This invention relates to a method for the formation of a pile surfaced product from plastic materials, and to the product of said process.

It is an object of this invention to provide a material of the character indicated wherein the pile backing portions of the sheet material are integrally formed of a plastic material such as a natural or synthetic resin.

It is also an object of this invention to provide a method for the formation of a nap or pile surfaced material wherein a plastic material such as a synthetic resin forms a matrix of a product comprising a fiber resembling a hair or a filaments comprising the filamentary projections from the material being formed "in situ" in an integral form, or to the backing or support thereof.

Another object of this invention is to provide a simple, economical and effective process for the formation of nap or pile type materials, wherein the sheet or the like is readily adapted for large scale production, and wherein an efficient method is provided for the formation of fibrous or filamentary projections and for forming or uniting such projections with a suitable backing, support or reinforcement.

Another object of this invention is to provide a method for the formation of a product of the character indicated entirely of plastic materials such as natural or synthetic resins, particularly fiber forming polymers, to be used alone or in combination with or united to other materials; such method being adapted to produce numerous variations as to the fiber or filamentary shape, thickness, length, configuration or color. The fibers or filaments may impart thereto other characteristics of a functional or ornamental character.

An additional object of this invention is to provide a product indicated and a method for the formation of the same wherein the above characteristics are realized, said product having highly desirable utilitarian, functional and decorative characteristics.

Other and further objects, benefits and advantages of this invention will be more fully set forth herein and will be apparent from the drawings, specifications and claims forming part thereof.

In the accompanying drawings:

FIGURE 1 is a schematic view of an extrusion arrangement employing the method of this invention for the formation of the herein described novel product;

FIGURES 2 and 3 are cross-sectional views showing a press arrangement employing the method of this invention for the formation of the novel product;

FIGURE 4 is a cross-sectional view of a pile surfaced sheet in accordance with present invention in the process of removal from the matrix sheet or membrane used in the process of its formation;

FIGURE 5 is a cross-sectional view of a product in accordance with this invention wherein the foraminous matrix or membrane remains in position and is incorporated in the filamentary surfaced structure;

FIGURE 6 is a view of a calendaring arrangement wherein the method of the present invention is employed to form a product in accordance herewith; and

FIGURE 7 is a cross-sectional view of another form of the product of the present invention.

Plasticized or treated with a gelling agent and gelled as by fusion upon the application of heat to set the resin. Fusion of the resin produces dimension...
ally stable permanently set useful end products. Typical examples of the thickeners or gelling agents useful in the formation of such plastigels are metallic soaps such as aluminum stearate, copper stearate, etc. Other useful agents are materials such as colloidal silica or organophilic bentonites. Fillers may also be used such as china clay or copper phthalocyanine pigments which pigment the product and produce a moderate thickening action. As heretofore stated, a significant characteristic of such plastigels is that they are of thick putty-like consistency and require relatively light pressure to exceed the yield value for deformation to the desired configuration. The deformation may therefore be achieved by manual manipulation or by means of many types of equipment used in the handling or processing of plastic materials. Plastigels are cured, set or dimensionally stabilized to the form of useful articles or products by the application of a temperature adequate to produce fusion. This fusion temperature is in the range of 300° to 400° F., a practical fusion temperature in most cases being 350° F. The duration of the bake need only be long enough to achieve the required heat transfer to the interior of the object.

Examples of plastigel formulations are given below:

<table>
<thead>
<tr>
<th>Parts by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin (&quot;Geo 121&quot; or &quot;Vinyline QYV&quot;)</td>
</tr>
<tr>
<td>Didodcylo Phosphate</td>
</tr>
<tr>
<td>Terephthalic Phosphate</td>
</tr>
<tr>
<td>Diethylene Glycol</td>
</tr>
<tr>
<td>Stabilizer (&quot;Dynesh&quot;)</td>
</tr>
<tr>
<td>Gelling Agent (&quot;Bentone 34&quot;)</td>
</tr>
<tr>
<td>Gelling Agent (&quot;Bentone 38&quot;)</td>
</tr>
</tbody>
</table>

The material is fused at 350° to 370° F.

