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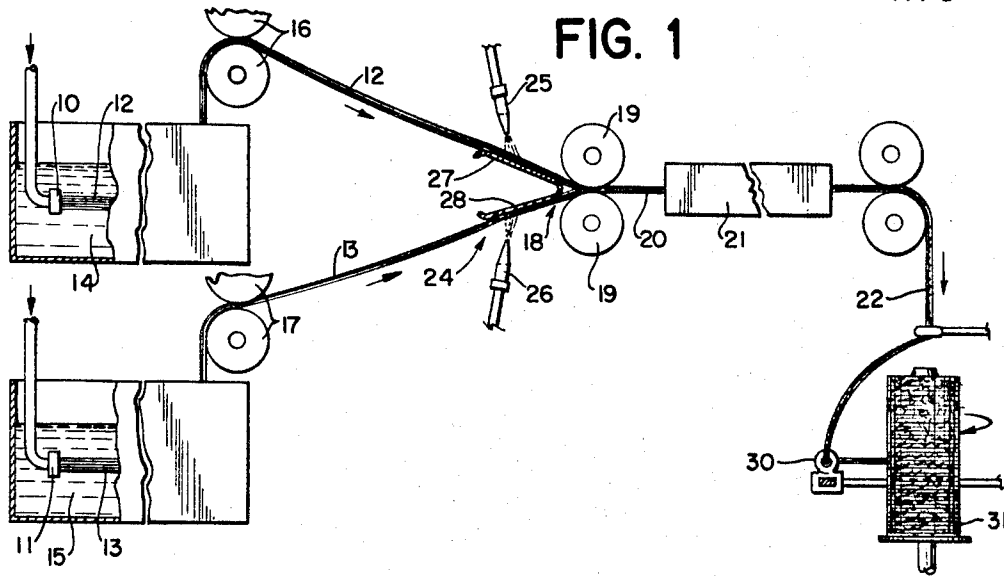
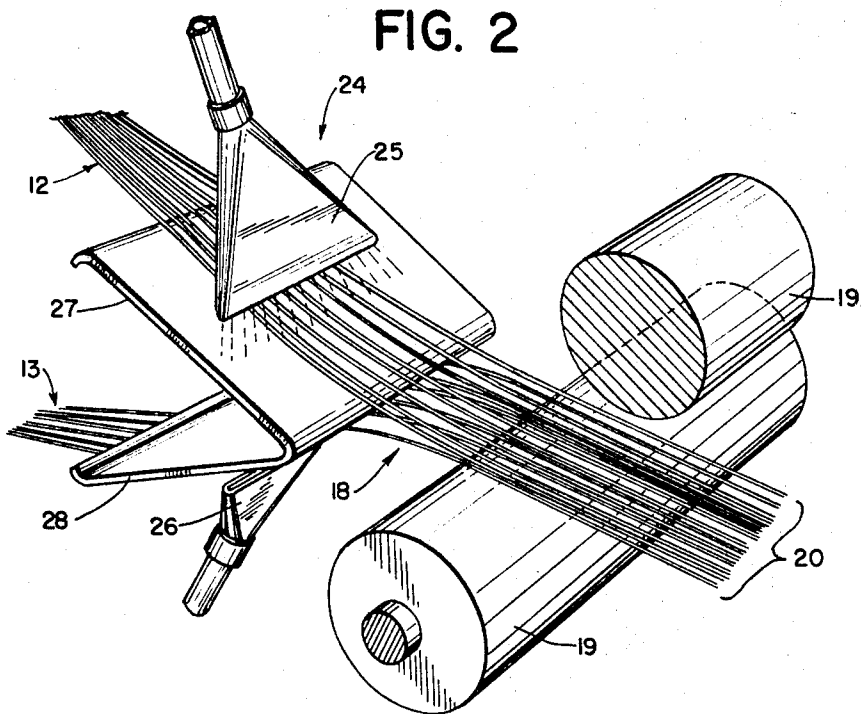
G. BLOCH

