

United States Patent

Eichler et al.

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[54] PROCESS FOR THE PRODUCTION OF FOIL RIBBON FABRICS AND APPARATUS FOR CARRYING OUT THIS PROCESS

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[63] Continuation-in-part of Ser. No. 672,803, Oct. 4, 1967, abandoned.

[30] Foreign Application Priority Data

Oct. 25, 1966 Austria9941/66

[52] U.S. Cl.139/11, 139/420, 28/72, 264/103, 264/147

[51] Int. Cl.D03d 41/00, D03d 15/00

[58] Field of Search.....139/11.1, 420, 122; 28/1 CS, 28/72 CS; 57/140; 264/147, 103

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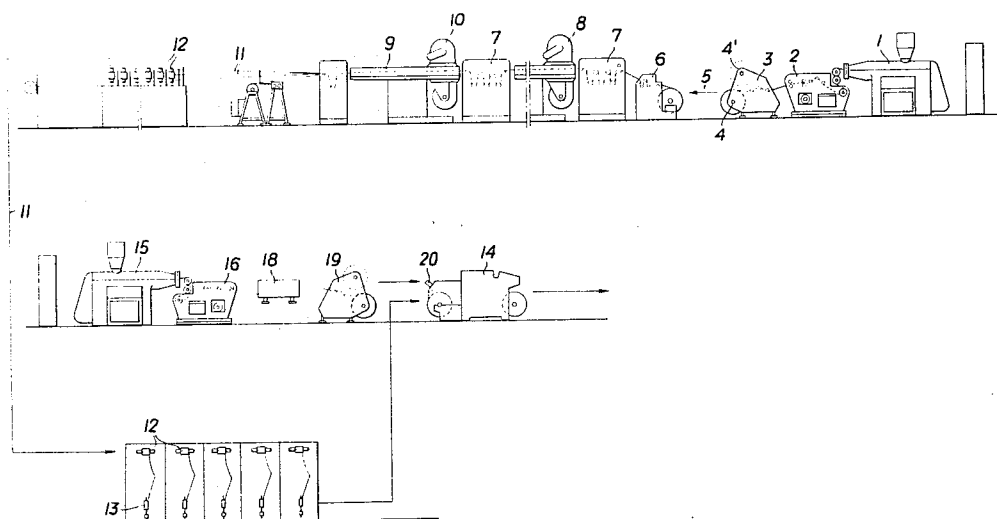
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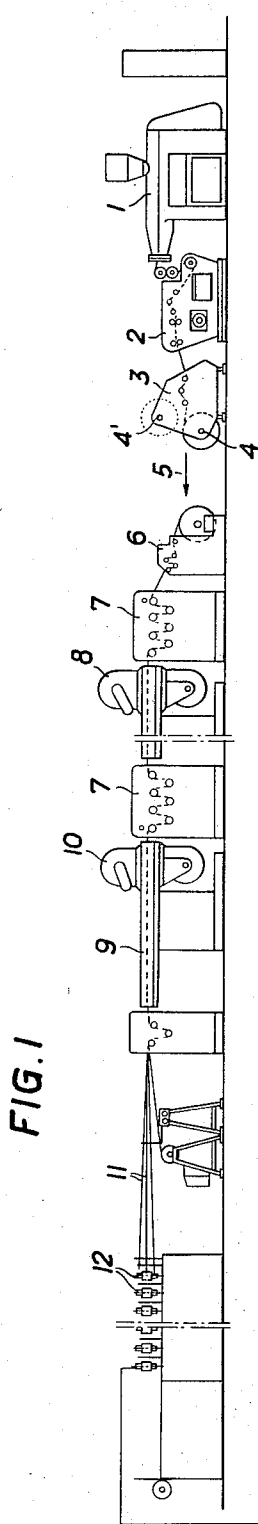
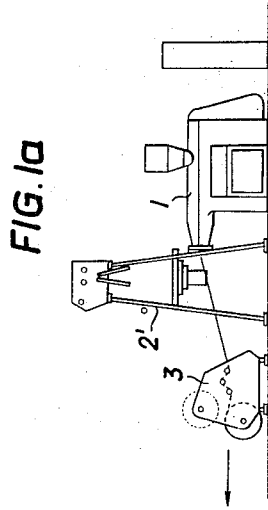
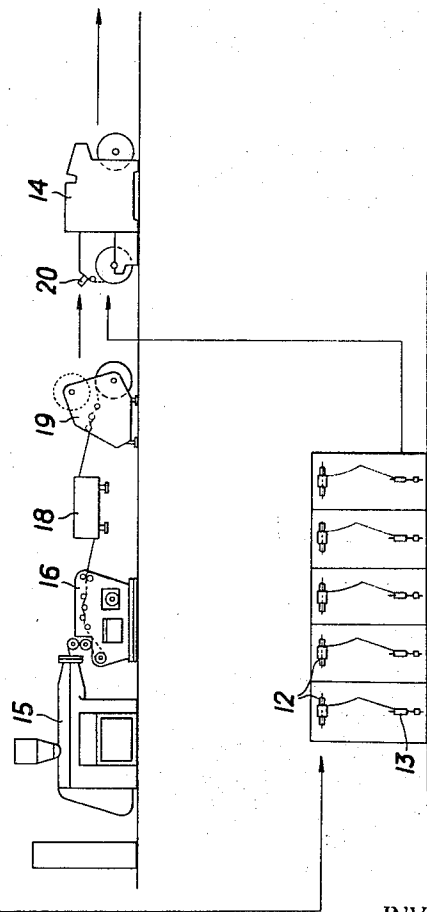
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[57] ABSTRACT