"Geo 121" is a dispersion grade high molecular weight vinyl chloride polymer product of B. F. Goodrich Chemical Company. "Vinyline QYV" is a dispersion grade high molecular weight vinyl chloride polymer product of Bakelite Company. "York Whitting" is a china clay filler product of R. E. Carrol, Inc. "Dynesh" is a dibasic lead phosphte stabilizer product of National Lead Company. "Bentone 34" and "Bentone 38" are montmorillonite gelling agent products of National Lead Company. Additional formulations are well known to those skilled in the art and are described in the technical literature, such as for example, Plastics Engineering Handbook (Reinhold Publishing Corp., New York, 1954), pages 247-334.

It will be understood that the foregoing reference to the use of a plastigel is made by way of example only and is not intended to limit the scope of this invention.

The mop or pile surfaced sheet materials produced by the herein disclosed method are subject to considerable variation as to the dimensions and configuration of the individual fibers or filaments. Since the cross-sectional configuration of each individual filament is determined by the matrix aperture configuration, a large range of configurations is available. The matrix material employed may, as heretofore stated, be a membrane such as a wire mesh or textile fabric. Under these circumstances, the weave of the mesh is a determining factor for the fiber configuration and density. The quantity of material expressed through the fabric mesh is determinative of the fiber length and consequently the depth of the mop or pile. By adjusting the rate at which the extrusion of the material takes place through the matrix mesh, curvature or curling or expressed fibers may be achieved to obtain interesting and desirable decorative effects. Instead of using a mesh cloth as a matrix membrane, perforated or apertured sheets may be employed. Similarly, textile fabrics of natural or synthetic fibers may be employed as the foraminous membrane or matrix material. The employment of the latter type of material is particularly desirable under circumstances wherein such matrix structure is permitted to remain within the ultimate sheet and is thus incorporated therein. Under such circumstances, the textile fabric sheet is left in situ and becomes part of the ultimate product acting to reinforce the sheet material and to impart other desired physical characteristics thereto.

The instant process is equally applicable to the production of pile surfaced sheets from a wide variety of other matrix materials as well as plastigels or plastigel matrix. The matrix material may be employed. In each case the resinous material is expressed through a foraminous membrane or matrix so that the expressed material is formed into a relatively dense filamentary mass during the course of its passage through the apertures of the matrix and is supported by a backing of unexpressed residual material or the matrix element itself. The material is brought into contact with the matrix surface under conditions wherein it is rendered mobile, using such heat and pressure as is appropriate for the particular material. In any case, the yield value of the material is exceeded as by the application of heat and/or pressure, so that at least a portion of the plastic material is expressed through the matrix thereby forming a multiplicity of closely spaced normally extending fibers or filaments projecting through the matrix. The matrix sheet or membrane may then be separated from the sheet or left in situ as above indicated.

Thus, resinous materials such as polyethylene, polyvinyl chloride, cellulose acetate, etc., may be readily formed into pile surfaced sheets of the character indicated by the suitable application of heat and pressure as by means of a press apparatus heretofore described. The resin is disposed in contact with the matrix membrane and is subjected to heat and pressure. The yield value of the material is exceeded so that a portion thereof is expressed through the matrix. The densely spaced filaments thus formed are dimensionally stabilized and form the pile surface of the product. Dimensional stabilization may occur by fusion as heretofore described, by cooling, solvent evaporation or by some other method amenable for the particular material employed. In the case of many thermoplastic materials mere exposure to the ambient temperature is adequate. Where lower temperatures are required, the expressed material may be subjected to a coolant as for example, an air or water stream or bath.