3,273,328

PROCESS AND APPARATUS FOR MAKING BULKED FILAMENT YARNS

Filed Feb. 4, 1965

3 Sheets-Sheet 1



INVENTOR.
GODFREY BLOCH

BY

Augustus L. Lamm
ATTORNEY

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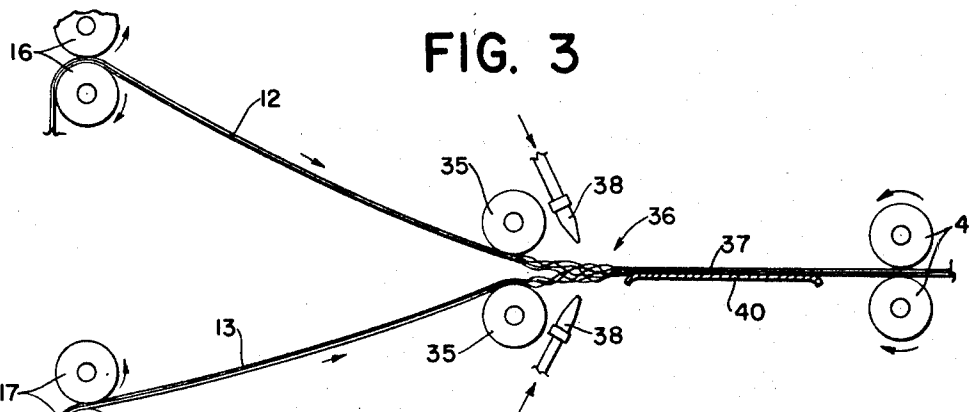
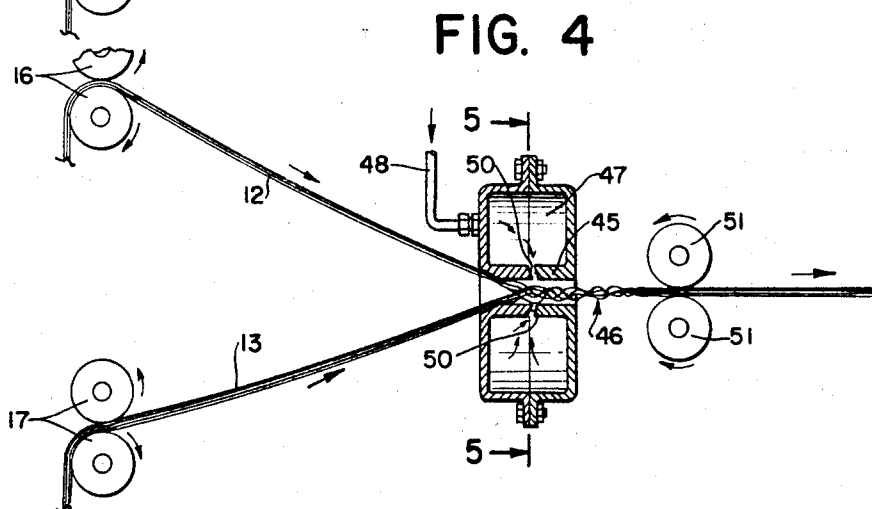
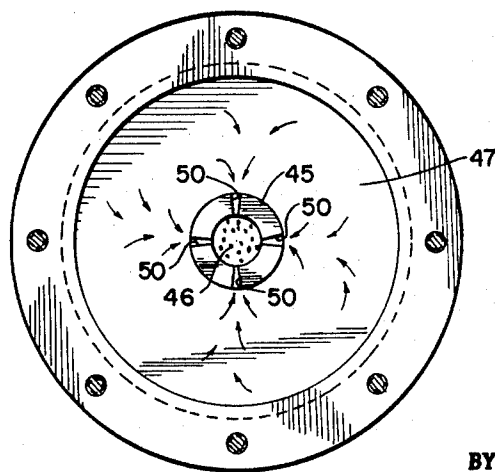
G. BLOCH

