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STOCKING AND METHOD FOR PRODUCING SAME

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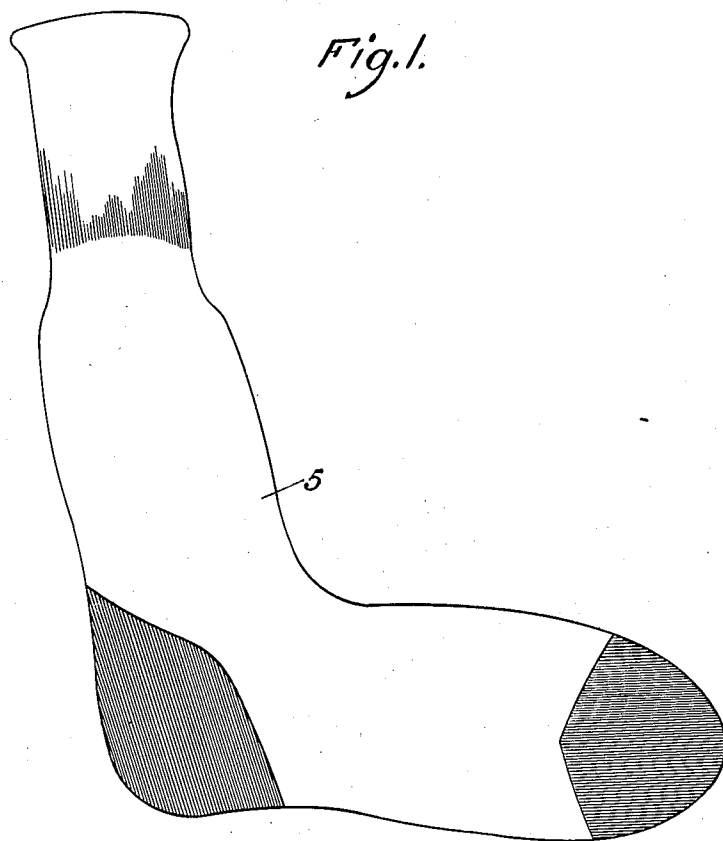
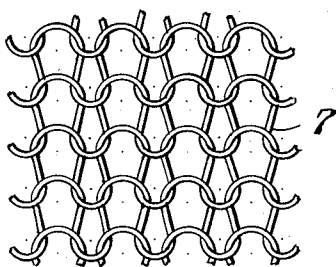


Fig. 2.



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STOCKING AND METHOD FOR PRODUCING
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14 Claims. (Cl. 66—202)

This invention relates to knitted fabrics, and more specifically to new and improved hosiery.

This application is a continuation-in-part of applications Serial No. 74,811, filed April 16, 1936, and Serial Number 91,617, filed July 20, 1936, which are in turn continuations-in-part of Patent No. 2,071,250, filed July 3, 1931.

This invention has as an object the preparation from synthetic materials of knitted hosiery equal to silk hosiery in appearance and superior in elasticity and wearing qualities. Other objects will appear hereinafter.

These objects are accomplished by preparing the knitted hosiery from synthetic linear condensation polyamides.

In general, knitting gives a more elastic fabric than weaving, and for this and other reasons is used in the preparation of hosiery which must give a snug fit and which must at the same time be capable of considerable stretching without being permanently deformed. In order to obtain a knitted fabric having satisfactory wearing qualities, i. e., strength and elasticity, however, it is necessary that the fibers or yarns employed have good "bending elasticity" as more fully defined below. This is particularly true in the case of stockings. To prepare an elastic hose, threads or yarns must be used which can be set in a wavy shape by some process like boarding, and when so set the bent threads must tend to retain their shape with sufficient force to overcome the friction between the threads at all humidities encountered in wear.