The invention comprises a process and an apparatus for the production of foil ribbon fabrics, wherein the warp ribbons and the weft ribbons are interwoven on a weaving device, at least the warp ribbons being cut from monoaxially stretched foil stock. The stretching device and the cutting device immediately precede the weaving device so that the plurality of warp ribbons cut from the monoaxially stretched foil can be directly and immediately fed to the weaving device. During stretching of the foil certain conditions are maintained, such as a small stretching gap, preferably electrostatic adherence of the foil to the stretching rolls, and specific temperature control.

15 Claims, 6 Drawing Figures





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FIG. 2

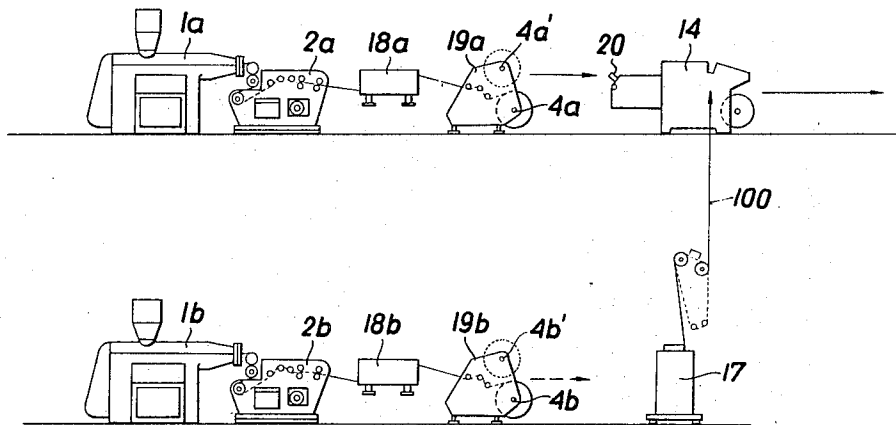
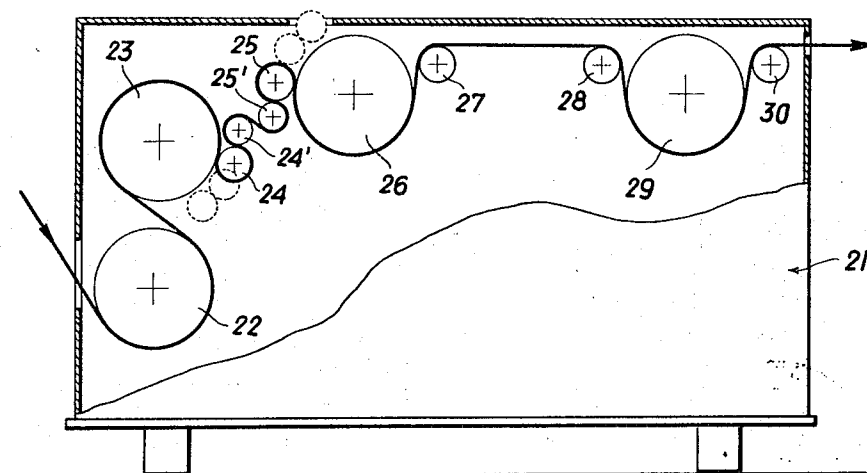