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PROCESS AND APPARATUS FOR MAKING BULKED FILAMENT YARNS

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3 Sheets-Sheet 2



INVENTOR
GODFREY BLOCH

BY

Augustus Lemme
ATTORNEY

Sept. 20, 1966

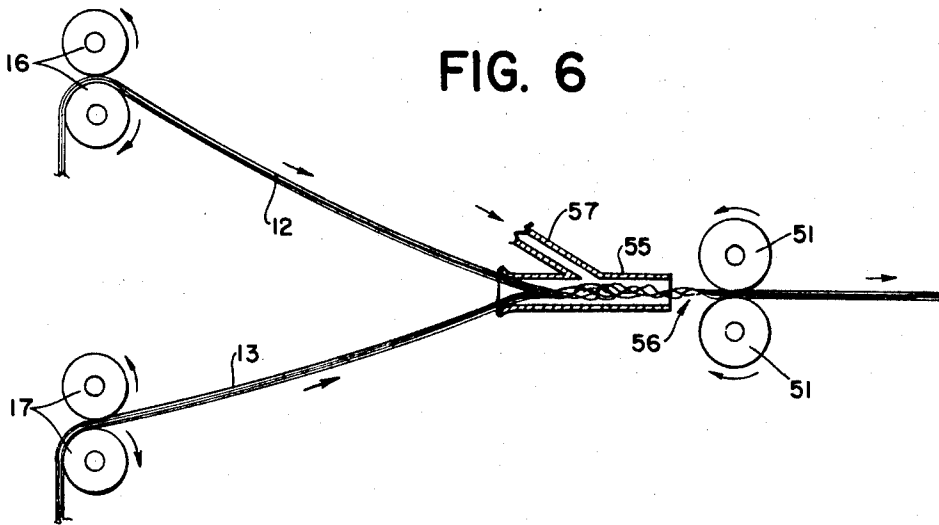
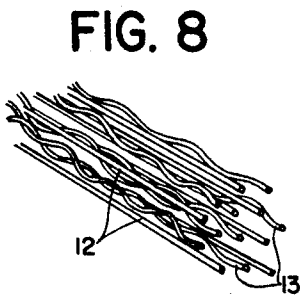
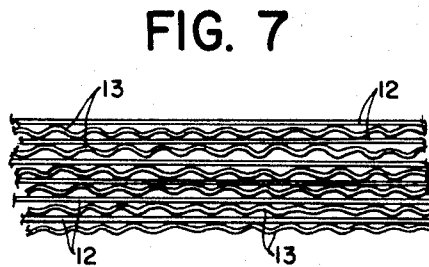
G. BLOCH

3,273,328

PROCESS AND APPARATUS FOR MAKING BULKED FILAMENT YARNS

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3 Sheets-Sheet 3



INVENTOR
GODFREY BLOCH

BY

Augustus Lemmon

ATTORNEY

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3,273,328 PROCESS AND APPARATUS FOR MAKING BULKED FILAMENT YARNS

Godfrey Bloch, 38 E. 75th St., New York, N.Y.

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18 Claims. (Cl. 57—34)

The present application is a continuation-in-part of application Ser. No. 210,314, filed July 13, 1962, now Patent No. 3,175,351, which is a divisional application of Ser. No. 852,515, filed Nov. 12, 1959, now Patent No. 3,061,998, issued Nov. 6, 1962, which, in turn, is a continuation-in-part of application Ser. No. 497,776, filed March 29, 1955, and now abandoned.

The present invention relates to a process and apparatus for making filament yarns.

In my Patent No. 3,061,998, there is disclosed a process for producing a yarn composed of a group of crimped continuous filaments and a group of uncrimped continuous filaments, the straight filaments serving as stretch controls to impart to the yarn dimensional lengthwise stability and the crimped filaments providing the necessary bulk. In such a process, it is desirable for the filaments of one group to be interleaved with the filaments of the other group and to be distributed throughout the cross-section of said yarn, to produce a yarn in which the two groups of filaments are randomly or substantially uniformly disposed throughout the cross-section of said yarn.

One object of the present invention is to provide a new and improved process and apparatus for producing a yarn of the general type described in the aforesaid patent composed of crimped and uncrimped filaments in interleaved relation with the two groups of filaments disposed throughout the cross-section of the yarn.

In accordance with the primary feature of the present invention, two groups of continuous filaments having differential crimping properties are brought together to form a combined bundle, and are subjected to the turbulent action of a gaseous jet, preferably an air jet, either before the two filament groups are merged into a combined bundle or after they are merged, to open up the filament groups and cause them to be thoroughly mixed in the bundle. If the air jet is applied to the two filament groups before they are combined, the filaments in each group are spread apart before the groups merge, so that as the spread filaments of the two groups come together, they become interleaved and distributed throughout the cross-section of the combined bundle. If the air jet is applied to the two filament groups after they have become merged into a combined bundle, it opens up the bundle and at the same time, it creates a turbulent action in the region of the combined bundle, causing the filaments in the two groups to be thoroughly intermixed, so that the filaments in each group are distributed throughout the cross-section of the combined bundle.

The filaments of the two groups have differential crimping properties before the two groups are merged. For that purpose, the filaments of one group may be crimped before the two groups of filaments are merged, while the filaments of the other group may not be crimped, so that they are substantially straight, or the filaments of one group may have a latent crimp before the merging of the two groups of filaments, which is developed into an actual crimp after the two groups of filaments are merged, while the filaments of the other group retain their substantially uncrimped condition.

As far as certain aspects of the invention are concerned, both groups of filaments in the final bulked yarn may be crimped, but the filaments of one group are crimped to a much lesser extent than are the filaments of

the other group, so that the filaments of said one group, while permitting limited lengthening of the yarn prevent straightening out of said other group of filaments.

Another object of the present invention is to provide a new and improved process and apparatus for crimping filaments continuously and in correlation with the operation of combining the crimped filaments with substantially straight filaments.

