

June 28, 1960

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2,942,300

METHOD OF FORMING STIFF THREADS

Filed Sept. 11, 1957

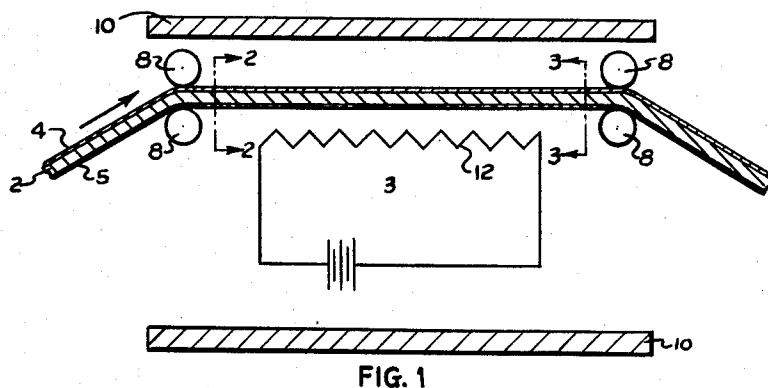


FIG. 1

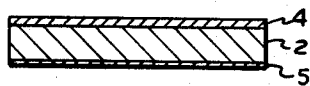


FIG. 2

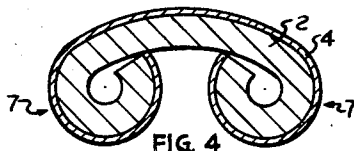


FIG. 4



FIG. 3

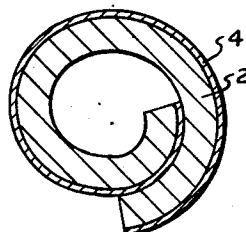


FIG. 5

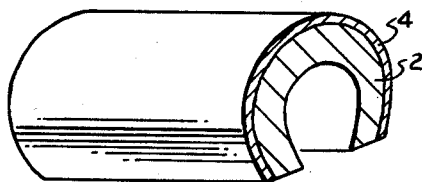


FIG. 6

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2,942,300

METHOD OF FORMING STIFF THREADS

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Filed Sept. 11, 1957, Ser. No. 683,330

4 Claims. (Cl. 18—47.5)

This invention relates to producing a "set" in pliable metallized fibers so that rigidity is improved.

With the advent of vacuum coating on a commercial scale there have appeared on the market plastic substrates with brilliant metallic coatings, having extremely high reflectance. One such flexible substrate is polymerized ethylene glycol terephthalate. A common adherent coating on such a substrate is aluminum, deposited as a coating by vacuum deposition as is described in U.S. Patent 2,665,557 issued to Clough et al.

Such metallized plastic substrates, having high luster and strength, have been found to be useful as thread and weaving material, the useful form being produced by cutting the metallized plastic into thin strips less than $\frac{1}{4}$ " in width, and normally of the order of 0.010 to 0.020 inch width.

A property of thin metallized plastic strips which detracts from their usefulness in certain applications is the characteristic of being so extremely flexible that a thin strip will fold upon itself with the application of the slightest force or due to its own weight. With this property it has been found impossible to utilize the thin metallized plastic strips as fibers in pile-like cloth where a fiber is desired to stand erect while unsupported.

An object of this invention is therefore to produce stiff metallized plastic substrate strips.

Another object is to produce a stiff metallized plastic fiber for decorative and functional applications.

Other objects will in part be obvious and will in part appear hereinafter.

The objects of this invention are realized by putting a permanent curl or "set" in the thin metallized plastic strips around their longitudinal axes. Thus a transverse cross-section of a strip that has been subjected to the process of the invention will be arcuate. It should be apparent to anyone acquainted with the studies of of geometry and strength of materials that for a given thickness and width of strip, more force is necessary to bend along its longitudinal axis a strip with an arcuate cross-section transverse to that axis than is the force necessary to bend a strip with a rectangular cross-section in planes perpendicular to the longitudinal axis.

The invention specifically relates to a method of creating such cross-section in certain types of flat metallized plastic strips.

Some materials are permanently changed in dimensions when subjected to changes in temperature. One such material is polymerized ethylene glycol terephthalate which contracts when subjected to heat and assumes smaller dimensions. This invention utilizes such changing properties and is hence limited to substrates which permanently shrink when heated. Likewise the tendency of deposited metal coating to maintain its original form is utilized as follows. The invention involves heating the metallized plastic strip. Upon heating the substrate contracts. The adhering metal coating on the surface of the strip sets up a surface tension resisting the con-

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traction. Where the metal coating exists on only one side of the strip or the metal coating on one side is thicker than on the other, the surface tension causes a curling action, the amount of curl being dependent on the temperature, the time of treatment and the relative thickness of the coating on the substrate as well as the thickness and width of the substrate. This invention relates, therefore, only to plastic strips where one side has a thicker metal coating than the other side so that on the opposing flat surfaces of the substrate adjacent to the metal there will be dissimilar surface tensions.