FIG. 3



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FIG. 4

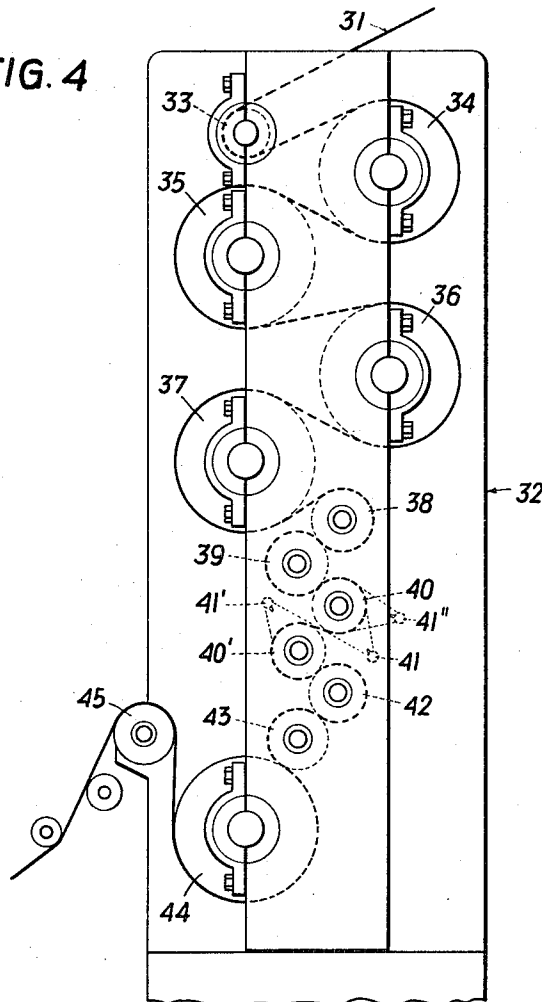
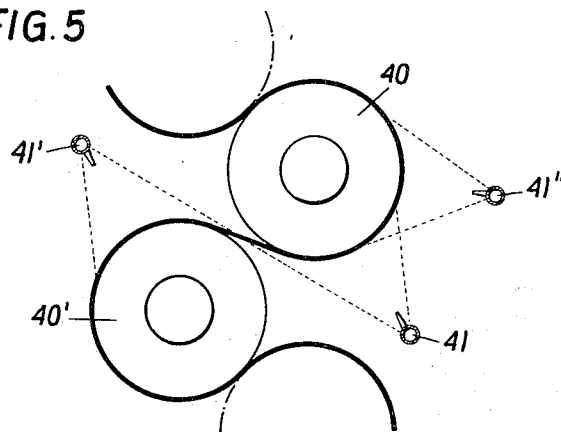


FIG. 5



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PROCESS FOR THE PRODUCTION OF FOIL RIBBON FABRICS AND APPARATUS FOR CARRYING OUT THIS PROCESS

This application is a continuation-in-part of our copending application Ser. No. 672,803, filed Oct. 4, 1967, now abandoned.

This invention relates to a process and an apparatus for producing foil ribbon fabrics on a weaving device wherein the ribbons constituting the warps and those constituting the wefts are cut from foil stock and continuously fed to the weaving device, where the weft ribbons are interwoven with the warp ribbons. Particularly suitable as foil materials are polymer plastics which are capable of being stretched and fixed under heat, in particular polyethylene, polypropylene, polyesters, polyvinylchloride, etc.