In carrying out the foregoing objective, the two groups of filaments to be combined are advanced towards a merging zone at different rates, so that one group of filaments is overfed with respect to the other, thereby causing the excess length of filaments in the overfed group to crimp and produce a bulked yarn with the other group of filaments.

Various other objects, features and advantages of the present invention are apparent from the following description and from the accompanying drawings, in which

FIG. 1 is a diagrammatic view illustrating one method and apparatus for producing a thoroughly mixed bulked yarn in accordance with the present invention;

FIG. 2 is a perspective showing an enlargement of the air jetting part of the apparatus illustrated in FIG. 1;

FIG. 3 is a diagrammatic view illustrating another method and apparatus for producing a thoroughly mixed bulked yarn in accordance with the present invention;

FIG. 4 is a diagrammatic view partly in section illustrating still another method and apparatus for producing a thoroughly mixed bulked yarn in accordance with the present invention;

FIG. 5 is a section of the jet device employed in the procedure illustrated in FIG. 4, taken on lines 5—5 of FIG. 4 but on a larger scale;

FIG. 6 is a diagrammatic view partially in section, illustrating a still further method and apparatus for producing a thoroughly mixed bulked yarn in accordance with the present invention;

FIG. 7 is a side elevational view of a yarn on an exaggerated scale made by the method and apparatus of the present invention; and

FIG. 8 is a perspective view of the yarn on an exaggerated scale made by the method and apparatus of the present invention.

Referring to FIGS. 1 and 2 of the drawings, there is shown a process and an apparatus for forming the thoroughly mixed bulked yarn described. In accordance with procedure shown, there are two spinnerets 10 and 11, through which two groups of continuous filaments 12 and 13 are extruded directly into spinning baths 14 and 15, where they are coagulated, drawn and fixed in accordance with standard spinning techniques. The filaments 12 and 13 in the two groups will have shrinkage characteristics which depend upon the amount of drawing and fixation to which they have been subjected in the spinning baths 14 and 15, and also to the amount these filaments have subsequently been allowed to be stabilized by shrinking and relaxing under heat.

The two groups of filaments 12 and 13 are fed by rolls 16 and 17 towards an interleaving merging zone 18 at feed rolls 19, where they are combined into a thoroughly mixed combined bundle 20. The group of filaments 12, before reaching the merging zone 18, may be processed in the bath 14 by stretching and finishing in the usual manner but without relaxing, while the group of filaments 13 may be processed by stretching and finishing in the bath 15, and then relaxing to cause the same to shrink, so that upon subsequent relaxing treatment, after the two filament groups have been combined, the filaments 13 will shrink slightly, if at all, whereas the filaments 12 will shrink to a substantial extent.

When the combined bundle 20 of filaments 12 and 13

having differential shrinking properties is passed through a heating zone indicated by a heating chamber 21 carrying steam or a heated liquid, the filaments are shrunk. The shrinking of the filaments 12 in the combined bundle 20, while the filaments 13 remain substantially free from shrinkage, and while all the filaments remain in substantially parallel relationship, will cause the filaments 13 to be drawn up into crimped form, so that the final yarn 22 bulked in this manner, will consist of the crimped filaments 13 stabilized against stretching by the substantially straight filaments 12.

As a feature of the present invention, the two groups of filaments 12 and 13 are subjected to the action of gas jet means 24 to open up these groups, these filament groups being slack enough in the region of the gas jet means to permit these groups to open up. As the two groups of spread filaments 12 and 13 come together between the feed rolls 19, the filaments in the two groups become interleaved and thoroughly mixed. As a result, the filaments of each group become distributed throughout the cross-section of the resulting combined bundle 20 somewhat randomly but as uniformly as the procedure will permit.

In the specific form of the invention shown in FIGS. 1 and 2, the gas jet means 24 comprises two air jet nozzles 25 and 26 shaped to project fan shaped streams of air against the two groups respectively of filaments 12 and 13 as they approach the feed rolls 19 to spread these groups laterally. Desirably, the two groups of filaments 12 and 13 are backed by flat plates 27 and 28 respectively, converging towards the feed rolls 19, so that the filament groups are spread flat against said plates by the air jets, as shown in FIG. 2. These plates 27 and 28 are desirably integrally connected together at their juncture to form a unit.

The flattened groups of filaments 12 and 13 will come together in interleaving relationship as shown in FIG. 2, so that as they pass underneath the feed rolls 19, they form the combined bundle 20 of filaments with the filaments of the two groups thoroughly mixed and with the filaments of each group distributed throughout the cross-section of the bundle randomly but almost uniformly.

