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SPINNERET FOR PRODUCTION OF SYNTHETIC GRASS YARN

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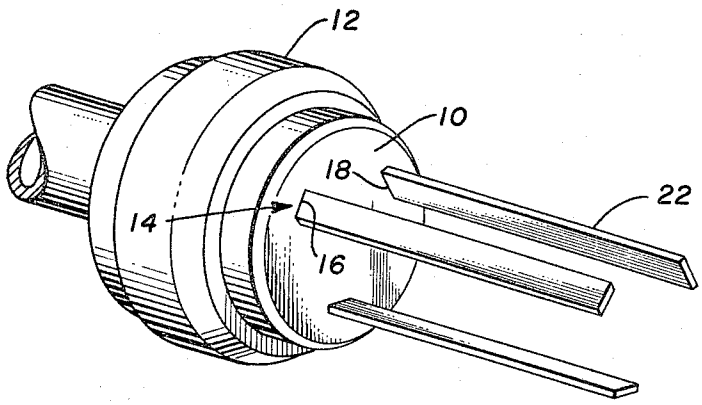


FIG. 1.

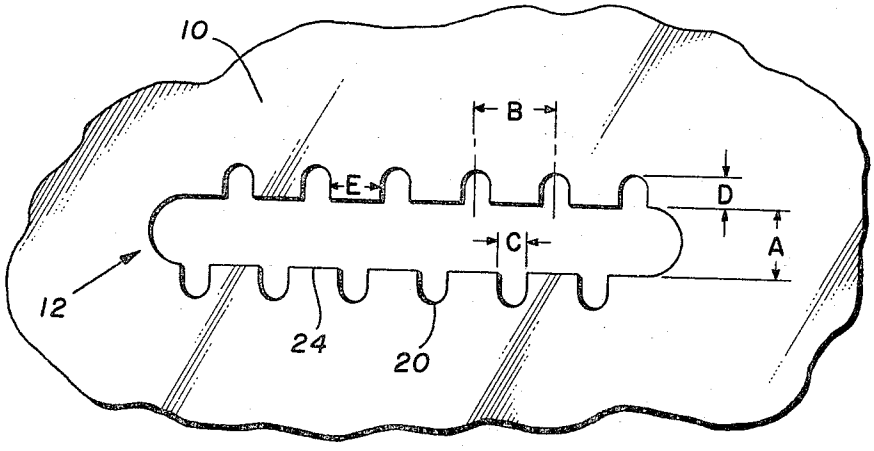


FIG. 2.

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SPINNERET FOR PRODUCTION OF SYNTHETIC GRASS YARN

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ABSTRACT OF THE DISCLOSURE

A spinneret having a slotted orifice characterized by profiled walls is provided for producing longitudinally extending protuberances on ribbons extruded from a polymer melt through the profiled orifice for the purpose of delustering said ribbons.

It is known to deluster certain synthetic yarns for the purpose of making these yarns more closely simulate the natural fibers. The delustering of synthetic yarns has been achieved both chemically and mechanically. Whether a surface reactant or an abrading action is employed to deluster a yarn, the results of either of these delustering processes may substantially affect the performance capabilities of said yarn. The undesirable effects become even more apparent when the yarn is to be subjected to adverse weather conditions and severe wear treatment. Therefore, yarns which have been delustered by special chemical reactions or abrading are not particularly suitable for products such as synthetic grass that may be installed outdoors and subjected to severe wear conditions as imparted by cleated or spiked shoes. There has not been a significant problem with excessive sparkle in the past because the synthetic yarns used previously to produce artificial grass have been composed of multifilament cross-sections which do not promote an undesirable amount of light reflectance. Such yarns however have been found to be inferior when used as a substitute for grass. The small denier yarns do not resemble grass and when they are fused to form a multifilament ribbon yarn having the structure of grass blades, an objectionable amount of splitting occurs if they are subjected to abusive conditions.

