This invention relates to the preparation of piled webs and the like. The invention is particularly useful in the manufacture of plastic products constituting artificial fur, rugs, tassels, and other forms of trimming, together with many other products having the characteristics of a flexible web to which are integrally attached filaments, etc.

An object of the invention is to provide a piled flexible web, suitable for uses to which furs are put and for other uses, such as rugs, trimming, etc. Yet another object is to provide a novel method of preparation of such products whereby a web of the desired flexibility may be prepared while at the same time forming integrally therein with filaments or monofilaments, as well as multifilaments. Yet another object is to provide a new type of product having the characteristics of skin, hair, or fur, and the pliability desired for rugs, tassels, and other like products, while providing a simple method for accurately and expeditiously forming the product in large sheets of a predetermined shape and character. A further object is to provide a product of the character above described from plastic material which may be readily washed in soap and water and kept in hygienic condition, while at the same time providing the advantages that flow from such products as fur, fur peltries, rugs, velvets, plushes, trimmings, and similar products. Other specific objects and advantages will appear as the Specification proceeds. Other specific objects and advantages will appear as the Specification proceeds.

The invention is illustrated, in a preferred embodiment, by the accompanying drawing, in which—

Figure 1 is a diagrammatic plan view of apparatus that may be employed; Fig. 2, a perspective view of a bundle of filaments which may be subjected to the process described; Fig. 3, a side view in elevation of the structure shown in Fig. 2, illustrated in the process of being severed through the action of a heated body; Fig. 4, a side view in elevation of the resulting web and a portion of the filaments formed integrally therewith; Fig. 5, a perspective view of a flexible web with filaments extending from opposite sides thereof; Fig. 6, a broken view of the apparatus shown in Fig. 1 but illustrating the bundle of filaments supported for engagement, with the cutting wire at a different angle; Fig. 7, a side view in elevation of the flexible web and filaments resulting from the cutting and fusing operation illustrated in Fig. 6; and Fig. 8, a perspective view of the piled web structure secured to a backing of fabric or other material.

In the illustration given, 1 designates a wire having a high electrical resistance and high tensile strength, such as a wire formed of nickel-chromium alloy. The wire is supported firmly within insulating members carried by the supports 2 and 3. In the illustration given, the supports maintain the wire tautly between them in a horizontal position and insulate the wire from the ground. At the ends 4 and 5, two electrical conductors 6 and 7 are connected to the wire 1 and at their other ends lead to a regulating instrument 8 through which current is supplied to the elements 6 and 7. The regulating instrument is connected to an electric source 9 by the two electrical conductors 10 and 11.

When an electric current is sent through the circuit incorporating the regulating instrument 8 and the high resistance wire 1, the temperature of the high resistance wire will rise in direct proportion to the strength of the current sent through it. Its length also will increase in direct proportion; and it must, therefore, be adjusted to provide the desired tautness at the finally selected temperature found satisfactory.

To make a fur pelt of heat-fused thermoplastic piled sheet, the thermoplastic fibers to be used, which may be either filaments or spun threads, are presented to the high resistance wire 1 in any suitable manner, enabling the wire to provide a fusion of the filaments along at least one end of the filaments. This may be done by bringing the wire or any other heated body along the ends of the filaments arranged in a compact manner, or, as illustrated in Figs. 1, 2 and 3, the bound filaments may be brought into contact at an intermediate point with the wire 1 so as to cut through the filaments. In this form of the invention, the filaments are clamped within the binders 12 so as to provide a compact and aligned arrangement of the filaments. It will be understood that any suitable type of clamping means for maintaining the filaments in the desired shape and arrangement may be employed. The chief purpose of the clamping operation is not to compress the fibers but, rather, to orient them, as
certain degree of circumambient freedom being desirable for each filament or fiber. The fibers are preferably thermoplastic and a large variety of material may be employed which will respond to the process as described. Examples may be set out as:

1. The polyamides (generally recognized under the name “nylon”)

   \[
   \begin{array}{c}
   \text{C} \quad \text{H} \\
   \text{O} \quad \text{N} \\
   \text{H}
   \end{array} \quad \begin{array}{c}
   \text{C} \quad \text{H} \\
   \text{O} \quad \text{N} \\
   \text{H}
   \end{array} \\
   \begin{array}{c}
   \text{C} \quad \text{H} \\
   \text{O} \quad \text{N} \\
   \text{H}
   \end{array}
   \]

2. Vinlylene chloride

   \[
   \begin{array}{c}
   \text{H} \\
   \text{Cl} \\
   \text{H}
   \end{array} \quad \begin{array}{c}
   \text{H} \\
   \text{Cl} \\
   \text{H}
   \end{array} \\
   \begin{array}{c}
   \text{H} \\
   \text{Cl} \\
   \text{H}
   \end{array}
   \]

