METHOD AND MEANS FOR TREATING WITH A GASEOUS STREAM A THREAD BUNDLE MADE OF A PLURALITY OF ELEMENTARY THREADS
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METHOD AND MEANS FOR TREATING WITH A GASIFORM STREAM A THREAD BUNDLE MADE OF A PLURALITY OF ELEMENTARY THREADS Gaetano Cerutti and Giorgio Faraci, Gozzano, Novara, Italy, assignors to Benberg S.p.A., Milan, Italy, a company of Italy
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9 Claims

ABSTRACT OF THE DISCLOSURE

To ensure the cohesion of a bundle of thread, chiefly synthetic threads, said bundle is caused to move across a gasiform stream wherein sonic oscillations are produced which are constituted mainly by supersonic waves of an intensity made with a 115 decibels and of a frequency ranging between 15,000 and 30,000 cycles, the pressure of the air or the like gas forming the stream ranging between 3.2 and 6 atmospheres. This method cutting out intense audible frequencies is executed in a unit constituted by a nozzle opening into a coaxial cylindrical resonance chamber whose outlet is connected rigidly by a rod extending underneath and laterally of the common axis of the nozzle and chamber.

The present invention has for its object a method for treating a thread bundle made of a plurality of elementary threads showing at the utmost an only reduced cohesion and according to which a gasiform stream is directed onto the bundle and sonic oscillations are produced within the said gasiform stream.

Furthermore, the invention covers an arrangement for executing said method. Said arrangement comprises a nozzle with a circular outlet and into which compressed gas is fed, a resonance chamber provided with a circular inlet facing coaxially the nozzle and two thread guides adapted to guide the bundle of threads in a manner such that its axis crosses the common axis of the nozzle and of the resonance chamber.

It is general knowledge that synthetic threads constituted by a plurality of elementary threads and showing only a reduced twist if any can be worked up only with difficulty, that is their weaving or knitting are difficult since their structure is too loose.

In order to ensure a greater cohesion for synthetic threads constituted by a plurality of elementary threads, the latter are generally twisted and if required sized so as to hold the elementary threads together to an improved extent.

The twisting of the threads constitutes however an expensive operation as concerns both the time required and economic conditions and consequently many attempts have been made with a view to finding other methods leading to a better cohesion between elementary threads forming synthetic threads with only a slight twist, if any.

For this reason, method and means of the above-disclosed type have been developed which allow reaching the desired cohesion without passing through the conventional twisting procedure. Now, the action of a gasiform stream on a tensioned moving thread in association with that of a resonance chamber ensures an interlacing of the elementary threads whereby the latter are bestowed with cohesion. Since the thread is held in a tensioned condition, it remains smooth during the treatment and does not increase in volume as would be the case if the speed of feed of the thread were larger than the speed of its taking up and the thread were consequently fed without any tensioning. A smooth thread thus obtained with coherence between its elementary threads will be designated hereinafter as an interlaced thread.

The above-defined interlaced thread can be worked up on a loom or a knitting machine without it being necessary to previously twist the thread.

It has been ascertained that the shape and size of the resonance chamber must be suitably selected in order to obtain a high grade of cohesion for the elementary threads.

A drawback of such known arrangements constituted by a nozzle and a resonance chamber consists in that they produce during the execution of the method a sound which is very unpleasant to the ears of any person standing near and which can be reduced to an allowable level through acoustically insulating media only with difficulty. This drawback sets thus a bar to a general use of the known arrangements.

The above drawback is removed by the present invention which does not only cut out entirely the disturbing whistling and hissing noise such as that produced by the prior arrangements during the procedure but ensures also a better cohesion of the elementary threads for a similar speed of progression of the thread and a similar increase in the pressure of the air passing out of the nozzle.