In the specific form illustrated, each group of filaments 12 or 13 is shown consisting of only a few filaments in order to illustrate the principle of the invention as simply and with as much clarity as possible. However, it must be understood that in actual practice, the number of filaments in each group, very likely, would be much greater than that illustrated. Moreover, it must be understood that the number of filaments in the two groups may be different according to the character of the bulk yarn desired to be produced therefrom. In any case, regardless of the number of filaments in each group, the two groups of filaments 12 and 13 when spread across the plates 27 and 28 should have substantially the same width and the filaments in each spread group should be as equally spaced as possible. This can be controlled by the width of the nozzles 25 and 26, and the velocity of the air jets projected therefrom. Also, the groups of filaments 12 and 13 when spread across the plates 27 and 28 should be in vertical alignment, so that as they merge, the two groups of filaments will be in registry.

After the combined thoroughly mixed filament bundle 20 has been formed as described, the bundle passes through the heater 21 where the filaments are subjected to shrinkage conditions. Under these conditions, the filaments 12 in this bundle 20 will contract to a greater extent than will the filaments 13, thereby causing the filaments 13 to have an excess length, which is pulled up into crimps to form a bulked filament bundle, which is then wound with or without twist as a yarn in package form, as for example, by passing through a ring twister 30, and then winding onto a package spool 31 for subsequent

use. The resulting bulked yarn is shown in exaggerated scale and in untwisted form in FIGS. 7 and 8.

In carrying out the process of the present invention, the filaments extruded from the two spinnerets 10 and 11 may be of the same composition or may be composed of different materials. Such filaments may be composed, for example, of polyethylene, polypropylene, Dynel (copolymer of vinyl chloride and acrylonitrile), Saran (polyvinylidene chloride), Orlon (polyacrylonitrile), nylon or other materials, which are suitable for making synthetic textile fibers.

If, for example, the filaments are composed of polypropylene, it may be assumed that the filaments 12 after being extruded from the spinneret 10, and after coagulation and stretching for molecular orientation with whatever relaxation is needed, are stretched by an additional 20%, whereas the filaments 13 extruded from the spinneret 11 are stretched by an additional 1% only. The filaments 12 will thereby have a shrinkage potential of 20%, while the filaments 13 will only have a shrinkage potential of 1% before being subjected to shrinkage in the heater 21. After shrinkage in the heater 21, the filaments 13 will have a length correspondingly greater than the more shrinkable filaments 12.

The filaments 12 and 13 may be of the same denier or may be of different deniers. Preferably, the more highly shrinkable filaments 12 are of larger denier than the less shrinkable filaments 13. The more shrinkable filaments 12 may, for example, be five denier and the less shrinkable filaments 13 of two denier. In this way, the finer filaments 13 are pulled up into crimped form and bulked in the final product.

The process of FIGS. 1 and 2 is shown carried out continuously with the spinning of the filaments. However, in some instances, it may be desirable to package the filaments after being subjected to treatment imparting differential crimping properties to the two groups of filaments 12 and 13 before being combined. The filaments 12, for example, may be substantially straight and the filaments 13 may be already crimped before the two groups of filaments are brought into the field of action of the air jet nozzles 25 and 26 and before they are combined into a mixed bundle. In that case, of course, the heater 21 is dispensed with.

As another alternative, the preformed filaments 12 and 13 having differential latent crimping properties are supplied from packages for passage into the field of action of the air jet nozzles 25 and 26 and then combined into a mixed bundle for subsequent differential crimping treatment, as by means of the heater 21 in the manner described.

As a further alternative, the groups of filaments 12 and 13 are produced, air jetted and combined into the bundle 20, in the manner described in FIGS. 1 and 2, and the bundle then packaged as a yarn prior to shrinkage treatment. The yarn is then fabricated into a woven, knitted or tufted fabric, after which the fabric is subjected to treatment as in a dryer or oven, to effect differential shrinkage of the filaments as above described, thereby causing the yarn to bulk and to produce a fabric having the characteristics of a fabric made from spun prebulk yarn described.

As still another alternative, the filaments 12 and 13, instead of having differential shrinking properties before being combined, are differentially crimped by operating the feed rolls 17 at a higher feed rate than the feed rolls 16, so that the group of filaments 13 is overfed with respect to the group of filaments 12, thereby causing the excess length of filaments 13 to crimp. The filaments 12 are substantially straight as they pass over the plate 27 and as they are spread against said plate by the air jet from the nozzle 25, while the filaments 13 are in crimped condition as they pass over the plate 28 and are spread against the latter plate by the air jet from the nozzle 26. These filaments 12 and 13, therefore, are

already differentially crimped as they come together into interleaving relationship, and are combined into a thoroughly mixed bundle of filaments 12 and 13 to form the desired yarn shown in FIGS. 7 and 8, without subjecting the filaments to subsequent differential crimping treatment. In that case, the heater 21 is dispensed with.