3. The copolymers, such as vinlylene chloride-vinyl chloride

   \[
   \begin{array}{c}
   \text{H} \\
   \text{Cl} \\
   \text{H}
   \end{array} \quad \begin{array}{c}
   \text{H} \\
   \text{Cl} \\
   \text{H}
   \end{array} \\
   \begin{array}{c}
   \text{H} \\
   \text{Cl} \\
   \text{H}
   \end{array}
   \]

or vinly chloride-vinyl acetate

   \[
   \begin{array}{c}
   \text{H} \\
   \text{H} \\
   \text{H}
   \end{array} \quad \begin{array}{c}
   \text{H} \\
   \text{H} \\
   \text{H}
   \end{array} \\
   \begin{array}{c}
   \text{H} \\
   \text{H} \\
   \text{H}
   \end{array} \\
   \begin{array}{c}
   \text{H} \\
   \text{H} \\
   \text{H}
   \end{array}
   \]

4. The cellulose derivatives, such as cellulose acetate

   \[
   \begin{array}{c}
   \text{H} \\
   \text{O} \\
   \text{CCH}_3
   \end{array}
   \]

The bundle of fibers 13 is brought to bear transversely upon the hot resistance wire, as illustrated in Figs. 1 and 3, and the portions of the fibers or filaments adjacent the wire soften and melt, forming a thin flexible web. In the severing operation, the wire will pass through the first layer of fibers, will then melt the second layer, and so on. In the meantime, the sections of the thermoplastic fibers which have been thus severed by a hot wire, once past contact, will resolidify. Fig. 3 is a bottom plan view of the fiber bundle and shows the wire partially having passed through the fibers. The resulting product is illustrated in Fig. 4, which represents one-half of the fiber bundle as shown being divided in Fig. 4.

The fibers 17 of the bundle 13, after being severed and having their inner ends fused into a sheet, now become the filaments 18 of the structure shown in Fig. 4. Here, the fused ends of the filaments provide the flexible web 19. The web or substratum 19 is thus formed upon resolidification of the flowing material and provides a thermoplastic film integral with the fibers.

I have found that high efficiency is attained in this process when the fiber bundle is moved along the hot resistance wire, as indicated by the arrows 20 and 21 in Fig. 1. This permits the excess material flow to be left behind on the hot wire, and also insures that the heat absorbed by the thermoplastic in fusion will not cool the wire through the length of contact.

As the bundle is moved down the wire, under this desired method, it should be pressed firmly against it, as is indicated by the arrows 22 and 23 in Fig. 3. Also, I prefer to apply force in the direction of the arrows 24 and 25 in Fig. 3 to keep apart the two thermoplastic sheets 19 as they are being formed, so that they do not fuse with one another.

Under certain circumstances, it may be desired to have the two plastic sheets 19 fused together so as to form a plastic web of the type shown in Fig. 5, having filaments extending from opposite sides thereof. In this operation, the two sheets 19 are pressed together and a fusion is formed, with a single plastic web 26 being formed, as illustrated in Fig. 5. The filaments 27 extend from the opposite sides thereof.

In the making of certain types of fur peltries, it is desired to have the filaments emerge at an oblique angle from the base sheet or web, and this is accomplished by presenting the fiber or filament bundle to the hot wire 1, as illustrated best in Fig. 6. The filament bundle 13, being presented to the wire at an angle as illustrated in Fig. 6, forms a thermoplastic skin 28 from which the filaments 29 emerge at an angle, as in many fur pelts. This is illustrated in the greatly enlarged view of Fig. 7.

While the heat-fused thermoplastic piled web may be used as such in many products, it will be understood that for many uses it should be attached to a backing material. In Fig. 8, the piled web 19 is shown secured by cement 30 to the fabric or other backing 31.

Operation

In the operation of the process, the filaments or fibers, preferably of a thermoplastic type, are united by fusing a portion of an aligned group of fibers so that the fused material forms a thin plastic skin or web integrally uniting the fibers.

When the fibers are thermoplastic, they may be brought into an aligned position by the clamping means 12 or by any other holder and drawn along the heated wire 1 to sever the bundle, as illustrated in Fig. 3. By drawing the lower portion of the bundle apart as the severance is accomplished, there are provided two webs 14, each having filaments attached thereto. If the members 19 are pushed together immediately after the severance, a structure such as shown in Fig. 5 is produced.