While attempting to provide a yarn which could be employed with other materials to construct a synthetic turf closely simulating natural turf, the discovery was made that a thin, monofilament ribbon extruded from a pigmented green composition resembles natural grass when fabricated into a backing as disclosed in copending appliaction Ser. No. 446,915 filed Apr. 9, 1965 of Robert T. Wright et al. and now abandoned. The flat, ribbon-like yarns as described in the above copending application have proved to be excellent for producing substitutes for natural turf. It has been found however that for some installations the large smooth surfaces of these ribbons promote an undesirable amount of sparkle or sheen. Attempts to deluster the ribbons by the use of conventional methods such as abrading and with chemicals degraded the fiber structure to the extent that the ribbons had reduced performance capabilities when they were employed as a substitute for natural grass. As described in said copending application Ser. No. 446,915, referred to earlier herein, a substantially rectangular cross-sectional monofilament ribbon is almost essential for the purpose of duplicating the resemblance and performance characteristics of natural grass.

Fabrics made from conventional flat ribbon yarn for use as synthetic grass exhibit a sheen or sparkle which is unrealistic in appearance and therefore obviously objectionable. The conventional methods of delustering synthetic fibers by the inclusion of delustering pigments are

not effective on ribbons large enough for producing a desirable grass-like fabric because the luster comes primarily from the smooth surface which is unaffected by the conventional delusterants. Synthetic ribbons that have any structural resemblance to grass must be at least 300 denier with the cross-section having a width at least 5 times greater than the average thickness in order to attain suitable bending properties. Attempts to overcome the luster transmitted from smooth surfaces on low denier textile yarns have been successful where lobes are imparted to the cross-sectional configuration of the fibers during spinning. Contrary to this success with low denier textile yarns however it has been found that when a large denier ribbon yarn possesses the lobed configuration known heretofore, a wavy appearance is created on the ribbon surfaces which may actually enhance luster.

The discovery has now been made which facilitates the production of a high denier ribbon having the degree of dullness desirable for making synthetic grass. Quite unexpectedly, it was discovered that a series of distinct protuberances extending in the direction of the major axis of a ribbon divided the broad surfaces of the ribbon into small planar areas to produce a lower degree of luster than the various configurations used previously. The protuberances can be shaped and dimensioned properly to retain the physical properties of a ribbon which has good performance when employed as a substitute for natural grass. There have been instances where polymer melts have been extruded through a series of round holes which form a sinusoidal path to produce ribbon yarns having lobed surfaces. Such yarns are quite susceptible to splitting because the structural formation thereof must depend upon melt cohesion of the several round extrusions to form a ribbon-like product. This cohesion is erratic and very difficult to attain in a water quenching process which is essential for ribbons having large deniers especially profiled ribbons having above 300. Thus, it is most important and highly desirable to be able to deluster a thin ribbon-like monofilament yarn without substantially changing the other physical properties thereof.

It is an object of the present invention to provide a spinneret for producing synthetic ribbon yarn which does not exhibit an undesirable and unrealistic luster and has satisfactory resistance to wear and abrasion.

Another object of the present invention is to provide a spinneret having a profiled orifice which imparts a plurality of distinct protuberances to a synthetic material when extruded through said orifice to form a ribbon that closely simulates natural grass.

Another object of the present invention is to provide a spinneret for producing a monofilament ribbon having a plurality of longitudinally extending protuberances on the broad surfaces thereof.

A further object of the present invention is to provide a spinneret for extruding delustered ribbon-like yarns having striated surfaces which closely resemble natural grass and have satisfactory resistance to wear abrasion.

Other objects and advantages of the invention will become apparent from the following description.

A preferred embodiment of the present invention contemplates a spinneret plate having several slotted orifices therein which are characterized by a predetermined number of opposed grooves staggered with respect to each other so that each groove is facing a flat surface on the opposed wall.

A better understanding of the invention will be apparent when considered with reference to the drawing wherein:

FIGURE 1 is a pictorial view of a spinneret plate, typical of the present invention, mounted in a conventional manner for the extrusion of ribbon yarn; and

FIGURE 2 is a fragment of the spinneret plate in FIGURE 1 illustrating in magnification, the serrated configuration of a single orifice of the type employed to shape the cross-section or profile of extrudable materials.

