METHOD AND APPARATUS FOR SPINNING OF STAPLE FIBER YARN

The method and the apparatus find application for spinning of yarn from staple fibers under the influence of the twisting moment (M) created by the rotation at high revolutions of the mechanical twisting chamber (5), as a result of which a yarn is formed (3) with a structure similar to the traditional one and with very high speed of spinning. The apparatus includes a perforated outgoing roller (4) with a pressure roller (4"), an access chamber. (2) and a conical end (7) of the guiding element (8), which enters the twisting zone (μ), inside of which the high speed rotating micro spindle (5) is mounted, and inside of it a short stationary spindle (10) with a small axial hole is placed.
Method and Apparatus for Spinning of Staple Fiber Yarn

Field of Technology

The invention relates to a method and apparatus for spinning of staple fiber yarn that is used in the textile industry and particularly in spinning.

Pre-existing state of technology

There is a known method and an apparatus / 1,2/ for spinning of yarn from staple fibers, that are delivered by a pair of rollers, passing through specially formed access chamber, twisted by an air flow and pulled through a hole of a rotating spindle as continuous yarn. In this method the created loose ends of fibers are twisted before entering the central gate of the rotating spindle from the air vortex in the stationary chamber. The creation of the loose ends of fibers is achieved by restriction of the spreading of the torques near the zone of feeding of the fibrous sliver.

The disadvantage of the method lies in the fact that the rotating spindle does not have a considerable influence on the twisting of the yarn, which is mainly performed by the air vortex in the stationary chamber.

Another disadvantage of the method lies in the fact that the twisting air vortex in the vortex chamber has limitation in the receiving of more effective twists of the yarn due to slippage, which leads to high consumption of high pressure air.

Another essential drawback is that the twisting air vortex from the tangential channels in the vortex chamber for twisting creates centrifugal forces on the loose ends of fibers and the fibers that left with their rear end around the delivery zone, go out of the yarn and are separated as waste.

Another essential disadvantage lies in the fact that the method is sensible to the foreign impurities, found in the fibrous sliver. Those impurities disturb the stability of the air vortex, cause interruption of the spinning process and contaminate the small central hole of the spindle and worsen the quality of the yarn.

Technical Character of the Invention

The aim of the invention is to create a method for spinning a staple fiber yarn, in which huge number of loose fiber ends is created, then they are twisted by strong mechanical twisting moment in the twisting high rev. mechanical chamber, where a strong structure of yarn is formed at high-speed of spinning.

The task is solved by a method for spinning a yarn according to claim 1. In particular the task is solved by a method for spinning a yarn from the fibrous sliver that is delivered by a pair of rollers,
pass through an access chamber, then it is being twisted by the mechanical high revolution chamber and pulled through a hole of the twisting vortex chamber as continuous yarn. According to the invention, the movement of the fibers is on the perforated surface of the supplying drawing roller and after the drawing line, the fibers pass through a zone of pre-compaction of the main fibers and of parallel movement with compaction of the fastening fibers to the main fibers and then they are delivered together to the access chamber, after that the fibers enter the twisting zone, in the front end of the twisting zone the rear ends of the fastening fibers are pulled as a result of the centrifugal forces caused by the fast rotation of the mechanical chamber and after entering the rear end of the twisting zone, the fastening fibers are strongly twisted around the main fibers under the influence of the mechanical twisting moment created by the spindle with high revolutions of the small mechanical twisting chamber, as a result of which a yarn is formed with a structure similar to the traditional one and with very high speed of spinning.

According to possible embodiments of the method according to the invention, one or more of the following steps, independently and/or in mutual combination, are provided:

a) the trajectory and the compaction of the main and the fastening fibers are determined and controlled by the shape of the diaphragm and the force of the vacuum inside the feeding perforated drawing roller and by the shape of the zone of compaction and transportation from the beginning of the access chamber to the end of the leading element, and by the size of the twisting moments in the twisting chambers;

b) in a variant without a zone for pre-compaction of the fibers with thick bottom drawing roller, the trajectory and the compaction of the main and the fastening fibers are determined and controlled by the shape of the zone for compaction and transportation from the beginning to the conical end of the access chamber, and by the size of the twisting moments in the twisting chambers;

c) the spreading of the torques to the fibrous sliver is limited by the shape of the conical end of the access chamber and by its centering towards the top of the stationary spindle;