At the present time, the hosiery field is dominated by silk, since silk is the only fibrous material known which has the necessary elastic properties. Approximately 80% of the silk used in this country goes into this outlet alone. Numerous attempts have been made to supplant silk in hosiery with artificial fibers, namely, those of the cellulosic type, such as viscose rayon, but without success. Stockings prepared with these artificial yarns, owing to the poor bending elasticity of the fibers, have a greater tendency to wrinkle at the knee and ankle than silk stockings, a greater tendency to enlarge in diameter and shorten in length, and a tendency to slip over the skin in adjusting to movements of the leg instead of following the skin as does a silk stocking. In other words, they do not "cling" properly and soon become "baggy" at the knees. As a result, stockings prepared from these artificial fibers are inferior to silk stockings and cannot command so good a price,

It has now been found that knitted wear, and particularly stockings, fully equal to those obtained from silk can be prepared from synthetic linear condensation polyamide yarns; in fact, most yarns derived from such polyamides have been found to yield knitted fabrics which are superior to silk. The synthetic polyamide stockings cling properly and do not become baggy.

Reference is made to the accompanying illustration in which:

Fig. 1 is a stocking of the type in which synthetic linear condensation polyamides of the present invention may be utilized.

Fig. 2 is an enlarged section of a stocking showing the knitted structure thereof.

In the accompanying drawing reference numeral 5 designates the stocking.

Reference numeral 7 designates the yarn from which the stocking has been knitted, which yarns are composed of synthetic polyamide fibers prepared as described in the following description.

Before describing the preparation of the knitted fabrics of this invention, it should be stated that fiber-forming synthetic linear condensation polyamides are of two general types, those derived from polymerizable monoaminomonocarboxylic acids or their amide-forming derivatives and those derived from suitable diamines and dicarboxylic acid or amide-forming derivatives (i. e., ester, anhydride, amide, or acid halide) of dibasic carboxylic acids. These polyamides, it will be noted, are derived from bifunctional polyamide-forming reactants.

While the properties of the synthetic polyamide fibers will of course vary somewhat with the nature of the reactants used in their preparation, common characteristics of the fibers are high tenacity, high degree of fiber orientation, lack of sensitivity to conditions of humidity, extraordinary resistance to solvents and chemical reagents, exceptionally good elastic recovery, good dyeing properties, and good aging characteristics in air even at elevated temperatures. Although the fibers are resistant to most chemical reagents, they yield on hydrolysis with strong mineral acids the monomeric reactants from which they were derived. A valuable property of the synthetic polyamides is that they can be spun from melt, that is, by extruding a molten polymer through suitable orifices and cold drawing the filaments thus prepared. This cold drawing (stretching in the solid state) causes fundamental physical changes to take place in the filament which then shows under X-ray examination orientation along the fiber axis and exhibits the

physical properties most desired in fibers, as for instance great strength and pliability. Fibers prepared in this way resemble silk in certain respects; they are continuous, straight, and smooth, although fibers having crenulated surfaces can be prepared under suitable spinning conditions, e. g., by wet and dry spinning methods. While the fibers are, in general, lustrous, they can be delustered.

Two types of elasticity will be referred to herein, namely, "tensile elasticity" and "bending elasticity". Tensile elasticity of a fiber refers to its ability to recover when elongated and then released. It is expressed on some arbitrary basis such as the per cent recovery within a given time after having been elongated a given extent for a given time. On the other hand, bending elasticity is a term which I employ to describe the ability of a fiber to retain its shape under tension after it has been set in a wavy shape by some process like boarding. A fiber having good bending elasticity will tend to retain its shape with sufficient force to overcome the friction (tension) between threads when knitted into a fabric. The crimp or wavy shape recovery of a set fiber or thread is therefore a measure of the bending elasticity.

It might be expected a priori that a fiber having good tensile elasticity would give a good knitted fabric. This is not the case, however. There is little correlation between tensile elasticity and the elastic behavior of the knitted fabric. Thus, the tensile elasticity at "zero" or low loads of silk threads changes almost negligibly with relative humidity, whereas there is a very great difference between the elastic behavior of knitted silk fabrics when dry and when wet.

