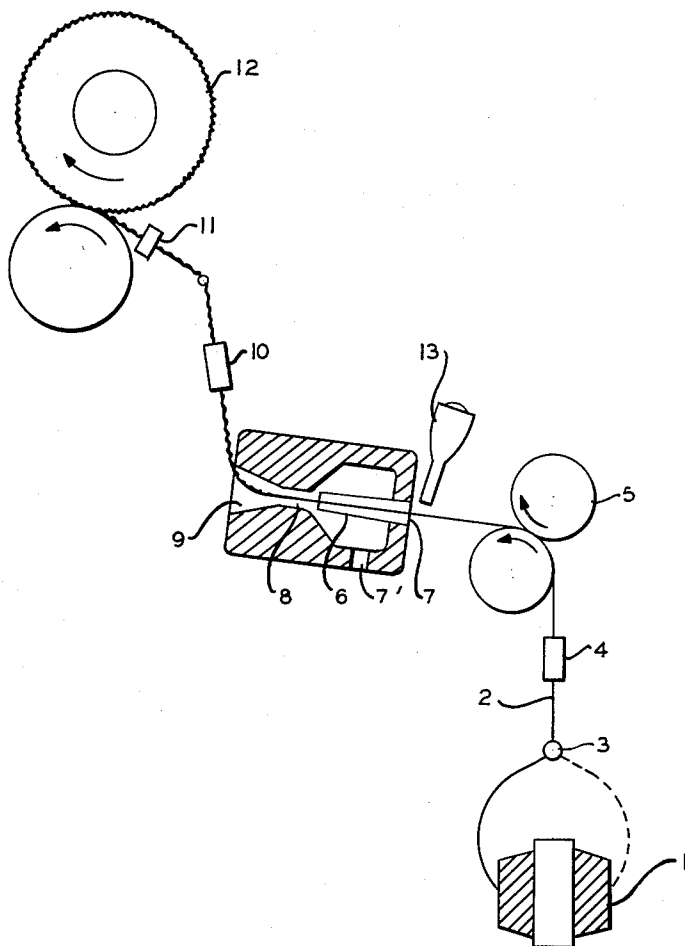


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MAKOTO YAMAMOTO
TREATMENT OF MULTIFILAMENT BULK YARNS

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TREATMENT OF MULTIFILAMENT BULK YARNS
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This invention relates to the treatment of multifilament yarns and is more particularly concerned with the treatment of yarns to increase their bulkiness wherein the yarn, composed of multiple filaments is subjected to the action of turbulent gas to cause the fibers to form numerous ring-like loops, curls and entanglements.

It is known to produce a multifilament yarn of increased bulk by subjecting yarn composed of multiple filaments to turbulence and agitation generated when the yarn is passed through a confined chamber and jetted from a nozzle-outlet, into contact with high velocity jetted gases. In such an operation, a smooth and precise nozzle surface is necessary. Even minor deviations in the nozzle adversely affect the gas flow and greatly diminish the ability of turbulence and agitation of the jetting gaseous body. In some cases, adverse interference with the entire operation is experienced. It will be understood that a rigid nozzle must be employed in order to minimize undesired variations in the process. However, even with a rigid nozzle, the operation cannot be continuously carried out for long periods of time because, even though the nozzle itself does not vary, the flow of fibers and gases out of the nozzle is gradually disrupted as foreign matter such as dirt, dust, oil, broken fibers, worn pieces of fiber, and the like, which enter the nozzle with the gases or the yarn, adhere to and accumulate on the surface of the nozzle. The velocity of the gases in the nozzle in a yarn bulking process of the character indicated is estimated to be over 100 to 300 meters per second. However, it has been observed that even under such a high gas velocity, dirt, oil and other foreign matter, carried into the turbulence zone on the yarn or in the gases, are transferred to the nozzle surface and accumulate thereon. For this reason, great care is exercised in supervising the manufacture of the textured yarn. However, even with the best of precautions, some dust, oil and other foreign matter enter the system, and the foreign matter soon accumulates on the nozzle. Consequently, after each passage of a few kilograms of yarn from the nozzle, the accumulated foreign matter must be removed to prevent adverse operation by means of wiping and overhauling of the nozzle. This is inefficient from the standpoint of both time and manpower.

It is an object of the present invention to provide improvements in the bulking of yarns with compressed gases whereby accumulation of foreign matter upon the nozzle of the bulking apparatus is minimized.