d) in the twisting zone, the protruding ends of the fastening fibers are strongly twisted around the main ones due to the mechanical influence of the twisting moment, created by the twisting chamber rotating at high revolution speed and the number of the torques of the yarn is determined by the number of the revolutions of the mechanical chamber and depends on the eccentricity and the height of the stationary spindle;

e) a process of spinning can be performed with twisting by the mechanical twisting moment of the small mechanical chamber rotating at high revolution speed, independently or along with the twisting moment of the twisting vortex chamber;

f) the trajectory and the compaction of the main fibers and the forces of pulling and wrapping in the loose ends is changed, and the incoming fibrous sliver comprises natural fibers or mixtures with chemical fibers, as well as the process of twisting from the twisting chambers is selected according
to the type of the yarn;
g) when switching the operation of the spinning place, the twisting of the yarn is performed by the
twisting moment of the vortex twisting chamber, and after starting the operation on the spinning
place, the influence of the twisting vortex of the additional twisting vortex chamber can be turned off
according to the selected process of spinning.
The apparatus for carrying out the method according to the invention comprises an outgoing drawing roller
that has perforated surface and under it the diaphragm is placed where before and after the drawing line
the zone for feeding and compaction of the fibers of the fastening fibers and the main fibers is
formed; above the surface of the roller the access chamber is placed and it is formed by the leading
driving element and has an extension at the beginning; the conical end of the driving guide enters
the twisting zone where the high-speed rotating micro spindle is mounted, inside of which a short
stationary spindle with a small axial hole is placed and after the stationary spindle an additional
vortex spinning chamber is placed.
The zones in the apparatus may comprise one or more of the following parts/components, independently
and/or in mutual combination:

a) the access chamber is placed below the axis of drawing and it has an extension at the
beginning on the direction of rotation of the roller and is formed by a sleeve in which the
driving guide is placed that has a shape of crossed cone with twisted guiding surface around
the longitudinal axis in the direction of rotation of the mechanical chamber, and the conical
end is with determined length and is shaped under an angle and through its whole length it
has a narrowing cylindrical slot;

b) the radius of the conical end is approximately equal to the internal radius of the stationary spindle and
its cylindrical slot is placed at a distance from the center of the top of the spindle top;

c) the access chamber can be placed above the axis of drawing and initially it has an extension
in the direction of rotation of the upper roller and is formed by a sleeve where the driving
guide is placed, which has the shape of a crossed cone with twisted guiding surface around
the longitudinal axis in the direction of rotation of the mechanical chamber, and the conical
end is the top of an additionally placed needle;

d) the mechanical twisting chamber is formed as turbo spindle with a small diameter and with formed
blades on the surface for rotation with very high revolutions; the beginning of the micro spindle is
shaped as an internal cone with radial ribs or cuts on its surface, as the access cone comprises the end of
the outlet guiding cone of the access chamber; the exit of the twisting spindle is shaped as an internal
cone as well, inside of which enters the stationary spindle, and the whole micro turbo spindle is placed at
a bearing created by two removable parts, inside of which there are formed holes for feeding an air with
high pressure against the blades and holes for taking out the processed air, and the bearing is mounted in
the annular bearing body;

e) in the vortex spinning chamber there are two separate access air holes for feeding of high pressure air
to the tangential holes for creation of an additional twisting vortex;

f) the whole micro turbo spindle is placed in a case of aerial bearings in which the high pressure air is
supplied.

An advantage of the proposed method for spinning of yarn lies in the fact that the mechanical
twisting moment of the micro spindle rotates at very high revolution speed and performs secure and
strong twist of the yarn.

Another advantage of the proposed method for spining of yarn lies in the fact that the mechanical twisting
moment of the micro spindle creates more effective torques of the yarn due to the small slippage and the air
consumption of the spindle is less.

Another advantage is that the fibers stay longer in the twisting zone of the mechanical chamber.

Another advantage lies in the fact that in the fibrous sliver there are fastening fibers formed preliminary that
protrude outside the main fibers.

Another advantage is that the foreign impurities do not essentially influence the mechanical revolutions of the
spindle.