Foil ribbon fabrics have so far been manufactured in such a way that continuous sheet foil or tubular foil stock is produced by an extruder having a slit or ring nozzle, said foil or foils are then cut to ribbons, stretched, fixed, and finally wound up on bobbins. Those bobbin-wound ribbons destined to constitute the warps are fed to the loom by means of a grate and possibly a warp beam. The weft ribbons are likewise collected on bobbins, the bobbins rewound onto shuttle spools and then fed to the loom. Complicated looms also provide the possibility of working without shuttles, the wefts being directly drawn off bobbins stuck onto the loom.

Obviously, the winding-up process is time consuming and, in addition, a large amount of space is required, since the grates preceding the loom or a warp beam forming means must be adapted to accommodate hundreds of bobbins.

It has also been proposed to produce flat yarn structures, such as woven or meshed fabrics, using synthetic yarns made from nonstructural cellulose material, in particular from waste cinematographic films, said films being cut to ribbons and the ribbons being fed as warps directly from the cutting station to the weaving or meshing station. This process avoids the intermediate winding up of the warps and warping on a warp beam, however, since the material to be cut is nonstructural, a complicated cutting device, such as a procupine-type cutting machine, must be used in order to ensure parallel cuts. This involves additional expenditure.

The invention aims at avoiding these disadvantages and difficulties and has as its object to provide a process and an apparatus for producing foil ribbon fabrics of high strength and homogeneous quality, while avoiding the previous high capital and work expenditure connected with the intermediate winding up of the warp and weft ribbons or yarns and the necessity of keeping a large stock of bobbins.

A specific object of the invention is to enable the production of foil ribbon fabrics in an uninterrupted and continuous sequence of process steps and on a compact machine, respectively.

Another object is to enable a monoaxial stretching of foil stock while avoiding reduction in the width of the foil and thickening of the foil edges. Still another object is to enable cutting of foil stock with simple means. Further objects will appear hereinafter.

The process of the invention comprises the steps of passing at least the foil stock from which the warp ribbons are to be cut through a stretching gap formed between two stretching rolls mounted in closely spaced-apart relation to each other, of monoaxially stretching the foil in said stretching gap at a ratio of 1:4 to 1:8 without thereby altering the width of the foil, of cutting the foil so stretched by means of knives over which the foil is drawn to form a plurality of parallel warp ribbons, and of immediately feeding the warp ribbons so formed to said weaving device.

Preferably, both the warp and weft ribbons are cut from monoaxially stretched foils.

No complicated cutting devices and no guide means are required for cutting a monoaxially stretched foil. The work can, for instance, be carried out with a stationary row of knives. The stretched foil splits up where it is touched by the knife and this splitup continues so that parallel cutting makes no difficulties whatever.

According to the invention the speed of cutting the foil to form the warp ribbons, i.e., the speed at which the foil is supplied to the knives, is equal to the speed of feeding the warp ribbons to the weaving device, i.e., the speed at which the ribbons are drawn off from the knives and supplied to the weaving device. In the absence of this correspondence between the speed of cutting and the speed of feeding the ribbons to the weaving device the ribbons would either break, if cutting was too slow, or pile up in a tangle, if cutting was too fast.

A preferred process for producing foil ribbon fabrics according to the invention comprises feeding the warp ribbons to the weaving device in two or more layers and interweaving them with the weft ribbons. When a tubular foil is produced for the warp ribbons, a two-layer stock results. Said tubular foil is stretched and cut through both layers. It is also possible to feed three or even more stretched foils collected on foil rolls arranged side by side or one after the other, in superposed relationship first to the cutting device and then to the weaving device. According to these embodiments with two- or multilayer warp ribbons, foil ribbon fabrics having a high tensile strength in longitudinal direction are produced. Besides, the rigidity of the woven weft ribbons is ensured by the warp ribbons lying in several flat, superposed layers.