It is another object of the invention to provide an improved process for bulking yarns wherein any accumulation of foreign matter upon the nozzle of the bulking apparatus is easily removed without interrupting the bulking operation.

In accordance with the present invention, accumulation of foreign matter upon the nozzle of the bulking apparatus is prevented or the nozzle is cleaned by introducing a liquid continuously or intermittently into the bulking zone wherein it becomes admixed with the gases in the bulking zone which are jetted from the nozzle while forming numerous ring-like loops, curls and entanglements in the fibers which form the yarns being bulked.

This invention is based upon the discovery that when the liquid is jetted from the nozzle together with the gases and the yarn, it is jetted as a spray, e.g. in atomized form, with the spray being vigorously agitated within the

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nozzle under the action of the accompanying high-velocity gases. These liquid particles in the spray are effective to dislodge, scatter, and remove any foreign matter adhering to the nozzle, whereby the nozzle is automatically cleaned.

This cleaning action is so efficient that generally only a few drops of liquid are sufficient to effect the desired cleaning operation. While the cleaning operation is advantageously carried out while the yarn continues to be fed into the bulking apparatus, and it is thus a feature of the invention that interruption of the bulking operation is not necessary, it will be understood that cleaning by the introduction of liquid into the bulking zone can also be satisfactorily effected when the yarn is not being passed through the nozzle. Even when cleaning is carried out during the texturing operation, the energy expended upon the liquid spray for the cleaning of the nozzle is extremely small compared to the total energy in the gases issuing from the nozzle and, accordingly, the influence of the spray upon the process itself is negligible.

As previously indicated, the process of the present invention is applicable to all yarn-bulking operations involving bulking devices defining a turbulent bulking zone into which the yarn and gases under pressure are introduced and from which the yarn and the gases issue through a nozzle, such as the operation described in Breen, U.S. Patent 2,783,609, which can be carried out in nozzle-containing devices of various forms, including a form having a baffle plate downstream of the nozzle outlet, as shown in FIG. 9 of Breen.

In order to facilitate further description of the invention, reference will be made to the accompanying drawing which shows, diagrammatically, a typical yarn-bulking device and which shows means for admitting liquid to the system.

Referring to the drawing, the yarn 2 coming from the supply bobbin 1 passes through the friction tension device 4, which is of conventional construction, via the guide 3, and then, being fed by the feed rollers 5, passes through the inlet 7 into the guide member 6 from which it issues into the jet passage 8 of the bulking chamber where it comes into contact with compressed gases which enter into the nozzle from the inlet 7'. Both the yarn and the gases are directed to and issue from the nozzle mouth 9. The yarn 2, after issuing from the bulking apparatus, passes through the friction tension device 10 and the guide 11, and is finally wound up upon the bobbin 12. In accordance with the invention, liquid is introduced into the system from a liquid-supply device indicated at 13, which may be a dropper, a syringe, a dropping funnel, or the like. Introduction of the liquid at the inlet 7 of the bulking device, as shown in the drawing, is the most advantageous procedure. Thus, when foreign matter accumulates upon the surface of the passage 8 or the mouth 9 of the nozzle, liquid is added by means of the device 13 upon the yarn as it enters the inlet 7. This liquid is brought into contact with the turbulent gases and is atomized and then brought into contact with the foreign matter on the surfaces to be cleaned. The nozzle surfaces are thereby cleaned in a matter of a few seconds. In this operation, the liquid is introduced along with the yarn during normal operation or it is drawn into the nozzle by the suctioning effect of the gases in the bulking zone. The cleaning action takes place as the gases flow out of the nozzle. However, the liquid is not necessarily added at the inlet 7, and may be added at any other point upstream of the nozzle surfaces upon which the foreign matter accumulates. Accordingly, the liquid can be added into the bulking zone, e.g. at the outlet of the guide member 6. In this case, the liquid must be introduced under a pressure corresponding generally to the pressure in the bulking zone

and more complicated liquid-supplying means are necessary, although such addition yields very good results. Generally speaking, however, the introduction of the liquid at the inlet 7 is entirely satisfactory.