FIGURE 1 illustrates a method of practicing the invention based upon the use of an extrusion apparatus. Thus, as shown in said figure, an extruder 19 is provided comprising an extrusion cylinder 20 into which material is fed from a hopper 21 and emerging through a sheeting die 22. A web or belt of foraminous matrix material such as a wire mesh screen is disposed so that a portion thereof traverses the mouth of the sheeting die 22. The foraminous membrane may advantageously be in the form of a belt 26 mounted upon suitable motive means such as rollers 23 which are in turn driven by a motive power source not shown. A roller 26 may be disposed adjacent the die mouth. An extrudable thermoplastic resin is fed into the extruding machine 19 and emerges through the mouth of the sheeting die at which point a portion of the material is forced and expressed through the openings in the mesh of the belt 26 and projects beyond the undersurface thereof to form a pile of filamentary or fibrous projections 24. The material remaining upon the upper surface of the foraminous belt comprises a continuous sheet 25 which remains integral with the dense fibrous pile 24 extending through the screen openings. As the expressed material strikes the atmosphere the temperature thereof is sufficiently reduced to render such materials sufficiently immobile and to prevent coalescence between the individual filaments or fibers. In the event that the particular thermoplastic material requires a temperature lower than that of the ambient atmosphere to impart this initial set thereto, conventional types of cooling or water sprays may be used to cool the temperature of the opening of the sheeting die directed toward the plastic material emerging therefrom. Thus for example, where such additional cooling is required an air stream 30 may be directed at the plastic material or the material
may be immediately passed through a cooling bath. In each case, the plastic material upon emerging from the die is caused to be expressed through the moving foraminous belt to the desired degree and is then rendered sufficiently stable so as to retain the individual fiber structures. The web from the belt form the web away from the extrusion die, it may be further processed or cooled until sufficient stability is achieved for the structure to enable it to be further manipulated. As the material is sufficiently cooled or otherwise stabilized, it may be peeled from and withdrawn from the foraminous belt, as shown in FIGURE 4. The resulting sheet comprises a web of continuous filaments formed by the individual fibers to form a purl surface therefor. The length of the individual fibers is determined by the amount of material which is expressed through the foraminous screen as it passes the die opening. It will be seen that by the foregoing method a sheet of plastic material having a purl surface may be continuously formed in any desired length.

An extrusion arrangement, such as is shown in FIGURE 1, may be employed with plastic materials having heat setting characteristics. Thus, a plastigel of the type hereinafter described may be employed as well as other resin systems having generally similar handling characteristics. Under such circumstances, the purl surfaced sheet material is passed through a suitable heating zone as indicated at 27. The arrangement may also be adapted for use with solvent evaporation systems as well as with two component systems, such as epoxy or polyester resin systems.

It will be evident that a continuous web of fabric or similar sheet foraminous or mesh material may be used in lieu of the endless belt 23. In such case, the web as for example of a textile fabric is first wound on the left hand roller 22 to form a supply roll and is taken up by the right hand roller 23 which forms a take-up reel whereby maintaining it in taut condition. The fabric is drawn across the mouth of the sheeting die at which point the plastic material is expressed therethrough in the manner hereinafter indicated. After the plastic material is stabilized to a sufficient degree, it may be wound up on the take-up reel in the form of the right hand roller 23. The purl surfaced sheet thus formed incorporates the textile web as part thereof as exemplified by the purl surfaced sheet shown in FIGURE 5. Said figure illustrates a sheet 40 wherein a multifilament purl surface 41 extends from the backing portion 42 and is additionally supported or reinforced by a foraminous matrix sheet 43.

An additional arrangement for practicing the instant invention is illustrated in FIGURE 6 wherein a calender 38 is employed for the purpose of forming the purl surfaced sheet. In this arrangement, a supply 29 of material is provided such as for example as plasticized resin which may be a vinyl chloride polymer or copolymer. The supply material 29 is successively passed between rollers 30, 31 and 32 which may be heated in accordance with the requirements of the particular resin for the purpose of achieving the desired plasticity. The material emerges as a uniform layer or sheet 33 on the surface of roller 32. A web of foraminous matrix material, as for example a textile or wire mesh cloth 34 is fed between pinch rollers 36 across the lower surface of roller 32 and is tensioned so that it is pressed toward the surface of said roller so that a portion of the soft plastic mass of sheeted matrix is forced through the interstices of said matrix web in filamentary form to thereby form the purl surfaced sheet as shown at 35. Stabilization of the purl surfaced sheet formed of thermoplastic material may, if desired, be assisted by a cooling air stream as shown at 37. On the other hand, if the material employed requires heat for stabilization, it may be passed through a heating zone as shown at 39. The web thus formed is further processed through a tensioning arrangement such as for example under idler roll 44 between pinch rolls 45 before being wound on the take-up roll or other receiving device, not shown. Other forms of plastics processing equipment such as for example knife or other coating equipment may also be adapted for the practice of the instant invention.