In the overfeed method of crimping the filaments 13 described, these filaments would be soft enough to permit crimping thereof. For example, the filaments may be of Orlon (polyacrylonitrile) and have a low denier in the order of about 3.

FIG. 3 shows a modification of the invention in which the two groups of filaments 12 and 13 having differential crimping properties are combined into a bundle and the bundle subjected to gas jetting to thoroughly mix the filaments 12 and 13. In the specific form shown, the filaments 12 and 13 formed by spinning in the manner shown in FIGS. 1 and 2, or performed and prepackaged as indicated in the alternative methods described, are advanced from the spinning apparatus or from packages by means of the feed rolls 16 and 17, passed around guide rolls 35 and brought together in the region 36 where they merge into a combined bundle 37. The bundle 37 at the merging region 36 is subjected to the action of two or more jets of gas, desirably air, projected from air nozzles 38 at sufficiently high velocity, to mix the filaments 12 and 13 in said bundle thoroughly, so that the filaments of each group are distributed throughout the cross-section of the bundle, randomly but as thoroughly as possible, so that the distribution is close to being uniform. The combined bundle 37 is sufficiently slack at the region 36 to permit the mixing by air jetting as described, and after being mixed as described, is advanced along a table 40 to feed rolls 41. From the feed rolls 41, the thoroughly mixed bundle 37 may be subjected to any of the differential crimping treatments described above. For example, if the filaments 12 and 13 have only latent differential crimping properties, as for instance, differential shrinking properties, these latent properties are developed, as for example, by passing them through a heater, such as the heater 21 of FIGS. 1 and 2, where they are differentially shrunk to produce the singles yarn shown in FIGS. 7 and 8 with thoroughly mixed straight and crimped filaments. If one of the groups of filaments, such as the filaments 13 are precrimped, while the group of filaments 12 are straight or are crimped by overfeed while being advanced towards the merging zone 36, and if the filaments are combined in the manner described, the desired bulked yarn will be produced without subjecting the combined filaments to a shrinking treatment. To carry out the operation shown in FIG. 3 by overfeeding to precrimp the filaments 13 before merging the filaments 12 and 13, it may be desirable to provide an additional pair of positive feed rolls for the yarn 13 in place of the corresponding guide roll 35 or in advance thereof between the feed rolls 17 and the guide roll 35, near said guide roll.

FIGS. 4 and 5 show a modification of the invention, in which the two groups of filaments 12 and 13 having differential crimping properties are combined into a bundle and passed through a tube where the bundle is subjected to gas jetting to thoroughly mix the filaments 12 and 13. In the specific form shown in FIGS. 4 and 5, the filaments 12 and 13 formed by spinning in the manner shown in FIGS. 1 and 2 or preformed and prepackaged as indicated in the alternative methods described in connection with FIGS. 1 and 2 are advanced from the spinning apparatus or from packages by means of the feed rolls 16 and 17, and passed through a tube 45 where they are combined into a bundle 46. The combined bundle 46 in the tube 45 is slack and is subjected therein to gas jets, in the form of air jets, to create a turbulent region in which the filaments 12 and 13 are thoroughly mixed. To that end, the jet device comprises an annular

plenum chamber 47 connected to a source of air under pressure by means of an inlet pipe 48, and having the tube 45 as its inner peripheral wall. This tubular wall 45 has a series of orifices 50 extending radially and slantingly forwardly for projecting air streams at high velocity against the combined bundle. The turbulent action created in the tube 45 thoroughly mixes the filaments 12 and 13, and the resulting thoroughly mixed bundle 46 is advanced by feed rolls 51 for further differential crimping treatment described above, according to whether the filaments have only latent differential crimping properties or the filaments 13 have already been crimped by overfeed or otherwise to form the bulked yarn shown in FIGS. 7 and 8. If overfeed technique is employed in the operation shown in FIGS. 4 and 5 to precrimp the group of filaments 13 before they are combined with the group of filaments 12, an additional pair of positive feed rolls may be desirable for the group of filaments 13 near the tube 45 in advance thereof.