When the addition of water is effected intermittently in accordance with one embodiment of the process of the present invention, the liquid is added after each accumulation of foreign matter. That such an accumulation has taken place and that introduction of liquid is necessary, is readily apparent from the noise generated from the nozzle as the nozzle begins to operate irregularly, or by touching the gases jetted out of the nozzle, the irregularity in the stream being readily felt. However, no difficulty is involved in the course of the bulking operation upon the yarn if liquid is continuously added for continuously carrying out the cleaning operation. In accordance with this embodiment of the process of the invention, no accumulation of foreign matter occurs because the continuous presence of the liquid insures continuous cleaning of the susceptible surfaces. Thus bulking may be steadily carried out. In cleaning the nozzle continuously, not only may the above-mentioned methods of adding liquid be employed, but liquid may be applied to the entering yarn by means of a roller-type calendar to which the liquid is supplied and through which the yarn passes, e.g. rollers 5, this latter method also giving entirely satisfactory results.

Various liquids can be used for the cleaning operation in accordance with this invention. Water is fully effective for this purpose. It may be used alone or it may contain a small amount of a surface active agent. Methanol may also be employed but preferably methanol is used in admixture with an oil, e.g. corn oil or a light mineral oil, e.g. in all proportions. As previously mentioned, the cleaning action is apparently effected by the mechanical action of the moving liquid particles, and it varies somewhat with the momentum and the size of the particles of the spray, and with the velocity of the gases, the surface tension of the liquid, its viscosity, and the like. However, in conventional bulking operations, liquids having the characteristics of those referred to above are completely suitable. Solid particles, e.g. powders such as talc, can thus also be used and have a satisfactory cleaning effect. However, solid materials are difficult to supply to the nozzle and liquids, the application of which is readily effected, are much preferred.

The invention will be further understood from the following specific examples of practical application. However, it will be understood that these examples are not to be construed as limiting the scope of the present invention in any manner. In these examples, all parts are by weight, unless otherwise indicated.

Example 1

620 t./m. yarn of 120 denier, 50-filament viscose rayon was subjected to a continuous bulking operation in a conventional bulking apparatus as shown in the accompanying drawing with the yarn being fed at the rate of 100 m./min. and being wound up at the rate of 90 m./min., compressed air at a gage pressure of 3 kg./cm.² being employed in a quantity to effect turbulence in the bulking zone. Cleaning of the nozzle was effected by adding a few, e.g. ten, drops of water at the inlet 7 for every 500 grams of yarn processed. As a result, completely normal manufacture of bulked yarn was ensured and the nozzle was as clean as it was initially even after 20 kg. of yarn had been processed.

Example 2

600 t./m. yarn of 75 denier, 50-filament formalized polyvinyl alcohol was bulked as described in Example 1. The operation was carried out continuously, and the nozzle was cleaned by applying a few drops of water, containing 2% of a surface-active agent, on the yarn

as it was fed from the feed rollers 5 for every 100 g. of yarn supplied. The nozzle was found out to be entirely clean, and in normal condition, even after 20 kg. of yarn had been processed.

Example 3

Bulked yarn was manufactured from 600 t./m. yarn of 90 denier, 50-filament benzalized polyvinyl alcohol in an apparatus such as shown in the drawing using a feed rate of 165 m./min. and a winding rate of 150 m./min., compressed air of 2.0 kg./cm.² gage pressure being employed. After one pound of the yarn had been processed, the feeding of yarn was stopped, and the nozzle was cleaned by adding to the bulking chamber several drops of a liquid mixture of corn oil and methanol. This procedure was repeated after each pound of yarn had been processed. The nozzle was clean and operating perfectly even after 40 pounds of yarn had been processed.

The invention is applicable to the bulking of all types of fibers which are subjected to treatment to increase their bulkiness, e.g. those referred to in Breen U.S.P. 2,783,609, as well as polyvinyl alcohol fibers and the like.

As previously mentioned, water is the preferred cleaning agent. However, if the fibers being treated are of such nature that it is not desirable to apply only water to them, then a mixture of water with a water-soluble alkyl alcohol, such as methanol, is employed, or solutions of oils in such alcohols are suitably used. In addition to corn oil, other vegetable oils which are liquid at room temperature can be utilized and, similarly, use can be made of various mineral oils which are likewise liquid at room temperature.