FIGURE 7 illustrates a modified form of product which may be produced by the instant process. This form of product may advantageously be formed by applying a coating of plastic material 46 to a foraminous membrane such as a woven textile fabric 47 as by means of a knife coater. The coated fabric is then passed under an additional knife or other form of pressure applicator, thereby forcing the plastic coating material 46 through the interstices of the fabric to form the filamentary or purl surface 48. If a very substantial portion of the coating material is thus expressed through the foraminous membrane, an additional reinforcing backing layer 49 is advantageously applied to the back of the purl surfaced sheet. The additional reinforcing backing 49 may be in the form of an additional coating of plastic material, or it may be in the form of an adhesively bonded plastic film or textile fabric.

I have here shown and described preferred embodiments of my invention. It will be apparent, however, that this invention is not limited to these embodiments, and that many changes, additions and modifications can be made in connection therewith without departing from the spirit and scope of the invention as herein disclosed and hereafter claimed.

Having disclosed my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of forming a purl surfaced sheet which comprises a purl of material in plastic state from one surface of a foraminous membrane through and beyond the other surface until a desired depth of purl extending beyond said other surface of said membrane has been achieved while permitting a portion of said material to remain in the foramen of said membrane and allowing said purl including the portions within the foramen of said membrane to achieve dimensional stability.

2. The method of forming a multifilament sheet of material which comprises expressing a filament forming material from one surface of a foraminous membrane through the interstices of said membrane and beyond the other surface thereof, the expressed material extending beyond said other surface of said membrane and having portions disposed within the foramen of said membrane and subjecting said material to stabilizing conditions in expressed form while supported within the foramen of said membrane.

3. The method of forming a purl surfaced sheet which comprises disposing a plastic material along one surface of a foraminous membrane, applying pressure to said plastic material so that it is extruded through the interstices of said membrane and extends beyond the opposing surface thereof and continuing the extrusion of said material through said membrane until the desired depth of purl has been achieved and discontinuing said extrusion while portions of said plastic material remain within the interstices of said membrane.

4. The method of forming a purl surfaced sheet which comprises expressing a material from one surface of a foraminous membrane through the interstices of said membrane and beyond the other surface thereof, said material in the course of its passage through the foraminous membrane being formed by the mesh of said membrane into a dense filamentary mass, said mass extending beyond the other surface thereof and discontinuing the expression of said material while portions thereof remain within the interstices of said membrane and form a support therefor and subjecting said material to stabilizing conditions.

5. The method of forming a purl surfaced sheet which comprises disposing a material along one surface of a foraminous matrix extruding said material through said matrix, said material in the course of its pass-
sage through said matrix being divided into a plurality of filamentary elements, said elements extending substantially beyond the other surface of said membrane and constituting a dense filamentary mass having portions thereof disposed within said matrix and subjecting said mass including said portions to stabilizing conditions.

6. The method of forming a pile surface on a sheet of woven textile fabric which comprises expressing a pile forming material in plastic state from one surface of said fabric so that said material passes through the interstices of said fabric and extends beyond the other surface thereof, and extending beyond the opposing surface thereof in the form of a plurality of filamentary projections formed from said plastic material and subjecting said material to stabilizing conditions.

7. The method of forming a sheet of multi-filamentary surface material which comprises rendering said material subject to plastic flow in contact with one surface of a foraminous membrane and expressing at least a portion of said material through said membrane and beyond the other surface thereof whereby said expressed material is formed into a multiplicity of filaments by passage through said matrix and continuing the expansion of said material until a desired filamentary length has been achieved, arresting the expression of said material with portions thereof remaining in said matrix membrane and subjecting said material to stabilizing conditions.

8. The method of forming a pile surfaced textile fabric sheet which comprises coating one side of a textile fabric sheet with a plastic material, subjecting said plastic material to flow through the interstices and beyond the other surface of said fabric whereby a portion of said coating material is expressed through said fabric sheet and extending beyond the opposing surface thereof in the form of a plurality of filamentary elements formed solely of said plastic material and subjecting said plastic material to stabilizing conditions.

9. The method of forming a pile surfaced sheet of plastic material which comprises forming said plastic material into a sheet and contacting said sheet with plastic state with one side of a foraminous member under pressure so that at least a portion of said plastic material is expressed through the opposing surface of said foraminous member in the form of filaments formed solely of said material and subjecting said sheet to stabilizing conditions supported by said membrane.