A preferred mode of stretching in accordance with the present invention consists in that an electrostatic charge is deposited on the foil during stretching, whereby the foil is caused to adhere firmly to the surfaces of the two stretching rolls in the immediate vicinity of the stretching gap where actual stretching takes place. This firm adherence is achieved by providing at least one electrode at a distance from each stretching roll. Preferably, two electrodes are allocated to that stretching roll over which the foil is passed first, while only one electrode is provided for the second stretching roll. The fields emitted by the two electrodes allocated to the first stretching roll overlap on the surface of said first stretching roll. This arrangement of the electrodes makes it possible to electrostatically pin the foil to the first stretching roll at a circumferential angle of between 90° and 180°, and on the second stretching roll at a circumferential angle of at least 30°.

The process of the present invention further comprises heating of the foil prior to stretching by means of heating rolls and keeping the foil during stretching at a temperature of between 2° to 5° C. below its melting point.

The deposition of an electrostatic charge on the foil in connection with the use of heating rolls involves a considerable advantage in that immediately prior to an within the stretching region the air is dried under the influence of heat emanating from the heating rolls, whereby leakage of charge-carrying particles through humid air is prevented and consequently the effect of the electrostatic charge on the foil is retained. In this manner the foil is brought into intimate contact with the stretching roll surfaces and the foil is thereby prevented from slipping off the stretching rolls. Under the stretching conditions described above monoaxially oriented foils of highly uniform structure are obtained, which split readily in the longitudinal direction when touched by knives to form parallel ribbons with straight edges.

During stretching the melting point of the foil is raised, wherefore the stretched foil has a higher melting point than the unstretched foil. For this reason it is of advantage to keep the second stretching roll at a higher temperature than the first stretching roll, preferably by 2° to 5° C.

The apparatus for producing foil ribbon fabrics in accordance with the present invention comprises a device for producing a flat thermoplastic foil, a cutting device for cutting out of said thermoplastic foil a plurality of parallel foil ribbons, a weaving device and conveying means for supplying the parallel foil ribbons to said weaving device to be used at least as warp ribbons, as well as a stretching device for stretching said thermoplastic foil, said stretching device being arranged between said device for producing the flat thermoplastic foil and said cutting device and including a stretching gap formed by a first stretching roll and a second stretching roll, said stretching rolls being mounted in closely spaced-apart relation

to each other and provided with drives so dimensioned as to permit monoaxial stretching of said foil within said stretching gap at a ratio of 1:4 to 1:8, and means adapted to immediately supply said warp ribbons to said weaving device.

The stretching rolls used in the apparatus of the invention are preferably such having a relatively small diameter, i.e., a diameter between 1.5 and 5 inches.

According to a preferred embodiment of the invention the stretching rolls are spaced apart so closely that they form a stretching gap having a width of less than 10 times the thickness of the foil prior to stretching, preferably a width of 7.5 to 10 times the thickness of the unstretched foil. When a polyethylene foil having a thickness of approximately 0.008 inches is used the width of the stretching gap, i.e., the distance between the surfaces of the two stretching rolls in the line connecting the central points of their cross sections, is about 0.06 to 0.08 inches. By using such a small stretching gap, which amounts to only about one-tenth of usual gap widths, any necking in of the foil or thickening of the foil edges within the stretching gap is avoided. The stretched foil has the same width as the unstretched foil and it is not necessary to cut off and remove the edges of the foil after stretching.

The stretching device contained in the apparatus of the present invention is preferably provided with electrostatic pinning means, i.e., means that cause firm adherence of the foil to the surfaces of the stretching rolls prior to and during stretching. These pinning means preferably consist of needle electrodes and the stretching rolls used in connection therewith are electrically grounded metallic rolls.

The process of the invention and the apparatus for carrying out this process are illustrated in more detail in the drawing.

FIG. 1 is a diagrammatical view of an apparatus according to the invention, where the warp ribbons are cut from a monoaxially stretched foil, while the weft ribbons are cut from a foil and temporarily collected on bobbins.

FIG. 1a shows a modified part of this apparatus.