With reference to FIGURE 1, there is shown a spinneret plate **10** mounted in a conventional spinneret retaining head **12**. The spinneret **10** has several slotted orifices **14** therein which are generally spaced concentrically around the center of the plate. The orifices **14** are essentially rectangular with the long edges or walls **16** and **18** having a plurality of notches or grooves **20**. The walls **16** and **18** are at least 5 times the distance which separates the surfaces of said walls so that a filament-forming material can be extruded through the orifices to form a ribbon-like yarn **22**. The cross-sectional area of each orifice is dimensioned to produce monofilament ribbon yarn having between 300 and 1500 denier.

When high denier yarns are shaped by the extrusion of a material through slotted orifices having the above dimensional ratio, the broad flat surfaces of said ribbon produces an undesirable amount of sparkle or sheen. As stated earlier, this sparkle or sheen is substantially rereduced as the broad flat surfaces are reduced in area by a number of distinct protuberances whereby a novel delustered yarn of the type disclosed in our copending application Ser. No. 521,159, filed Jan. 17, 1966, is produced. A preferred method for obtaining the desired profile on the ribbons disclosed in our copending application comprises the extrusion of a suitable material through a spinneret orifice having restrictive limitations and rapidly quenching the emerging extrusion, preferably in a liquid bath. Thereafter, the ribbons may be further oriented and treated with selective finishes.

In FIGURE 2, a vertical section of the spinneret plate **10** is shown to illustrate the profile of an orifice **14** of the type described herein as the invention. The grooves **20** are staggered with respect to the grooves on the opposed wall to protect against splitting of an extruded ribbon at the thin section which would otherwise occur because of preferential quenching and stress loading when placed into use. The portions **24** of orifice walls occurring between the grooves should be flat surfaces to insure that a flat surface is imparted to that part of ribbon shaped by said surface.

The dimensional ratios found to be preferred for orifices used in shaping ribbons having a duller appearance which simulates grass and possesses satisfactory resistance to wear and abrasion that is suitable as a substitute for natural grass are as follows:

$$C/A = 0.25\text{–}0.90$$
$$B/A = 0.80\text{–}4.00$$
$$D/C = 1.0\text{–}4.00$$

Wherein

A=distance between opposed walls (width of orifice)
B=groove distance apart
C=groove width
D=groove depth

These ratios, when used in designing spinneret orifices for producing synthetic turf of the type described in said copending application Ser. No. 446,915, filed Apr. 9, 1965, are considered to be critical. For example, if the ratio of B/A exceeds **4** there are not enough protuberances to reduce the luster to an acceptable level, and should the ratio fall below 0.8 the ribbon will have a wavy surface which may actually enhance its light reflective properties. Also, as the ratio of C/A is increased, the ratio of B/A should be increased to prevent a wavy surface. It will be recognized that the increase or decrease of either of the above dimensions or ratios within the critical ranges given will inherently produce different results and thus may necessitate the changing of one or more of the other values within the given ranges.

The spinneret of this invention is applicable to all materials that can be melt spun. Specific polymeric materials which can be melt spun include: nylon-66, nylon-6, nylon-4, nylon-610, nylon-11, and their filament-forming copolymers thereof; polyesters derived from terephthalic acid and ethylene glycol and from terephthalic acid and bis-1,4-(hydroxymethyl)-cyclohexane; polyethylene; polypropylene; and other substances.

It will be apparent that many modifications and specific ratios and proportions can be made from the illustrations given herein; therefore, the invention is not intended to be limited except as indicated in the appended claims.

What is claimed is:

1. A spinneret for producing delustered monofilament ribbons having novel cross-sections, comprising spinneret retaining means and a spinneret mounted in said retaining means, said spinneret having at least one essentially rectangular slotted orifice, said orifice having opposed profiled walls in close proximity to each other, said walls having a plurality of selectively spaced grooves, said grooves, being staggered on opposite walls whereby each groove faces a flat surface on the other wall, said orifice having dimensions determined by the ratios of B/A ranging from 0.8 to 4.0 and D/C ranging from 1.0 to 4.0 when the ratio of C/A is between 0.25 and 0.90.

2. The spinneret of claim **1** in which the orifice is dimensioned to shape a ribbon-like yarn having at least 300 denier from an extrudable synthetic polymer.

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