10. The method of forming a pile surfaced sheet of polyvinyl chloride resin which comprises forming a dispersion of said resin in a plasticizer disposing said dispersion in contact with a foraminous membrane and applying pressure to said dispersion whereby it is subjected to plastic flow and at least a portion thereof is expressed through the interstices of said matrix to form a plurality of resin filaments comprising a pile surface, a portion of said dispersion remaining disposed in the interstices of said foraminous membrane, heating said dispersion to fusion temperature to thereby stabilize said resin.

11. The method of making a plastic sheet material comprising disposing plastic material against an open mesh fabric sheet having a multitude of closely spaced interstices, a coating of organic thermoplastic material on one side of said sheet; and individual substantially contiguous strands of said thermoplastic material forming a pile and extending through the individual interstices of said sheet and anchored in said coating to form a pile comprising plastic projections from the other side of said sheet.

12. The method of forming a pile surfaced sheet which comprises disposing a mass of plastic material on one side of a foraminous membrane, subjecting said mass to plastic flow and expressing a portion thereof in the interstices and beyond the other side of said membrane, whereby a continuous sheet of said plastic material is disposed on one surface of said membrane, and a multiplicity of filamentary projections are formed extending from said sheet through said membrane beyond the opposing surface thereof, said filaments being integrally formed with said sheet, allowing said plastic material to be stabilized and upon the stabilization thereof, removing said pile surface from said membrane by withdrawing the pile filaments through the membrane foraments.

13. The method of forming a body of multi-filamentary surfaced material which comprises disposing a synthetic resin plastigel on one surface of a matrix membrane subjecting said plastigel to plastic flow through said matrix, so that said material is formed extending beyond the opposing surface of said matrix having root portions disposed within the interstices of said matrix and stabilizing said plastigel including the root portions thereof disposed in said interstices.

14. The method of making a plastic carpet comprising disposing a layer of unfused thixotropic plastic material against an open mesh fabric sheet having a multitude of closely spaced individual interstices continuously moving said sheet under tension while bending said sheet around the surface of a member extending transversely of said sheet to place said plastic layer under pressure across the opposing surface of said member extending beyond the opposing surface of said member, whereby said plastic layer is formed integral with said interstices individual plastic strands integral with said layer of plastic material to form plastic bristles.

15. The method of forming a pile surfaced sheet which comprises freely expressing material in plastic state through a foraminous membrane so that a filament is formed by the passage of said plastic material through each of the foraments of said membrane and extends beyond the opposing surface of said membrane, each of said filaments having substantially the cross-sectional configuration of said foraments throughout their length and continuing to express said material through said membrane foraments until a desired filament length has been achieved while portions thereof remain disposed in the foraments of said membrane and subjecting said material to stabilizing conditions.

16. A pile surfaced sheet comprising a backing sheet, a foraminous sheet disposed in contiguity with said backing sheet and a plurality of filaments formed integrally with said backing sheet and extending through the foraments of said foraminous sheet, said filaments having root portions disposed in the foraments of said foraminous sheet.

17. A pile surfaced sheet comprising a foraminous, a plurality of filaments extending from said sheet, the root of each of said filaments being disposed in one of the foraments of said membrane.

18. A plastic sheet material suitable for use as a covering material comprising an open mesh fabric having a multitude of closely spaced interstices, a coating of organic thermoplastic material on one side of said sheet; and individual substantially contiguous strands of said thermoplastic material forming a pile and extending through the individual interstices of said sheet and anchored in said coating.

19. A plastic sheet material suitable for use as a carpet comprising an open mesh fabric sheet having a multitude of closely spaced interstices, a smooth coating of plastified vinyl chloride copolymer on one side of said sheet; and individual substantially contiguous strands of plastified vinyl chloride copolymer extending through the individual interstices of said sheet and anchoring said coating to form a pile comprising plastic projections from the other side of said sheet.

20. A pile surfaced sheet comprising a sheet of woven material, a plurality of filaments of plastic material disposed along one surface of said fabric, said filaments having root portions thereof through the interstices in the weave of said material and beyond the surface of said fabric.

21. A pile surfaced sheet comprising a sheet of woven material, a layer of plastic material disposed along
one surface of said sheet having integrally formed filaments extending therethrough, said filaments having root portions extending through the interstices of the weave of said material and beyond the other surface thereof forming a pile surface therefor.

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