Since there are many variables some experimentation is necessary with a given thickness of coating, a given thickness and type of substrate and a given strip width to achieve a desired amount of curl. An example follows indicating specific results. A substrate of polymerized ethylene glycol terephthalate was coated on one side to a thickness on the order of 5 to .5 microinches of aluminum. Strips of .020 inch were cut and subjected to heat treating at the following conditions with the corresponding results:

Temp. of Treatment, ° F.	Time, Sec.	Circular Degree of Curl
350	10	180
350	30	260
375	10	220
375	30	300
400	10	260
400	30	340
425	10	300
425	30	360

It has been found that no curling occurs in polymerized ethylene glycol terephthalate strips until the strip is heated to 200° F. At 482° F. that plastic melts, hence treatments at higher temperatures than 482° F. are not possible.

There is a limit to contraction of that plastic which is less than 10 percent; hence, when it has shrunk to its limits, its unstressed form assumed when that limit is reached is permanent absent melting.

It has thus been determined that curls of 360° and more are easily attainable with this process producing relatively stiff fibers. When heated slowly the cross-section produced with curves in excess of 360° is a unitary spiral. Faster heating especially with the wider strips results in curling of both edges hence two adjacent spirals are produced.

To prevent longitudinal curling slight longitudinal tension should be maintained. To allow curl around the longitudinal axis the strip must be free from external transverse tension. The curl thus produced is of a permanent nature absent subsequent heating to temperatures near the treating range. Thus it is possible to roll the curled strips onto cylindrical reels so that the strips are forced to assume a flat transverse cross-section. Because of good configuration "memory," when the strips are later unrolled, they will again assume the arcuate cross-section.

The invention will be best understood when taken in conjunction with the drawings wherein:

Fig. 1 schematically represents the apparatus necessary for the process of this invention;

Fig. 2 is a cross-section of a plastic metallized strip before being treated to the process of this invention;

Fig. 3 is a cross-section of a plastic metallized strip that has been subjected to the process of this invention.

Figs. 4 and 5 show configurations that are possible to attain using the process of this invention;

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Fig. 6 indicates the tubular nature of the product of this process.

Referring now to the drawings the method of treating will be more fully explained.

Fig. 1 indicates a strip of substrate 2 of the type which contracts when it is heated, such as polymerized ethylene glycol terephthalate with a coating of a metal 4 thereupon. A thinner metal coating 5 appears on the opposite surface. The strip is fed into a heating zone 3 defined by walls 10 through pinch rolls 8 which are so constructed as to maintain the strip under slight tension. Within the heating zone is a heating means 12 such as an infra red bulb. The nature of the strip as it enters the heating zone if it were not under the slight tension is indicated by Fig. 2 which is a cross-section taken on a plane indicated on Fig. 1 as plane 2—2. It should be noted that the cross-section is substantially rectangular.

Absent the slight tension the cross-section of the strip at plane 3—3 in Fig. 1 is indicated in Fig. 3. There it will be noted that the substrate 2 has contracted, and the metal coating 4 having changed less than either the substrate 2 or the thinner coating 5 has caused the strip to assume an arcuate cross-section.

Fig. 4 indicates a cross-section with adjacent spirals 7, obtainable with wide strips of substrate, especially when subjected to fast heating.

Fig. 5 indicates a single spiral which results from slow heating or with fast heating when very narrow strips are treated.

Fig. 6 indicates the tubular geometry obtainable with this process. Absent the slight tension along the transverse axis it is possible not only for the substrate longitudinal axis to curl but also for the substrate to spiral around the longitudinal axis.

Though this invention has been described in relation to polymerized ethylene glycol terephthalate such relation has been used for illustration only, it being obvious that any substrate which contracts permanently when subjected to heat while under longitudinal tension will be curved to some extent by the method of this invention.

Since certain changes may be made in the above process it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

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What is claimed is:

1. A method of strengthening a fiber comprising a strip of substrate which contracts permanently upon heating and a thickness of metal coating on one side greater than such coating that may appear on the other side of said strip said method comprising heating said strip while subjecting it to a slight tension in the direction of the length of the strip, said heating being continued for a sufficient time to cause said strip to curl around its longitudinal axis.

2. A method of stiffening strips of polymerized ethylene glycol terephthalate which have coated on one side a thickness of metal coating, said strips being capable of permanently shrinking when heated, said method comprising heating the strips to a temperature between 200° F. and 482° F. for sufficient time to cause the strips to curl around their longitudinal axes, each strip being subjected to slight tension in the direction of the length of the strip during heating.

3. A method of putting a permanent set in strips of plastic substrate of less than one-quarter inch in width said strips being capable of permanently shrinking when subjected to heating conditions which do not equally affect metal on such strips, said method comprising coating upon said strips by vapor deposition metal coatings and treating said combination to heating conditions as determined by the particular plastic substrate involved so that the metal coating creates a surface tension on the shrinking strip so that the strip is caused to curl around its longitudinal axis, each strip being subjected to slight tension in the direction of the length of the strip during heating.

4. A process for producing plastic fibers which comprises aluminizing a flexible, heat shrinkable plastic substrate by vacuum vapor deposition means, slitting said substrate into strips not more than one quarter of an inch in width and thereafter heating said plastic strips while under a slight longitudinal tension to cause the strips to curl about their longitudinal axes.

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