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YARN CRIMPING METHOD AND APPARATUS

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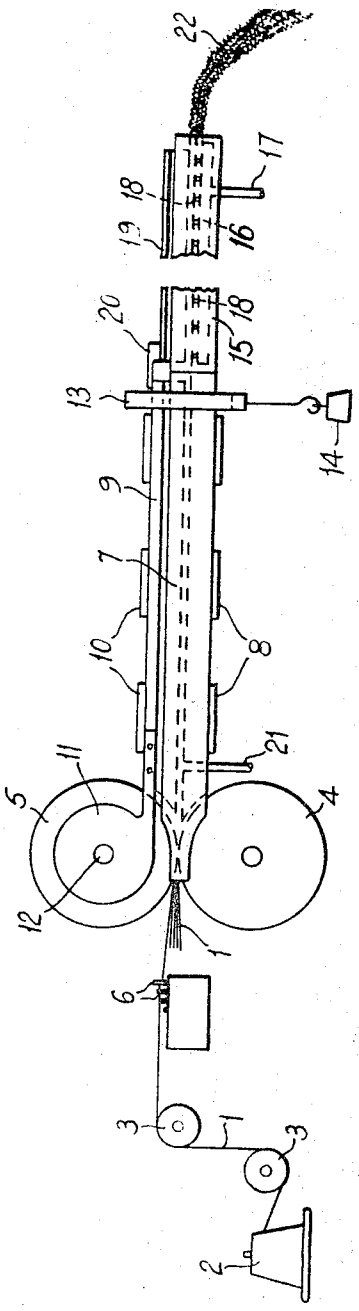


FIG. 1

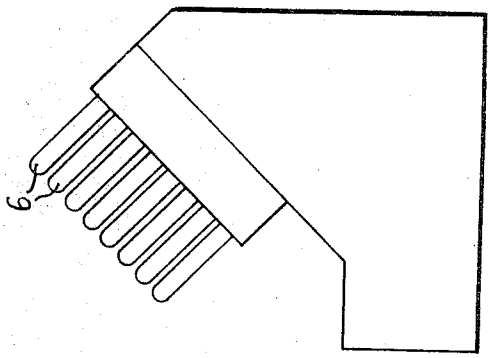


FIG. 2

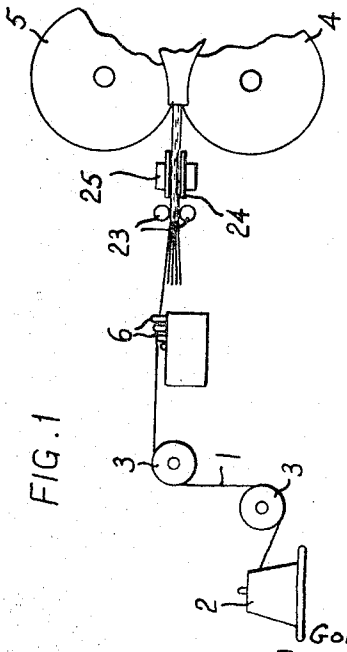


FIG. 3

Inventor
Gordon Stuart BUCKLEY
Ronald Arthur Robb
By Howson & Howson
their Attorneys

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YARN CRIMPING METHOD AND APPARATUS

Gordon Stuart Buckley, Coventry, England, and Ronald Arthur Robb, Holywell, Wales, assignors to Courtaulds Limited, London, England, a British company

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14 Claims. (Cl. 28—1)

The invention relates to crimped yarns and apparatus for producing them.

It is already known to produce crimped yarns and fibres by forcing them by means of positively fed rollers into a confined space generally described as a stuffing box through which the yarns or fibres are forced against the friction of the walls of the box to emerge at the far end. In the box the individual fibres or yarns assume a crimped configuration and the extent to which this is retained in the yarn which emerges can be enhanced by the application of heat to the yarn or fibre in the box.

Usually in stuffing box processes the fibres or yarns are free to crimp in any direction, but we have developed a modified process in which the direction of crimp is controlled and which enables crimped yarns to be handled with greater ease in the form of a multi-strand crimped tow which can be stored in boxes or bales and can thereafter readily be separated into individual strands. The process is of particular interest for the crimping of heavy denier yarns for carpet manufacture, but is not limited to such yarns.

According to the invention a yarn crimping process comprises passing a plurality of yarns, parallel to and in contact with each other in a single layer between a pair of nip rollers into a stuffing box comprising a heated channel of width such that the yarns are maintained under a degree of lateral compression, the open side of the channel being closed by a heated pressure plate, and from the stuffing box onto a cooling surface, and cooling the yarns on the surface to set the crimp.

Preferably the crimped yarns are cooled as they pass through to the cooling surface by blowing air through holes in the surface. The cooling surface may simply be a flat or curved surface or may be the inner base surface of a cooling channel of width equal to the heated channel and, in this case, preferably the open side of the cooling channel is closed by a second pressure plate to retain the crimp in the yarns during cooling.

The yarns may be heated before passing them between the nip rollers and, in addition to heating the channel and the pressure plate, steam may be passed into the layer of yarns within the heated channel through apertures provided in the channel and/or the pressure plate provided for this purpose.

Since the yarns are constrained to lie in side by side contact with each other during their passage through the stuffing box they are permitted to crimp only in the direction perpendicular to the base of the channel-shaped member and, by virtue of the clinging together of adjacent yarns all the yarns in the layer tend to crimp together so that they emerge from the stuffing box onto the cooling surface in the form of a zig-zag crimped tow in which the yarns are arranged side by side parallel to each other. By virtue of the lateral compression of the yarns in the layer against each other, projecting fibres of adjacent yarns become lightly entangled so that the yarns form a stable tow which can be handled, boxed or baled without risk of entanglement of the individual yarns, but the yarns in the tow can readily be separated by pulling them apart laterally when desired. The yarns may be fed between the nip rollers and into the stuffing box in two or more superposed layers, each comprising a plurality of yarns in side by side contact with each other. In this case the filaments

or yarns in adjacent layers likewise become lightly entangled and a coherent multi-layer tow is produced. In addition to the crimp of the tow, the fibres in the individual yarns are also crimped to a degree depending upon the pressure in the nip of the feed rollers and the weight applied to the pressure plates.

The process is applicable to any heat settable yarn, particularly to synthetic fibres containing a major proportion of polyacrylonitrile. By a number of yarns is meant at least two but the number may rise to the limit of the number of yarns which can be controlled in the stuffing box.

The zig-zag crimped tow can be separated into individual yarns which can be used for the production of carpets by any conventional method. Alternatively the tow can be kept compressed and lengths can be adhered by the angles of the crimps on one side to a backing layer to form a carpet. If a two-layer tow is produced as described above it is possible to form a carpet by applying a coating of latex or other carpet backing material to the angles of the crimps on opposite surfaces of the tow so that one layer of backing material is attached to one layer of the tow and the other layer of backing material to the other layer of the tow but thus on separating the two layers each forms the tufts of a carpet already attached to the latex backing.

An example of apparatus for carrying out the invention is shown in the acmompanying drawing in which:

FIGURE 1 is a side elevation of the apparatus, and

FIGURE 2 is an end elevation on an enlarged scale.

FIGURE 3 shows a modification.

Eight yarns **1** are drawn from individual yarn packages **2** over tension rolls **3** and are presented to the nip of a pair of feed rollers **4, 5** through a guide comprising inclined comb pins **6** which separate each yarn from its neighbour. The axis of the lower roller **4** is fixed and the upper roller **5** is subjected to downward pneumatic pressure of about 300 lbs.

The yarns are spun from a 50/50 blend of viscose rayon and polyacrylonitrile fibres and are of 2 fold 1.9 cotton count. The yarns are guided by the positioning of the rolls **3** and the guide pins **6** so that they are drawn into a nip of the rollers in a single layer, in side by side relation, and are fed as a layer into a channel **7** which has electric heaters **8** in its base. The walls of the channel are smooth and the width of the channel is just sufficient to accommodate the eight yarns in side by side relation under a degree of lateral compression. The open top of the channel **7** is closed by a pressure plate **9** of T-shape cross-section, the limb of which is of width such as to fit closely but freely between the walls of the channel and of depth somewhat greater than the depth of the channel. Electric heaters **10** are mounted on top of the pressure plate **9** and the plate is pivotally mounted by arms **11** upon the shaft **12** of the upper roller **5**. A yoke **13** spans the opposite end of the pressure plate **9** and the adjacent part of the channel **7** and enables weights **14** to be applied to it to vary the pressure of the yarn being treated.

In end to end abutment with the channel **7** is a cooling channel **15**, the yarn-receiving portion of which is of similar cross-section to that of the channel **7**. In its base, the channel **15** has a chamber **16** into which cooling air can be supplied through a pipe **17**. A large number of holes **18** is formed in the upper wall of the chamber **16** so that air can pass from the latter into the cooling channel to permeate and cool the yarns passing through it. The open top of the cooling channel is closed by plate **19** similar to the pressure plate **9** and having at one end a locating member **20** to engage the end of the pressure plate **9**. The plate **19** is not heated and simply rests upon the yarns passing through the cooling channel **15**.

In addition to the electric heaters **8** and **10**, provision

may be made for steam heating the yarn passing through the crimping channel **7**. This is particularly desirable in some yarns, where the presence of moisture from the steam is advantageous in setting the crimp.

For this purpose a pipe **21** is provided, passing through the base of the channel **7** close to its end adjacent to the rollers **4**, **5** so that steam may be passed into the channel to permeate the yarns at this point.

In the embodiment illustrated for crimping the yarns mentioned above the crimping channel is approximately 13 inches long, measured from the axes of the rollers **4**, **5** and has an internal width of 0.5 inch. The cooling channel **15** is 3 feet long.

The yarns emerge from the end of the cooling channel **15** as shown in the form of a flat ribbon or tow **22**, the adjacent yarns adhering together and each of the yarns having a zig-zag crimp. This tow **22** can be readily handled baled, and when desired for use can be drawn from the bale. If desired the individual yarns can be separated by pulling them laterally apart as the tow is drawn from the bale.

In the modification shown in FIGURE 3 the yarns after being aligned by the guide pins **6** in a single layer between a pair of guide rollers **23**, parallel to the rollers **4**, **5** and then between a pair of plates **24** spaced apart and parallel to the axes of the rollers. The plates are heated for example by electric heating elements **25** secured to their outer surface so as to preheat the yarns before they enter the stuffing box. Instead of the weight **14** for loading the pressure plate it will be understood that other means such as springs or fluid pressure devices may be used. In one modification of the apparatus the channel **7** is inverted and the pressure plate **9** is pivoted about the axis of the lower rollers **4** and is urged upwardly into the channel by a pneumatic cylinder.

What we claim is:

1. A yarn-crimping process which comprises forcing a plurality of yarns, parallel to and in contact with each other, in a single layer, by means of a pair of nip rollers, into a heated channel having a width such that the yarns are maintained under lateral compression, applying pressure by means of a heated surface against said layer of yarns as said yarns are passed through said channel, and ejecting said yarns from said channel onto a cool surface, thereby cooling the yarns to set crimp developed in said heated channel.

2. Yarn crimping process according to claim **1** including the step of blowing air through holes in the cool surface to cool the yarns passing thereover.

3. Yarn crimping process according to claim **1** wherein the cooling surface is the inner base of a cooling channel of width equal to the heated channel, and including the step of applying pressure by means of a surface against the yarns as they are passed through the cooling channel to retain the crimp in the yarns during cooling.

4. Yarn crimping process according to claim **1** including the prior step of heating the yarns before passing them between the nip rollers.

5. Yarn crimping process according to claim **1** including the step of passing steam into the layer of yarns after it has passed between the nip rollers through apertures in the base of the heated channel.

6. Yarn crimping process according to claim **5** including passing steam also through holes in the heated pressure surface.

7. Yarn crimping process according to claim **1** wherein the yarns are fed to the nip rollers in a plurality of layers each comprising a plurality of yarns parallel to and in contact with each other.

8. Yarn-crimping apparatus which comprises means for forcing a plurality of yarns, parallel to and in contact with each other, in a single layer, by means of a pair of nip rollers, into a heated channel having a width such that the yarns are maintained under lateral compression, means comprising a heated surface against said layer of yarns for applying pressure on said yarns as said yarns are passed through said channel, and means for ejecting said yarns from said channel onto a cool surface, thereby cooling the yarns to set crimp developed in said heated channel.

9. Apparatus for crimping yarns by the process claimed in claim **8** comprising a pair of nip rollers, a channel shaped member fixed with its inner base surface substantially tangential to the rollers at their nip and a pressure plate closely fitting between the walls of the channel shaped member and pivoted about the axis of one of the rollers, means for heating the channel shaped member and the pressure plate and a loading device for urging the pressure plate towards the base of the channel shaped member, a cooling surface being provided to receive yarns discharged from the end of the channel shaped member remote from the rollers.

10. Apparatus according to claim **9** wherein the means for heating the channel shaped member and the pressure plate comprise electric heating elements secured to the member and the plate.

11. Apparatus according to claim **9** having means in the channel shaped member adjacent to the nip of the rollers through which steam may be passed into the channel.

12. Apparatus according to claim **9** having means in the cooling surface through which air may be blown to cool yarns passing over it.

13. Apparatus according to claim **8** including a pair of plates in advance of the nip rollers and substantially aligned with the nip parallel to the axes of the rollers and spaced apart sufficiently for yarns to be crimped to pass between them, and means for heating the plates so as to preheat yarns to be crimped as they pass between the plates.

14. Apparatus according to claim **8** wherein the cooling surface is the base of a cooling channel of the same width as the channel shaped member, aligned with the channel shaped member, and a second pressure plate closing the open side of the cooling channel.

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MERVIN STEIN, *Primary Examiner.*

L. K. RIMRODT, *Assistant Examiner.*