FIG. 2 is a diagrammatical view of an apparatus according to the invention where the warp ribbons as well as the weft ribbons are cut from monoaxially stretched foils.

FIG. 3 shows the stretching and fixing device for a continuous foil, also in diagrammatical view.

FIG. 4 is a lateral view of the preferred mode of stretching;

FIG. 5 is an enlarged view of the stretching rolls shown in FIG. 4.

Numeral 1 in FIG. 1 denotes an extruder for extruding thermoplastic material. The extruder may have a slit or ring nozzle. Numeral 2 denotes a device for producing flat foil stock, e.g., a chill-roll device. The apparatus part designated by 2' in FIG. 1a is different from the device for producing a flat foil, it being a blowing device, which is used for producing a tubular foil, i.e., two-layer foil stock. 3 is a roller block having sleeves 4,4' whereon the foil can be wound. This roller block is, of course, not absolutely necessary; the foil or foils, which are numbered 5, could also be fed directly to the subsequent devices. These subsequent devices are a cutting device 6 wherein the foil 5 is cut to ribbons, a stretching device comprising two stretching means 7 and a heat supply means 8, which can either be a hot water bath or a hot air bath. The stretching means 7 comprise rollers running at different speeds, which extend the ribbon in desired measure. Following the stretching device, the fixing device 9 is provided, comprising another heat supply means 10. Finally, the ribbons which have been stretched and heat fixed, and which are designated by 11, are wound up on bobbins 12, only a small number of which are shown in the drawing. Normally, 100 to 200 bobbins are required. These bobbins are then rewound onto shuttle spools 13 and fed to the loom 14.

The warp ribbons of the invention are produced as follows: A one-layer or two-layer foil is produced on the extruder 15, which is similar to the extruder 1, by means of the device 16 for producing a flat foil, or by means of a blowing device according to FIG. 1a, said foil is then fed to the stretching and fixing device 18, wherein the foil is monoaxially stretched at a

ratio of 1:4 to 1:8. The construction and function of the stretching device will be described in more detail in connection with FIGS. 3, 4 and 5. After having passed through the stretching device, the monoaxially stretched foil is again fed to a roller block 19, which is similar to the roller block 3, and subsequently the foil is cut to ribbons by means of the cutting device 20, said ribbons being immediately fed to the loom 14 as warps. The foil ribbon fabric leaving the loom 14 can be used for packaging, tilts, or the like. The fabric stands out for its high strength.

The preferred embodiment of the invention is diagrammatically illustrated in FIG. 2. In this embodiment, the warp as well as the weft ribbons are cut from monoaxially stretched foils. Numeral 1a denotes an extruder for extruding thermoplastic material, said extruder being similar to the extruder in FIG. 1. 2a is a device for producing flat foil stock, e.g., a chill-roll device. Instead of the chill-roll device a blowing device according to FIG. 1a may be used. Following the device for producing the flat foil, the stretching device 18a for stretching the foil is provided. This is followed by a roller block 19a having sleeves 4a and 4a' whereon the stretched foil, or, when using two-layer stock, the double foils are wound. From the roller block 19a the foil is fed to the cutting device 20 where it is cut to ribbons of desired width. The cutting device may consist of a row of stationary knives arranged in parallel. The cut ribbons are fed as warps to the loom or weaving machine 14.

Next to the described device for producing the warp ribbons is the device for producing the weft ribbons, again comprising an extruder, designated by 1b, a device 2b for producing a flat foil, a stretching and fixing device 18b and a roller block 19b. Thus, monoaxially stretched foil stock is produced also for the weft ribbons and collected on the sleeves 4b, 4b' of the roller block 19b. One sleeve 4b having the stretched foil wound up thereon is then transported to the cutting device 17. From said cutting device 17, the weft ribbons 100 are fed to the loom or weaving machine 14 where they are woven to a foil ribbon fabric. The fabric leaving the loom can be used for purposes where a very high strength is essential.