The method according to the invention is characterized by the fact that sonic oscillations are produced having a frequency spectrum mainly lying within a range between 15,000 and 30,000 cycles, and this frequency spectrum has a maximum intensity of at least 125 decibels within a narrow frequency band comprised between the said frequencies. By the above said frequency spectrum it is meant that to the total intensity of the generated sonic oscillations there contribute mainly those oscillations having frequencies between 15,000 and 30,000 cycles.

An essential feature of said novel method consists thus in the fact that sonic oscillations are produced, which instead of including a more intense transmission range within acoustic frequencies, as is the characteristic feature for known methods, show a very narrow range of very intense supersonic frequencies.

The intensity of the transmitted range depends on the pressure of air inside the nozzle, in order to obtain an intensity of at least 125 decibels the pressure of the gas should be at least equal to 3.2 effective atmospheres.

Generally speaking, the pressure of the gas lies approximately between 3.2 and 6 effective atmospheres. All kinds of gases may be used such for instance as air, carbon dioxide, nitrogen or else steam. For economical reasons, it is however preferable to resort to air.

The arrangement according to the invention for the execution of the proposed method is characterized by the fact that the resonance chamber is formed by a cylindrical hole the inlet opening of which coincides with the inlet opening of the resonance chamber, said hole having a diameter of 1 to 2 mm. and a length of 1 to 5 mm, while the diameter of the outlet opening of the nozzle is equal to the diameter of the cylindrical hole.

It has been found surprisingly that the sound produced by the arrangement during the execution of the method lies for its major part within the range of frequencies which cannot be heard by a human ear, that is the supersonic range inasmuch as the resonance chamber and the output opening of the nozzle satisfy the shape and size conditions disclosed heretofore.

It should be remarked that it would have been impossible starting from the known state of the art to assume that critical shapes and sizes could be found for the resonance chamber according to which the resonance phenomena would be shifted towards higher frequencies and still less could it be assumed that the transmission of supersonic waves could have a positive action through
resonance on the cohesion of a thread. The supersonic waves transmitted by the improved arrangement during the execution of the method claimed in the accompanying claims can by no means be dangerous for the ears of the persons standing by since they are absorbed readily by the atmosphere of the premises. In order to increase the safety of such persons, it is in fact possible to enclose the nozzle and the resonance chamber within a box of any desired shape.

As to the length of the cylindrical hole, a size of 2.5 to 4 mm. has appeared to provide the best results. The distance between the outlet opening of the nozzle and the inlet opening of the resonance chamber should range advantageously between 1.6 and 2.3 mm. It has been found that in all known arrangements the opening of the nozzle must of necessity extend in an accurately axial direction with reference to the opening in the resonance chamber. When these two parts are fitted separately as is the case for all known arrangements, this may lead to a deficient operation unless the mounting or relative positioning is executed with a very large accuracy. The accurate alignment between the nozzle and the reference chamber entails thereby as high cost in the manufacture of the prior arrangements.

An arrangement for interfacing the threads of a bundle according to which said problem of the alignment is solved very efficiently is characterized by the fact that the nozzle is rigidly connected with the resonance chamber by means extending underneath the common axis of the said nozzle and resonance chamber.

Said embodiment forms not only an advantageous development of the previously proposed arrangements, but it is generally advantageous for all interfacing means including a nozzle and a resonance chamber, whether the frequency of the sonic oscillations lies within an audible or a non-audible range. However, said embodiment is also of a particular interest for the arrangements adapted to execute the method according to the invention.

The alignment between the nozzle and the resonance chamber is of critical nature since the acoustic frequencies can be shifted back into the audible range if the alignment is inaccurate.

The upper surface of the rod connecting the two parts should lie preferably at least at 1.5 mm. underneath the common axis of the nozzle and of the resonance chamber. A simple manner of executing such an arrangement consists in forming a slot of the desired size in a metal rod for the thread to pass transversely therethrough while a bore is formed along the longitudinal axis of the rod in one operative stroke so as to simultaneously obtain the hole forming the nozzle and the resonance chamber. It is thus possible to obtain an accurate coincidence between the axes of the nozzle opening and of the resonance chamber, while no fortuitous modifications in the relative position of the nozzle and of the resonance chamber can possibly appear during the treatment leading to the interfacing of the thread. Furthermore, the invention has for its object the threads treated in accordance with the proposed method and covers the method for executing textile ware with such threads and it covers furthermore the textile products obtained in accordance with last-mentioned method.