Advantageously, as mentioned, a surface-active agent is added to the treating agent. In general, any of the many known anionic, non-ionic, and cationic surface-active agents are suitably used, such as sodium stearate (anionic), polyoxyethylenedodecyl ether (non-ionic), and dodecyltrimethyl ammonium chloride (cationic). By surface active agents are meant generally those compounds possessing a hydrocarbon group which is hydrophobic and a soluble group which is hydrophilic. The nature of the solubilizing group determines the classification of the surface active agent as anionic, cationic, and non-ionic. The sodium salts of the fatty acids (soaps) and the corresponding alcohol sulfonates, sulfates, phosphates, and thiosulfates are typical of the anionic class whose aqueous dispersions are negatively charged. Surface active agents in which cations act as the solubilizing groups are those in which the solubilizing action depends on amino or ammonium groups. Cetyl pyridinium chloride is a typical example of a cationic surface active agent, the aqueous dispersions of which are positively charged. The non-ionic surface agents do not form salts with acids of bases, and, under normal conditions, their dispersions do not carry electrical or ionic charges. Solubilization of this class of agents is achieved by a series of hydroxyl ether groups, and the hydroxy polyethylene ether of diamylphenol is a commercial example of another non-ionic surface active agent. As other suitable surface-active agents, reference may also be made to anionic surface-active agents of the alkylaryl sulfonate type such as Nacconol NRFS and Satomerse D, and alcohol sulfates such as sodium lauryl sulfate and triethanolamine lauryl sulfate. The alkyl phosphate salts are also suitable anionic surface-active agents for the purposes of this invention. Included among cationic surface-agents are such as n-octadecyl disodium sulfosuccinamate and the corresponding tetrasodium sulfosuccinamate. These materials are marketed by The American Cyanamid Co. under the trade-name Aerosol. Other suitable surface-active agents include the fatty amines of the type represented by Alkamine S. J. (marketed by Amalgamated Chemical Company), and the hexitol oleates, such as anhydrohexitol partial oleate marketed under the name Ariacel A (Atlas Powder Company). In the foregoing

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Example 2, the surface-active agent is suitably polyoxy-ethylenedodecyl ether.

The conditions and the relative relationships set forth in the examples are those preferred in carrying out the process of the invention but it will be understood that other conditions and relationships may be used within the scope of the invention.

It will also be understood that various changes and modifications in addition to those indicated above may be made in the embodiments herein described and illustrated without departing from the scope of the invention as defined in the appended claims. It is intended, therefore, that all matter contained in the foregoing description and in the drawing shall be interpreted as illustrative only and not as limitative of the invention.

I claim:

1. In the bulking of yarn wherein yarn is introduced into a bulking zone for confined contact with gases under pressure and the bulked yarn and the gases are withdrawn through a nozzle, the process of cleaning the surfaces of said zone and of said nozzle which comprises intermittently introducing a liquid into said bulking zone in a form adapted to be atomized by said gases and brought into contact with said surfaces of said zone and of said nozzle by the action of said gases.

2. In the bulking of yarn wherein yarn is introduced into a bulking zone for confined contact with gases under pressure and the bulked yarn and the gases are withdrawn through a nozzle, the process of cleaning the surfaces of said zone and of said nozzle which comprises intermittently introducing a liquid into said bulking zone in a form adapted to be atomized by said gases and brought into contact with said surfaces of said zone and of said nozzle by the action of said gases, said liquid being introduced by dropping it upon the yarn at its point of entry into said zone.

3. In the bulking of yarn wherein yarn is introduced into a bulking zone for confined contact with gases under

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pressure and the bulked yarn and the gases are withdrawn through a nozzle, the process of cleaning the surfaces of said zone and of said nozzle which comprises intermittently introducing a liquid into said bulking zone in a form adapted to be atomized by said gases and brought into contact with said surfaces of said zone and of said nozzle by the action of said gases, said liquid being introduced by dropping it upon the yarn at its point of entry into said zone.

4. In the bulking of yarn wherein yarn is introduced into a bulking zone for confined contact with gases under pressure and the bulked yarn and the gases are withdrawn through a nozzle, the process of cleaning the surfaces of said zone and of said nozzle which comprises intermittently introducing water into said bulking zone in a form adapted to be atomized by said gases and brought into contact with said surfaces of said zone and of said nozzle by the action of said gases, said liquid being introduced by dropping it upon the yarn at its point of entry into said zone.

5. In a process for bulking yarn wherein yarn is introduced into a bulking zone for confined contact with gases under pressure and the bulked yarn and the gases are withdrawn through a nozzle, the improvement which comprises intermittently introducing a liquid into said bulking zone in a form adapted to be atomized by said gases and brought into contact with the surfaces of said zone and of said nozzle by the action of said gases.

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