The stretching and fixing device for foil stock illustrated in FIG. 3, which device is used in producing warp ribbons as well as weft ribbons, comprises a casing 21 and two successively arranged heating rolls 22 and 23. A pair of rolls 24, 24' is allocated to the heating roll 23, said rolls being adapted to be swung clockwise to the position shown in broken lines. Similarly, a pair of rolls 25, 25' is provided adjacent to the next roll 26 and is again adapted to be swung clockwise to the position shown in broken lines. As evident from the drawing, there is a small gap between the roll 24' and the roll 25', which are the stretching rolls and between which the actual stretching process takes place. The foil entering the device according to FIG. 3 is heated on the rolls 22 and 23, turned around the roll 24, stretched between the rolls 24' and 25', turned around the roll 25, passed over the roll 26 and then drawn off over further rolls. During stretching between the stretching rolls 24' and 25' the foil does not alter its width, but only its thickness. A stretching ratio of 1:4 to 1:8 is applied. Following the roll 26 a fixing device is provided, comprising two rolls 27, 28 moving at different speeds. While the roll 27 runs at the same speed as the roll 26, the roll 28 moves slower, whereby the fixing is effected. Numerals 29 and 30 denote cooling rolls.

The preferred mode of stretching in accordance with the present invention is illustrated in FIG. 4. A foil 31 is supplied from above to a stretching stand 32. The stretching stand contains a number of rolls, as well as a drive and a motor. The foil is passed over a roll 33 and from there toward a group of heating rolls 34, 35, 36 and 37, which are driven at low speed. On these heating rolls the foil is heated at stretching temperature. From the heating rolls the foil is passed onto supporting rolls 38 and 39, which are followed by the stretching rolls 40 and 40'. Electrostatic pinning means, i.e., means that cause adherence of the foil to the stretching surfaces, are allocated to the two stretching rolls; these electrostatic pinning means con-

sist of electrodes 41'', 41 and 41', designed as needle electrodes. The stretching roll 40' is driven at a higher speed than the stretching roll 40, so that a stretching ratio of between 1:4 and 1:8 is obtained. Following the stretching roll 40' two further supporting rolls 42 and 43 as well as a cooling roll 44 are arranged. The stretched foil is drawn off from the cooling roll over a roll 45 and further conveyed.

FIG. 5 illustrates on an enlarged scale a detail of the stretching device shown in FIG. 4, namely the stretching rolls 40 and 40' and the needle electrodes 41'', 41 and 41'. Each electrode consists of a rod or a wire arranged above the surface of the roll to which it is allocated at a distance corresponding to approximately one-half of the roll diameter. Each rod or wire extends over the entire roll width and is provided with pointed needles which are spaced apart one another by about 0.2 to 0.4 inches and radially face the roll; their height amounts to approximately 0.08 to 0.16 inches. One or more electrodes may be allocated to each stretching roll. According to FIG. 5 two electrodes 41'' and 41 are allocated to the stretching roll 40 and only one electrode 41' to the stretching roll 40'. Thus the surface of the roll 40 preceding the stretching gap is under the influence of the two electrodes 41'' and 41, and the electrostatic fields of the two electrodes overlap on the surface of roll 40. In this manner the foil is adhered securely to the surface of the roll 40 at an angle of more than 90°, in the example shown at an angle of almost 180°. The DC voltage supplied for depositing an electrostatic charge on the foil ranges from 2 to 30 kilovolts. When using a high-density polyethylene foil a DC voltage of preferably 25 kilovolts is supplied.

What we claim is:

1. In a process for producing foil ribbon fabrics, comprising cutting warp ribbons and weft ribbons from foil stock, feeding said warp and weft ribbons to a weaving device and interweaving said weft ribbons with said warp ribbons, the steps of passing at least the foil stock from which the warp ribbons are to be cut through a stretching gap formed between two stretching rolls mounted in closely spaced-apart relation to each other, monoaxially stretching the foil stock in said stretching gap at a ratio of 1:4 to 1:8 cutting the foil stock so stretched by means of knives over which the foil stock is drawn to form a plurality of parallel warp ribbons, and immediately and continuously feeding the warp ribbons so formed to said weaving device, the speed of said cutting of the foil stock being substantially the same as the speed of said feeding the warp ribbons to the weaving device.