In the severing and solidification steps, it is important that the timing be such that the fused ends of the fibers form a continuous web or sheet and a sheet which is preferably highly flexible in character. By drawing the bundle 13 along the hot wire 1, an accurate flow of the melted material is produced and a web of the desired thinness produced. After one or two severing operations, the operator becomes adept at forming the thin skin integrally uniting the filaments.

Various effects can be produced by changing the angle of severance, as illustrated in Fig. 6.

It will be understood that considerable variation is contemplated in the practice of the process. Instead of confining the fibers within binders, as illustrated, they may be stacked in containers and heat applied either by way of severance or to one end of the fibers as they are supported in aligned relation.

Attractive trimmings are formed readily by the method described. A bundle of fibers may be quickly united to form a tassel or other forms of trimming by the application of a heated wire, etc., to form the integrating skin. Rugs, velvets, plushes may be similarly formed. Any suitable backing for these products may be provided by cementing the web, through the use of resilient
adhesive or other means directly to a backing sheet of fabric or other desired material.

The degree of heat may, of course, be varied in a number of ways by the character of the resistance wire, its diameter, etc. Further, the rate of speed at which the fiber bundle is moved along the wire, the pressure with which it is held to the wire, are also factors which should vary depending upon the type of material used. The thickness of the resulting base sheet or web and its pliability are affected directly by the speed at which the fiber bundle is moved along the wire. Instead of having the bundle move along the hot wire, it will be understood that the hot wire itself may be reciprocated or otherwise moved to provide the desired control.

In some cases, the process is most advantageously conducted in the absence of oxygen (as with nylon). Suitable attendant conditions will be, of course, employed as needed. For example, with nylon, for instance, the process is improved by a moistening of the fibers with water before processing. Further, the utilization of such agents as will promote plastic flow, such as solvents, plasticizers, etc., may be employed.

The resulting product is extremely sturdy, highly flexible, while at the same time providing soft and attractive filaments which are integrally connected to the web. The product may be readily washed. The flexible qualities of the web enable it to be used where peltries and fabrics have heretofore been employed. Further, the product is formed expeditiously and at slight cost and by methods which lend themselves readily to simple machines for carrying through the operation steps automatically.

While in the foregoing specification, I have set forth single embodiments of the invention in great detail for the purpose of illustrating the invention, it will be understood that such details may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:
1. In a process for forming a piled web from a bundle of thermoplastic filaments by heating said filaments to fusion temperature through contact with a hot wire, the steps of applying relative motion between the bundle and the wire longitudinally of the wire while the wire is passing transversely through the bundle.
2. In a process for forming a piled web from a bundle of thermoplastic filaments by heating said filaments to fusion temperature through contact with a hot wire, the steps of applying the fiber bundle to the wire by applying force at an oblique angle to the axis of the filaments and providing relative motion between the bundle and the wire longitudinally of the wire while the wire is passing transversely through the bundle.
3. In a process for forming a piled web from a bundle of polyamide plastic filaments by heating said filaments to fusion temperature through contact with a hot wire, the step of providing relative motion between the bundle and the wire longitudinally of the wire while the wire is passing transversely through the bundle.
4. In a process for forming a piled web from a bundle of polyamide plastic filaments by heating said filaments to fusion temperature through contact with a hot wire, the steps of applying the fiber bundle to the wire by applying force at an oblique angle to the axis of the filaments and providing relative motion between the bundle and the wire longitudinally of the wire while the wire is passing transversely through the bundle.
5. In a process for forming a piled web from a bundle of polyvinylidene chloride plastic filaments by heating said filaments to fusion temperature through contact with a hot wire, the steps of applying the fiber bundle to the wire by applying force at an oblique angle to the axis of the filaments and providing relative motion between the bundle and the wire longitudinally of the wire while the wire is passing transversely through the bundle.
6. In a process for forming a piled web from a bundle of polyvinylidene chloride plastic filaments by heating said filaments to fusion temperature through contact with a hot wire, the steps of applying the fiber bundle to the wire by applying force at an oblique angle to the axis of the filaments and providing relative motion between the bundle and the wire longitudinally of the wire while the wire is passing transversely through the bundle.

HYMAN GAIBEL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,871,946</td>
<td>Dickie</td>
<td>Aug. 9, 1932</td>
</tr>
<tr>
<td>2,332,540</td>
<td>Schwartzman</td>
<td>Feb. 19, 1941</td>
</tr>
<tr>
<td>2,328,063</td>
<td>Dodge</td>
<td>Aug. 31, 1943</td>
</tr>
<tr>
<td>2,438,156</td>
<td>Dodge</td>
<td>Mar. 23, 1948</td>
</tr>
</tbody>
</table>