The invention will now be described with further detail reference being made to the accompanying drawings with FIG. 1 being a cross-sectional view of the arrangement, FIG. 2 shows the resonance chamber in front view as seen from the line I—I of FIG. 1.

In said drawings:

The upper surface 8 of the rod lies underneath the common axis of the nozzle and of the resonance chamber and said rod extends downwardly beyond the opening of said nozzle. Said position of the resonance chamber with reference to the axis of the openings appears more clearly from inspection of FIG. 2.

The invention will now be disclosed furthermore with reference to the following example:

The grade of the relative interfacing of the elementary threads which is defined hereafter as a factor of cohesion can be reckoned as follows:

A thread of a length of 100 cm. is suspended through a clip in front of a centimeter scale. A clip hanging on the lower end of the thread carries a weight of about 0.2 g. per denier without however being heavier than 100 g.

In registry with the zero point of the scale and immediately underneath the clip, there is introduced across the thread a needle of a thickness of 0.4 mm., bent through 120°, care being taken that the needle lies as near as possible the middle of the bundle of elementary threads whereby at least one quarter and advantageously one third of the elementary threads lie to one side of the hook-shaped needle. The needle is then drawn by hand downwardly along the scale at a speed of about 2 cm. per second so that the elementary threads may not be damaged. The needle is depressed until a point is reached where a large resistance is opposed by the thread by reason of the intense entanglement of the elementary threads. At the point where the needle is arrested, it is possible to read on the scale the length by which the needle has been depressed.

Said measurement is repeated ten times on a succession of sections of the same thread after which the average length by which the needle has been sunk is calculated.

Said value is expressed as $\frac{\pi}{2}$ and the cohesion factor is then defined by $100\%$.

**EXAMPLE**

The arrangement described has been used, as fitted on a drawing and twisting machine, beyond the drawing means and ahead of the winding means. The opening of the resonance chamber had a diameter of 1.5 mm. and a length of 3 mm. The outlet opening of the nozzle had a diameter of 1.5 mm. The spacing between the openings facing each other in the nozzle and in the resonance chamber was equal to 2 mm. and the spacing between the two thread guides was equal to 32 mm.

The arrangement was contained in a metal box with a front flap door, enclosing the thread guides. A thread made of 15 elementary threads of nylon 6 with a final count after drawing of 60 deniers and a factor of cohesion equal to 1 was caused to move across the arrangement at a speed of 453 m./min. During its progression through said arrangement the twist of the thread did not rise beyond 20 revolutions per meter, while its tensioning in registry with the upper thread guide of the arrangement was equal to 0.1 gr. per denier. The relative pressure of the air fed into the nozzle was equal to 4 effective atmospheres.

After the treatment, the thread showed a very high cohesion factor equal to 95. Such a high factor had never before been obtained with any project of the invention as defined by the accompanying claims.

In said drawings:

FIG. 1 is a cross-sectional view of the arrangement, FIG. 2 shows the resonance chamber in front view as seen from the line I—I of FIG. 1, the thread is shown at 1 as extending through the thread guides, 2, 2', and moving across the gap between the outlet opening 3 of the nozzle 4 and the inlet opening 5 with a blind cylindrical hole 6 of the resonance chamber. A rod 7 connects rigidly the nozzle
the arrangement, said microphone being connected with a suitable measuring instrument and the transmitted sound spectrum being drawn on a chart, there was found a narrow frequency band having a distinct intensity of about 130 decibels for a frequency of 2,000 cycles. Other measurements made under identical conditions with prior arrangements have shown total sound intensities of 100 decibels and more while bands of reduced intensities which never rose above 90 decibels were found in the range of supersonic waves, that is the range of frequencies above 15,000 cycles.

The method according to the invention is applicable to various types of synthetic threads and in particular to polyamidic, polyester, polyacrylnitrile threads and also threads made of cellulose acetate, regenerated cellulose, glass and the like. The count of the threads can vary between a low value, say 20 deniers and a high value, say 2,000 deniers or more. The tensioning of the thread fed to the arrangement should lie between 0.05 and 0.3 gr. per denier.

Although it is possible to execute the interlacing of the elementary threads even with a thread tensioning lower than 0.05 gr. per denier, the interlaced thread would then show curls on its upper surface. When the thread tensioning is on the other hand above 0.3 gr. per denier, the grade of the interlacing obtained is reduced. At any rate, it is preferable to resort to a thread tensioning value lying between 0.1 and 0.125 gr. per denier. The thread to be treated should show a very reduced twist, if any. A reduced twist means that the thread is not twisted by more than 40 revolutions per minute. If the twist is larger, the elementary threads are not entangled by the gas flow and consequently no interlacing of the elementary threads is obtained. The spacing between the thread guides is advantageously equal to 20 to 55 mm. The larger the pressure of the gas stream passing out of the nozzle, the larger must the spacing between the thread guides be.

In addition to the above-mentioned application of the improved method to a moving thread, it is possible to use the method disclosed for the connection between the ends of two multi-filament threads: the two ends of the threads are then laid in parallelism and the thread bundle thus obtained is subjected in a tensioned condition to the action of the gas stream. Thus, the two ends are knotted securely with each other.

What we claim is:

1. A method of interlacing a multi-filament thread having little or no cohesion, comprising the steps of subjecting the thread to a gas stream and producing sonic oscillations in said stream substantially within the frequency range of 15,000 to 30,000 cycles per second and having an intensity of at least 115 decibels within said range.

2. A method as claimed in claim 1, according to which the efficient pressure of the gas stream ranges between 3.2 and 6 atmospheres.

3. Apparatus for interlacing a multi-filament thread having little or no twist, comprising a source of compressed gas, a nozzle having an outlet opening for emitting said gas in a stream, guide means for guiding the thread through said stream, and means for producing sonic oscillations in said stream substantially within the frequency of range of 15,000 to 30,000 cycles per second and having an intensity of at least 115 decibels within said range.

4. The apparatus of claim 3 wherein said means for producing sonic oscillations is a resonance chamber comprising an inlet opening and a blind cylindrical hole, the cylindrical hole having a diameter of 1 to 2 mm. and a length of 1 to 5 mm, while the nozzle outlet opening is circular and lies coaxially in front of the resonance chamber opening and is equal to the diameter of the cylindrical hole.

5. The apparatus of claim 4 wherein the length of the cylindrical hole ranges between 2.5 and 4 mm.

6. The apparatus of claim 4 wherein the outlet opening of the nozzle lies at a distance of 1.6 to 2.3 mm. from the inlet opening of the resonance chamber.

7. The apparatus of claim 4 wherein the means for guiding the thread through the gas stream includes two thread guides such that a line joining their centers crosses the common axis of the nozzle and the resonance chamber.

8. The apparatus of claim 4 having means rigidly connecting the nozzle to the resonance chamber.

9. The apparatus of claim 8 wherein said connecting means is a rod extending at least 1.5 mm. underneath the common axis of the nozzle and the resonance chamber.

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JAMES KEE CHI, Primary Examiner

U.S. Cl. X.R.

28—72.12; 57—34
UNIVERS STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,484,914 Dated December 23, 1969

Inventor(s) Giacomo Cerutti et al.

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

In the heading to the printed specification, line 9, "13,401/66, Patent 18,975" should read -- 13401/66 --.

Signed and sealed this 1st day of September 1970.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR. WILLIAM E. SCHUYLER, JR.
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