2. The process set forth in claim 1 wherein both warp and weft ribbons are cut from monoaxially stretched foil stock.

3. The process set forth in claim 1 wherein said warp ribbons are cut from monoaxially stretched foil stock in at least two layers and are fed to said weaving device in superposed relationship.

4. In a process for producing foil ribbon fabrics, comprising cutting warp ribbons and weft ribbons from foil stock, continuously feeding said warp and weft ribbons to a weaving device and interweaving said weft ribbons with said warp ribbons, the steps of passing at least the foil stock from which the warp ribbons are to be cut through a stretching gap formed between a first stretching roll and a second stretching roll, said first and second stretching rolls mounted in closely spaced-apart relation to each other, electrostatically pinning the foil stock to said first and second stretching rolls, monaxially

stretching the foil stock in said stretching gap at a ratio of 1:4 to 1:8 cutting the foil stock so stretched by means of knives over which the foil stock is drawn to form a plurality of parallel warp ribbons, and immediately and continuously feeding the warp ribbons so formed to said weaving device.

5. The process set forth in claim 4 wherein the foil stock is electrostatically pinned to said first stretching roll by means of two electrodes spaced from the surface of said first stretching roll and emitting fields which overlap on the surface of said first stretching roll.

6. The process set forth in claim 4 wherein the foil stock is electrostatically pinned to said first stretching roll at a circumferential angle of between 90° and 180° and on said second stretching roll at a circumferential angle of at least 30°.

7. The process set forth in claim 4 further comprising the steps of heating the foil stock prior to stretching and maintaining the temperature of the foil stock during stretching between 2° and 5° C. below its melting point.

8. The process set forth in claim 4 further comprising the step of keeping the temperature of said second stretching roll between 2° to 5° C. higher than the temperature of said first stretching roll.

9. The process set forth in claim 4 further comprising the step of keeping the air surrounding the stretching rolls free from moisture.

10. An apparatus for producing foil ribbon fabrics, comprising means for producing a flat thermoplastic foil, means for cutting said thermoplastic foil into a plurality of parallel foil ribbons, means for stretching said thermoplastic foil, said stretching means having a first stretching roll and a second stretching roll defining a stretching gap therebetween, means for weaving said parallel foil ribbons, and means for supplying the parallel foil ribbons to said weaving means to be used at least as warp ribbons, the improvement comprising the stretching means being arranged between said foil-producing means and said cutting means, said first stretching roll and said second stretching roll being mounted in closely spaced-apart relation to each other in said stretching means and being adapted to permit monoaxial stretching of said foil within said stretching gap at a ratio of 1:4 to 1:8, said supplying means adapted to immediately and continuously supply said parallel foil ribbons to said weaving means, and said supplying means adapted to draw the foil over the cutting means and to feed the parallel foil ribbons to the weaving means at substantially the same speed.

11. The apparatus set forth in claim 10 wherein said first and second stretching rolls have a diameter of between 1.5 and 5 inches.

12. The apparatus set forth in claim 10 wherein said stretching gap has a width of less than 10 times the thickness of the flat thermoplastic foil prior to stretching.

13. The apparatus set forth in claim 10 wherein said stretching gap has a width of between 7.5 and 10 times the thickness of the flat thermoplastic foil prior to stretching.

14. The apparatus set forth in claim 10 further comprising electrostatic pinning means comprising two first electrodes spaced from the surface of said first stretching roll and a second electrode spaced from the surface of said second stretching roll, said two first electrodes emitting fields which overlap on the surface of said first stretching roll.

15. The apparatus set forth in claim 14 wherein said first electrodes and said second electrode are needle electrodes.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,645,299 Dated February 29, 1972

Inventor(s) Josef Alfred Eichler et al.

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

First page, Item [30], following "Oct. 25, 1966 Austria....9941/66"
add -- June 8, 1967 Austria.....5333/67
Mar. 27, 1969 Austria....3014/69--

Signed and sealed this 27th day of June 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents