opposing end walls of the bubbles being substantially absent, and with the interrelated side walls of said bubbles providing a non-woven fabric, with the height of the bubbles corresponding in general to the height of the strip, the cross section of individual bubble openings being substantially symmetric between opposite sides of the strip.

7. The article of manufacture of claim 1, said end walls being mechanically punctured.

8. The article of manufacture of claim 1, elimination

of said end walls occurring by expansion during extruding of the plastic foam material into strip form, said expansion being in opposing directions substantially normal of the plane of the strip.

9. As an article of manufacture, a strip of material originally a two-phase dispersion consisting of a continuous phase and a discontinuous phase, said strip of material being substantially of the thickness of an element of the discontinuous phase, the opposing outer portions of the continuous phase about some of said discontinuous phase elements and said elements being substantially removed to form openings through said strip, said strip of material formed by the remaining continuous phase, the cross-section of individual continuous phase openings being substantially symmetric between opposite sides of the strip.

10. As an article of manufacture, a strip of material originally a two-phase dispersion consisting of a con-

tinuous phase and a discontinuous phase, said strip of material being substantially of the thickness of an element of the discontinuous phase, the opposing outer portions of the continuous phase about said discontinuous phase elements and said elements being substantially removed to form openings through said strip, said strip of material formed by the remaining continuous phase, the cross-section of individual continuous phase openings being substantially symmetric between opposite sides of the strip.

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