FIG. 6 illustrates a process and apparatus similar to that illustrated in FIGS. 4 and 5, except that the air jet device 45, 47 of FIGS. 4 and 5 is replaced by a long tube 55 in which the filaments 12 and 13 are combined into a bundle 56 and into which air or other gas is blown at high velocity by means of an inlet pipe 57 inclined with respect to the tube 55. This creates a turbulent condition in the tube 55, which thoroughly mixes the filaments 12 and 13 in the bundle 56, so that the bundle emerging from the tube will have each group of filaments 12 or 13 distributed throughout the cross-section of the bundle. The mixed bundle 56 so formed is advanced by feed rolls 51 for further differential crimping treatment described above, if the filaments have only latent differential crimping properties, to form the bulked yarn shown in FIGS. 7 and 8, or if the filaments in the group 13 are crimped before merging the two groups of filaments 12 and 13, as in the procedures described in connection with FIGS. 1 and 5, then such treatment of the mixed bundle 56 is not employed. In a procedure involving overfeed of the group of filaments 13 to precrimp them before combining the two groups of filaments 12 and 13, then additional positive feed rolls in advance of the tube 55 are desirably provided.

In all of the embodiments of the invention described, the final yarn produced is a singles yarn made up of two groups of continuous synthetic filaments, one group of filaments being crimped, the other group of filaments being substantially straight, or at least, much straighter than the crimped filaments, and the filaments of each group being distributed throughout the cross-section of the yarn.

In the following claims, the continuous synthetic filaments of one group are said to have the capability of being crimped to a substantially greater extent than are filaments of the other group, when the two groups of filaments are already crimped differentially before merging into a bundle, or have only potential differential crimping properties before the two groups of filaments are merged. In the latter case, the filaments in the two groups are treated or handled in accordance with the present invention in a manner to cause the differential crimp in the two groups to be developed either while the two groups of filaments are being merged into a bundle or after being merged into a bundle.

Also, in accordance with the present invention, and in accordance with the following claims, the filaments of two groups are said to be differentially crimped when they are differentially crimped to the extent and in a manner to make the filaments crimped to a lesser extent less extensible in the blended bulked yarn than are the other filaments, so that these filaments crimped to lesser extent act as stretch control in the final blended yarn.

While the invention has been described with particular reference to specific embodiments, it is to be understood that it is not to be limited but is to be construed broadly

and restricted solely by the scope of the appended claims.

What is claimed is:

1. A process of producing bulked filament yarn which comprises advancing and merging into a bundle two groups of continuous synthetic filaments in which the filaments of one group have the capability of being crimped to a substantial greater extent than are the filaments of the other group, subjecting the filaments from both groups to gas currents, intermixing in the bundle the filaments from both groups which have been subjected to said gas currents, the filaments from each group being sufficiently free from each other while they are being subjected to said gas currents to cause the filaments from each group to open up by the action of said gas currents and to cause thereby the filaments from the two groups so opened up to be interleaved as the filaments from the two groups are intermixed, said intermixing step being carried out under conditions to cause the filaments from each group to be distributed substantially throughout the cross-section of the bundle, and forming said bundle into a bulked yarn with the filaments from said one group crimped to an extent substantially greater than are the filaments from said other group, so that the filaments from said other group serve as stretch control for the bulked yarn, and with the filaments from said groups so intermixed and distributed in said bulked yarn.

2. process as described in claim 1, wherein the filaments crimped to a less extent are substantially straight.

3. The process as described in claim 1, wherein the two filament groups have differential latent shrinking properties, and the combined bundle is subjected to shrinking action to cause one group of filaments to shrink more than the other group of filaments to cause the filaments having less shrinking properties to be drawn up into crimped form.

4. The process as described in claim 1, wherein the filaments of one group are crimped to a substantially greater extent than are the filaments of the other group before the two groups of filaments are merged to form said bundle.

5. The process as described in claim 1, wherein the two groups of filaments are substantially free from twist to cause each group to be easily opened up by the action of said gas currents and to permit the filaments in the two groups to be freely interleaved into said distributed condition when said groups are merged and the filaments in said groups are intermixed, and wherein the filaments of one group are fed at a faster rate towards the region where the two groups of filaments are merged than are the filaments of the other group, to cause the filaments of said one group to be overfed towards said region and to be crimped thereby.

6. The process as described in claim 1, wherein the two filament groups are subjected to gas currents before they are merged into a bundle to cause the filaments in the two groups to be spread out and thereby to be interleaved as they merge in spread condition.

7. The process as described in claim 1, wherein the filaments from the two groups are subjected to gas currents after they are merged into a bundle to intermix thoroughly the filaments from the two groups in the bundle.

8. The process as described in claim 1, wherein the gas currents are in the form of two gas jets projected from opposite sides against the combined bundle to intermix thoroughly the filaments from the two groups in the bundle.

9. The process as described in claim 1, wherein the bundle passes through a tube and gas jets are directed into said tube to create a turbulent condition in said tube causing the filaments in said tube to be thoroughly intermixed.

10. The process as described in claim 1, wherein the bundle passes through a tube having an annular plenum chamber surrounding said tube and said tube has a series

of orifices through which gas is jetted from said plenum chamber into said tube to create a turbulent condition in said tube causing the filaments in said tube to be thoroughly intermixed.

11. The process as described in claim 1, wherein the bundle passes through a tube with an inlet gas pipe inclined forwardly to said tube to create a turbulent condition in said tube causing the filaments in said tube to be intermixed.

12. An apparatus for producing bulked filament yarns comprising means (1) for continuously advancing two groups of continuous synthetic filaments lengthwise towards a merging zone with the filaments in one group having the capability of being crimped to a substantially greater extent than are the filaments of another group, and (2) for causing said groups of filaments to form a bundle at said merging zone, means for causing the filaments in the two groups when combined into said bundle to be interleaved and intermixed sufficiently to cause the filaments from each group to be distributed substantially throughout the cross-section of the bundle and comprising means for subjecting the filaments from both groups to sufficient gas currents to open up the filaments from said groups, said advancing means being operable to advance the filaments from said groups with the filaments from each group sufficiently free from each other while being subjected to said gas currents to cause filaments from the two groups to open up and the filaments from the two groups to become interleaved and intermixed sufficiently when said opened filaments are in said bundle to cause the filaments from each group to be distributed substantially throughout the cross-section of the bundle, and means for forming said bundle into a singles yarn having the filaments still continuous and the filaments from said one group crimped to an extent substantially greater than are the filaments from the other group and having the filaments from each group distributed throughout substantially the cross-section of the yarn.

13. An apparatus as described in claim 12, wherein the two groups of filaments advanced towards said merging zone have differential latent shrinking properties, said yarn forming means comprising means for subjecting the bundle to a shrinking treatment to cause the filaments from the less shrinkable group to be drawn into crimps by the greater shrinkage of the filaments from the more shrinkable group.

14. An apparatus as described in claim 12, said advancing means comprising means for advancing one group of filaments at a faster rate than the other, to cause said one group of filaments to be overfed in relation to the other and to cause thereby the filaments of said one group to be crimped, before reaching said merging zone.

15. An apparatus as described in claim 12, said means for subjecting the filaments to gas currents being operable directly upon the bundle to cause the filaments from the two groups to be thoroughly intermixed in said bundle.

16. An apparatus as described in claim 12, said means for subjecting the filaments to gas current comprising a tube through which said bundle passes, and means for blowing a gas into said tube to create a turbulent condition therein causing the filaments from the two groups in said bundle to become intermixed.

17. A process of producing bulked filament yarn which comprises advancing two groups of continuous synthetic filaments along respective supports towards a zone to merge the two groups into a bundle, subjecting the two groups of filaments on said supports to gas currents projected against said supports before said groups of filaments are merged to spread the filaments in each group against its respective support and to cause thereby the spread filaments in the two groups to be interleaved as they merge and to be thoroughly intermixed as they are formed into a bundle, and forming a yarn from said mixed bundle in which the filaments from one group are

crimped to an extent substantially less than are the filaments from the other group, and in which the filaments from each group are distributed throughout the cross-section of the yarn.

18. An apparatus for producing bulked filament yarn, which comprises means for continuously advancing two groups of continuous synthetic filaments having differential crimping properties lengthwise towards a merging zone to cause said groups of filaments to combine into a bundle, means for subjecting said filaments to gas currents to cause the groups of filaments to open up and thereby to be thoroughly intermixed when formed into a bundle, said latter means being operable upon the respective groups of filaments while they are being advanced towards said merging zone to cause the filaments in each group to be spread before reaching said zone, whereby the filaments in the two groups as they merge at said zone are interleaved into thoroughly mixed relationship, and means forming said bundle into a singles yarn having the filaments still continuous and the filaments of one group crimped to an extent substantially less than are the fila-

ments of the other group and having the filaments of each group distributed throughout the cross-section of the yarn.

References Cited by the Examiner

UNITED STATES PATENTS

2,746,091	5/1956	Tissot et al.	57—157	X
2,852,906	9/1958	Breen	57—157	X
2,869,967	1/1959	Breen	57—34	X
2,962,794	12/1960	Field.		
2,979,883	4/1961	Waltz	57—140	
3,079,663	3/1963	Dyer et al.	28—1	
3,091,913	6/1963	Field.		
3,126,095	3/1964	Caines et al.		

FOREIGN PATENTS

557,020 10/1957 Belgium.
(Corresponding to Great Britain 861,327/61, 2/1961)

MERVIN STEIN, *Primary Examiner.*

STANLEY N. GILREATH, *Examiner.*