Recovery in the fabric appears to be opposed by the friction between threads, and so it might be expected that the recovery against a load in tension (tensile elasticity under stress) would be related to knitted fabric elasticity. This is not the case, however, for in comparing viscose and cellulose acetate rayons, it is observed that whereas there is little difference between the two in the manner in which the force of tensile recovery falls off with increase in relative humidity, there is a large difference in the manner in which knitted fabric elasticity changes with relative humidity. In other words, there is considerable difference in the bending elasticity of these two rayons as defined above.

In order to yield a knitted fabric of good elasticity, therefore, the fibers or threads employed must have good bending elasticity. Fibers of synthetic linear condensation polyamides are known to have good tensile elasticity and I have now found that they also have excellent bending elasticity, i. e., the type of elasticity required to make an elastic fabric. Good bending elasticity is not only necessary for good knitted fabric qualities but is also essential to the preparation of knitted fabrics of uniform texture, since poor bending elasticity seriously handicaps the loop formation in the knitting machine. In spite of the high elastic recovery of synthetic polyamide fibers, they quickly assume under the knitting needles the crimp or permanent distortion necessary in a knitted fabric.

As illustrated above, good tensile elasticity and good bending elasticity do not necessarily go hand in hand. By way of further illustration, viscose rayon has better tensile elasticity under many conditions of test than cellulose acetate

rayon but poorer bending elasticity. Thus, for 6% stretch held 3 minutes at 72% relative humidity the tensile elasticity recovery in 1 minute of viscose rayon is 30% and that of cellulose acetate rayon 25%, while at the same relative humidity the knitted fabric recovery of cellulose acetate is superior to that of viscose rayon at all degrees of stretch; for example, at 50% strength held 3 minutes the knitted fabric recovery (a measure of bending elasticity) in 1 minute of cellulose acetate rayon is 50% and that of viscose rayon only 30%. This is also illustrated by silk. The tensile elasticity of silk is not markedly affected by moisture, whereas its bending elasticity is decreased considerably by moisture. Thus, for 6% stretch held 3 minutes the tensile elasticity recovery in 1 minute of silk at 28% relative humidity is 57% and at 72% relative humidity it is 50%, whereas the knitted fabric recoveries of silk from 50% stretch at these humidities are 95% and 65%, respectively. It could not be predicted therefore from the good tensile elasticity of synthetic polyamide fibers that they would yield knitted fabrics of good elasticity.

Good bending elasticity is an especially essential property of yarns to be used in the knitting of stockings, since stockings are subjected to stretching conditions, particularly at the knee. Actual measurements show that typical distortions of the fabric in the region of the knee amount to about 50% extension laterally and approximately 10% contraction longitudinally on the unbent leg, while on the bent leg, the lateral distortion is an extension of about 20% and the distortion in the longitudinal direction is an extension of about 10%. As already indicated, stockings made of viscose rayon and similar artificial fibers do not stand up satisfactorily under these severe distortions. Silk stockings stand up quite satisfactorily except under conditions of high humidity. The polyamide stockings, which are the subject of this invention, stand up very well under all conditions of humidity.

The knitted fabrics of the present invention can be prepared directly from synthetic linear condensation polyamide yarns using various types of knitting machines and various types of stitches. The denier of the yarn and the number and fineness (denier) of the fibers which make up the yarn will of course determine the weight and appearance of the resultant fabric. The appearance of the fabric is also determined in part by the type of stitch employed and by the amount of tension employed during knitting. Since the synthetic polyamides are very elastic and strong, it is possible to obtain very closely knitted fabrics from them. Artificial polyamide fibers of widely different deniers can be prepared and it is therefore possible to vary the character of the yarn and fabric considerably. In the case of silk it is possible to vary the denier of the yarn or thread employed but it is not possible to vary the denier of the initial fibers, since these must be accepted in the form in which they come from the silk worm.

The fibers used in the preparation of the polyamide yarns are prepared by spinning the synthetic polyamide from melt or from solution by the wet or dry methods. Fibers of widely different sizes can be prepared and used. Fibers having deniers ranging from 0.5 to 10 deniers are particularly useful, but fibers having deniers outside of this range may also be used. The fibers are then doubled, twisted, or plied into yarn. If

desired, the twist can be set or made more permanent by steam treatment. While the yarns prepared in this way can be knitted directly, it is sometimes advantageous to lubricate them by addition of a suitable oily substance, such as a sulfonated oil, sulfated alcohol, soap in a paraffin oil, or with similar soap-like materials. Hygroscopic materials, such as glycol, diethylene glycol, glycerin, etc., may also be used. It has been found that water is a very effective lubricant; at least, wet yarns knit more readily than dry yarns.

For the preparation of high grade hosiery, it is desirable to use synthetic polyamide yarns prepared from fibers of fine denier. A yarn of approximately 50 denier containing 40 filaments or fibers is very useful in the preparation of sheer or chiffon grades of hosiery. However, yarns having a larger denier, prepared if desired with larger filaments, can also be used, e. g., in the preparation of hosiery of the "semi-service" or "service" weights. It is also within the scope of this invention to use filaments and yarns of smaller denier, e. g., 20-filament, 25-denier yarns and 25-filament, 25-denier yarns.

The polyamide yarns can be knit on circular or flat knitting machines. If a stocking is prepared on a circular knitting machine, a seamless product is obtained in which the number of stitches is usually the same throughout the length of the hose. The most desirable stockings, however, are prepared by using flat knitted fabrics. This gives what is known as full-fashioned hosiery. The edges of the flat knitted fabric are joined together with a perfect selvage by connecting the edge loops with a seaming thread or closing the seam by fusing the fibers together by means of heat. The great advantage of the full-fashioned article is that exact interpretation can be given to the size of the leg and that the fabric texture is identical throughout the garment, since the number of stitches is proportional to the diameter of the hose, i. e., the stocking would have more stitches in the region of the calf than in the region of the ankle. In other words, full-fashioned hosiery is constructed to fit the figure of the leg.

Before marketing knitted wear such as stockings, it is customary to scour the fabric in hot soap solution, rinse the fabric, and board it. This is done to give the fabric a neatly pressed appearance. In the case of silk, 40 minutes scouring in 0.5% soap solution of 70° C. followed by rinsing and boarding for five minutes in a blast of air at 70° C. is ordinarily employed. The synthetic polyamide products do not board satisfactorily under these conditions but in spite of the water insensitivity of the products, it has been found that they can be boarded satisfactorily by carrying out the operation at a higher temperature, preferably with the use of steam, e. g., superheated steam at 100-150° C.

The following examples illustrate this invention in greater detail:

EXAMPLE I

The synthetic polyamide used was polypentamethylene sebacamide of intrinsic viscosity 0.67 prepared by heating pentamethylene diammonium sebacate (the diamine-dibasic acid salt) in 50% xyleneol solution at 218° C. for three hours. The polyamide thus formed was spun into filaments from melt at approximately 235° C. under a pressure of 140 lb./sq. in. applied with oxygen-free-nitrogen. The filaments were cold drawn in

two stages for a total of approximately 250%, i. e., the final length was 3.5 times that of the original length. The resultant continuous fibers had a denier of 4.7, a denier at break of 2.54, and a tenacity at break of 7.1 grams per denier. The fibers were plied into a 123-denier, 24-filament yarn having four twists per inch. This yarn was then knit into a stocking tubing using a single end Wildman knitting machine. The stocking was found to have excellent elastic properties and wearing qualities. As shown in the following table it had far better elastic recovery than a stocking tubing similarly knit from a 95-denier, 7-thread, 10-turn silk. The superiority of the synthetic polyamide fabric was particularly pronounced under conditions of high stretch (100%), high humidity (85%) or wet, and when stretched for long periods of time (15 hours).

Elastic recovery of knitted fabric

Percent stretched	Time held	Relaxed	Silk recovery		Polyamide recovery	
			85% R. H.	Wet	85% R. H.	Wet
		Minutes				
25	3 min.	1	65	43	77	79
35	3 min.	1	58	38	71	79
45	3 min.	1	48	34	76	79
75	3 min.	1	24	32	73	80
100	3 min.	1	23	32	71	80
25	15 hrs.	5	23	32	71	80
50	15 hrs.	5	23	32	53	80

At the end of the above test, the silk fabric was drastically and permanently distorted while the polyamide fabric returned to essentially its former shape. Threads removed from the polyamide fabric also retained their wavy form much better than did the silk threads. In order to give silk an opportunity to make the best showing in making the comparison under the 15 hour stretch, the fabrics were stretched to the same thread count rather than to the same percentage. Even on this basis the polyamide fabric recovered fully twice as well as the silk.

EXAMPLE II

Polyhexamethylene adipamide of intrinsic viscosity 0.7 prepared from hexamethylene diammonium adipate and viscosity stabilized with adipic acid and ammonia was the polyamide used in this example. The polyamide was spun into filaments from melt at approximately 285° C. under a pressure of 50 lb./sq. in. applied with oxygen-free-nitrogen. The filaments thus obtained were cold drawn 61%. The cold drawn fibers had a denier at break of 5.6 grams. The fibers were plied into a 70-filament yarn which was further cold drawn making the total cold drawing approximately 300%. The yarn had four twists per inch, a denier of 113, and a tensile strength of 3.4 grams based on the original denier, and a residual elongation of 26%. Its wet strength was 93% of its dry strength. Following the method described in Example I, a circular knitted stocking was prepared from this yarn using a Wildman knitting machine. After washing and rinsing, the stocking was boarded, using water at 93° C. The stocking presented a smooth, ironed appearance. At low or very short stretches, the polyamide fabric was comparable in elasticity with similarly knit silk fabric but at very high or very long stretches it was superior to the silk stocking.

EXAMPLE III

Following the method described in the preceding examples, a stocking tubing was knit from a 115-denier, 40-filament, 3.7-twist-per-inch yarn prepared from polyhexamethylene adipamide having an intrinsic viscosity of 0.85. The filaments from which the yarn was prepared had been cold drawn until they had a residual elongation of 22%. The tensile strength of the filaments was 4.15 grams per denier calculated on the denier at break. This fabric was then tested in comparison with similarly knit fabrics prepared from a 95-denier, 7-thread, 10-turn silk and from a 100-denier, 40-filament, 4-twist viscose rayon yarn. The tests were made at varying degrees of stretch at high relative humidity, at high stretches for long periods of time, and under conditions which caused the fabric to dry out during the stretching. In all three types of tests, the polyamide fabric showed far better elastic recovery than either the silk or viscose rayon fabrics. This is illustrated by the following typical data. For a 50% stretch for three minutes at 85% relative humidity at 32° C., the polyamide fabric recovered 62% in one minute compared with 39% for silk and 26% for viscose rayon. Moreover, the elastic recovery of the polyamide fabric was found to vary little with the degree of stretching, whereas that of silk and viscose rayon fell off quite rapidly with an increasing degree of stretch. For stretches of 50% for eight hours, the recovery of the polyamide fabric was about 46% compared with 18% for silk and 1% for viscose rayon. When the three types of fabrics were conditioned at 98% relative humidity and then stretched 50% for ten minutes in an atmosphere maintained at 50% relative humidity so that drying occurred, the recoveries after 1.5 minutes were 48% for the polyamide, 34% for silk, and 10% for viscose rayon. Furthermore, the polyamide fabric continued to recover, the value after five minutes being 57%.

A full-fashioned stocking may be prepared by knitting a fabric of suitable shape on a flat knitting machine using a 50-denier, 40-filament, 4-twist polyhexamethylene adipamide yarn. The fabric is then formed into a stocking by joining the edge loops together by means of a seaming thread. The stocking is then boarded by heating it on a suitable form for a few minutes with saturated steam at 110° C.

In the preparation of knitted stockings by the process of this invention, polyamide yarns may be used which are lustrous, semi-lustrous, or dull. Delustered yarns are generally preferred in the preparation of stockings, since this tends to "slen-derize" the ankles. If dyed fabrics are desired, the dye may be applied to the finished fabrics or to the yarn used in knitting. It may also be incorporated in the polyamide from which the yarn is prepared. It is also within the scope of my invention to use other types of fibers and yarns, e. g., silk, viscose rayon, cellulose acetate rayon, etc. in combination with the synthetic polyamide fibers and yarns.

In the preparation of polyamide knitted wear it is generally desirable to use fibers which have been substantially completely cold drawn and to prepare the fabric in essentially the size and shape it is to assume in use. Such fibers usually have a residual elongation of 15 to 40% and have good elasticity. They require a greater force to elongate them than undrawn or partially cold drawn fibers. It is within the scope of this in-

vention, however, to knit fabrics from undrawn or partially drawn fibers. These fibers have a very high residual elongation, often as much as several hundred per cent. When such fibers are subjected to stress, they are capable of undergoing considerable elongation without breaking. This is sometimes desirable, e. g., in the preparation of a stocking, since it gives a product which is not easily broken. For example, when the stocking becomes caught on a protruding object, the wearer becomes aware of the fact and can release the stocking before it breaks. Moreover, by preparing stockings from partially drawn fibers, it is possible to prepare small stockings and subsequently stretch them to the extent required. The tension encountered in knitting of this novel type of stocking is generally insufficient to bring about this stretching.

The preparation of stockings of high quality is not limited to the use of the two specific polyamides cited in the examples. Other synthetic polyamide fibers can be knit into very desirable fabrics in a similar fashion. A very valuable class of polyamide fibers for the preparation of knitted wear are those derived from diamines of formula $\text{NH}_2\text{CH}_2\text{RCH}_2\text{NH}_2$ and dicarboxylic acids of formula $\text{HOOCCH}_2\text{R}'\text{CH}_2\text{COOH}$ or their amide-forming derivatives in which R and R' are divalent hydrocarbon radicals free from olefinic and acetylenic unsaturation and in which R has a chain length of at least two carbon atoms. An especially valuable group of polyamides within this class are those in which R is $(\text{CH}_2)_x$ and R' is $(\text{CH}_2)_y$ wherein x is at least two. As examples of polyamides which fall within one or both of these groups might be mentioned in addition to those already cited, polytetramethylene adipamide, polytetramethylene suberamide, polytetramethylene sebacamide, polypentamethylene adipamide, polypentamethylene suberamide, polyhexamethylene sebacamide, polyoctamethylene adipamide, polydecamethylene adipamide, polydecamethylene p-phenylene diacetamide, and poly-p-xylylene sebacamide. This invention is not limited, however, to the use of polyamides of the diamine-dibasic acid type, those prepared from polymerizable monoamino-monocarboxylic acids or their amide-forming derivatives also yield very useful fibers for the preparation of stockings. As examples of this type of polyamide might be mentioned the polymers derived from 6-aminocaproic acid, 9-aminononanoic acid, and 11-aminoundecanoic acid. It is within the scope of this invention to use fibers derived from mixtures of preformed polyamides as well as from interpolymers derived from a mixture of polyamide-forming reactants, e. g., a mixture of two diamines with one or two dicarboxylic acids. It is also possible to use polyamide fibers which contain modifying agents, such as plasticizers, e. g., o-hydroxydiphenyl or p-toluene sulfonethyl amide, resins, oils, pigments, dyes, and the like.

The elastic recovery of the stocking described herein, as shown by the table previously given, as well as other properties most desired in an article of the present kind, is markedly superior to that of natural silk stockings. Thus in the knitted stocking of this invention the elastic properties are such that when the stocking is stretched 50% for three minutes at 85% relative humidity at 30° C. the recovery in one minute is greater than 50% and usually greater than 60%. In the best similarly knitted natural silk stockings under the same considerations the

recovery is seldom as much as 40%. As previously indicated, yarns having good tensile elasticity do not necessarily yield knitted stockings having the unusual bending elasticity mentioned above for the knitted stockings described herein.

An important feature in the manufacture of my new stocking resides in the fact that it can be knitted without pretreatment of the yarn. Also the fact that water treatment acts to make the yarn knit still more readily is quite unusual. Furthermore, it is very surprising that although the polyamide yarns have high elasticity, they instantly undergo deformation under the action of the knitting needles. It is also noteworthy that although the stocking is knit from water-insensitive material it can nevertheless be boarded.

In view of the surprisingly good elasticity and wearing qualities of the synthetic linear condensation polyamide knitted fabrics, the products of this invention represent a phenomenal advance in the textile art. In many respects, these fabrics are as much superior to silk fabrics as the latter are superior to fabrics made from cellulosic materials. These fabrics are fully equal to silk in strength and are markedly superior in elastic behavior particularly under high degrees of stretch and at high humidities. Unlike silk stockings, the synthetic polyamide stockings do not require a "boll off" treatment. Owing to the fact that the polyamide fibers can be prepared in almost any size and with varying degrees of residual elongation, it is possible to obtain a wider variety of effects than is possible with silk. Thus, by using polyamide fibers which have been only partially cold drawn (high residual elongation) it is possible to prepare fabrics which do not break or tear when subjected to severe stretching. This is a particularly valuable property in stockings. Other advantages of polyamide stockings over silk stockings are that they are less sensitive to deterioration at elevated temperatures and less easily spotted by water.

Furthermore, the stockings of this invention are essentially creaseproof under ordinary conditions but retain creases introduced with steam. In other words, they hold their boarded form. This invention, therefore, represents the first truly successful stocking from a synthetic yarn.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. A stocking knitted from synthetic polyamide fibers.

2. A stocking knitted from synthetic linear condensation polyamide fibers, said stocking having elastic properties such that when stretched 50% for three minutes at 85% relative humidity at 30° C., the recovery in one minute is greater than 50%.

3. A stocking fabric knitted from artificial fibers obtained from a polymerized amino acid, said stocking fabric having elastic properties such that when stretched 50% for three minutes at 85% relative humidity at 30° C., the recovery in one minute is greater than 50%.

4. A stocking fabric knitted from polyamide fibers obtained from the reaction product of a diamine and a dibasic acid, said stocking fabric having elastic properties such that when stretched 50% for three minutes at 85% relative humidity at 30° C., the recovery in one minute is greater than 50%.

5. The stocking set forth in claim 2 in which said polyamide is the reaction product of a diamine and a dibasic acid.

6. A full-fashioned stocking knitted from synthetic polyamide fibers.

7. A knitted stocking fabric which yields on hydrolysis with strong mineral acids a mixture comprising a diamine of formula $\text{NH}_2\text{CH}_2\text{RCH}_2\text{NH}_2$ and a dicarboxylic acid of formula



in which R and R' are divalent hydrocarbon radicals and R has a chain length of at least two carbon atoms.

8. A process for preparing a stocking which comprises knitting a wet yarn comprising synthetic linear condensation polyamide fibers.

9. A stocking knitted from partially drawn synthetic polyamide fibers.

10. A boarded stocking knitted from substantially water-insensitive synthetic polyamide fibers.

11. A process for making stockings which comprises partially drawing a yarn composed of synthetic condensation polyamide fibers, and knitting said stocking from said partially drawn fibers.

12. A process for making stockings which comprises knitting yarn composed of synthetic condensation polyamide fibers, and boarding the knitted stocking with saturated steam.

13. A process for making stockings which comprises knitting unsized yarn composed of synthetic condensation polyamide fibers.

14. A boarded stocking circular knitted from synthetic polyamide fibers.

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CERTIFICATE OF CORRECTION.

Patent No. 2,157,116.

May 9, 1939.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 24, for "fiber-moving" read fiber-forming; line 29, for the word "acid" read acids; page 2, second column, line 28, before the word "stretching" insert severe; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of June, A. D. 1939.

Henry Van Arsdale

(Seal)

Acting Commissioner of Patents.