Description of the attached figures

The apparatus is described in detail by the attached figures wherein:

Figure 1 - a schematic plan of the apparatus, upright projection
Figure 2 - a schematic plan of the apparatus, plan section
Figure 3 - a schematic axonometric view of the fiber conductor
Figure 4 - front view of the access chamber
Figure 5 - a schematic plan of the twisting zone, plan section
Figure 6 - a schematic plan of the twisting zone, upright projection
Figure 7 - a schematic plan of the apparatus along with the vortex twisting chamber
Figures 7 a and 7b - sections through the two types of tangential holes of the vortex twisting chamber

Figure 8 - a schematic plan of another variant of the apparatus with thick bottom drawing roller and
with upper positioned access chamber with blocking needle.
Figure 9 - a cross-section of the mechanical twist chamber
Figure 10 - a longitudinal cross section of the mechanical twisting chamber
Examples for Implementation of the Invention

In the method for producing of staple fiber yarn, the movement of the fibers 1 is on the perforated surface η1 of supplying drawing roller 4 and after the line 0-0 of drawing, the fibers 1 pass through zone of preliminary compaction η of the main fibers n and of parallel movement with compaction of the fastening fibers m to the main fibers n and after that they are delivered to the access chamber 2, after which the fibers 1 enter the twisting zone μ, at the front end of which the rear ends of the fastening fibers m are pulled due to the centrifugal forces caused by the fast rotation of the mechanical chamber 5, and after entering the rear end of the twisting zone μ the fastening fibers m strongly twist around the main fibers n under the influence of the mechanical twisting moment M created by the rotating with high revolutions of the small mechanical twisting chamber 5, as a result of which yarn 3 is formed with a structure similar to the traditional one and with very high speed of spinning.

According to possible embodiments of the method according to the invention, one or more of the following steps, independently and/or in mutual combination, are provided:

a) the trajectory and the compaction of the main fibers n and the fastening fibers m are determined and controlled by the shape of the diaphragm 6 and the force of the vacuum inside the feeding perforated drawing roller 4 and by the shape of the zone for compaction and transportation from the beginning w of the access chamber 2 to the end 7 of the guiding element 8, and by the size of the twisting moments M and N in the twisting chambers 5 and 9;

b) in variation without a zone for preliminary compaction η of the fibers with dense bottom drawing roller 4 the trajectory and the compaction of the main ones n n and of the fastening fibers m are determined and controlled by the shape of the zone for compaction and transportation from the beginning w to the conical end 7 of the access chamber 2, and from the size of the twisting moments M and N in the twisting chambers 5 and 9;

c) the spreading of the torques to the fibrous sliver 1 is limited by the shape of the conical end 7 of the access chamber 2 and by its centering x and y towards the top of the stationary spindle 10;

d) in the twisting zone μ, the protruding ends of the fastening fibers m are strongly twisted around the main fibers n due to the mechanical influence of the twisting moment M, created by the rotation at high speed revolutions of the twisting chamber 5, and the number of the torques of the yarn 3 is
determined by the number of revolutions of the mechanical chamber 5 and depends on the eccentricity e and the height h of the stationary spindle 10;
e) a process of spinning can be performed with twisting from the mechanical twisting moment M of the rotating with high revolutions small mechanical chamber 5 independently or along with the twisting moment N of the twisting vortex chamber 9;
f) the trajectory and the compaction of the main fibers n and the forces of pulling and wrapping of the loose ends m can be changed, and the access fibrous sliver 1 comprises natural fibers 1 or of mixtures with chemical fibers, as well as the process of twisting from the twisting chambers 5 and 9 can be selected according to the type of yarn 3;
g) when switching the spinning place, the twisting of the yarn 3 is performed by the twisting moment N of the vortex twisting chamber 9, and after starting operation on the spinning place, the influence of the twisting vortex N of the additional twisting vortex chamber 9 can be switched of according to the selected process of spinning.
The apparatus for implementation of the method comprises an outgoing drawing roller 4 with perforated surface 11 under which the diaphragm 6 is placed and after the drawing line 0-0 a zone 6 for feeding and compaction of the fibers 1 of the fastening fibers m and of the main fibers n is formed and below the surface 11 of the roller 4 the access chamber 2 is placed, it is formed by the driving guide 8 and has an extension w at the beginning and the conical end 7 of the driving guide 8 enters the twisting zone 2 where the high-speed rotating micro spindle 5 is mounted, inside of which a short stationary spindle 10 with a small axial hole is placed and after the stationary spindle 10 an additional vortex spinning chamber 9 is placed.
The zones in the apparatus may comprise one or more of the following parts/components, independently and/or in mutual combination:
a) the access chamber 2 is placed under the axis of drawing 0-0 and it has an extension w at the beginning - direction the rotation of the roller 4 and is shaped from a sleeve 27 inside of which is placed the leading guiding element 8, that has a form of crossed cone with twisted a guiding surface around the longitudinal axis in direction of the rotation of the mechanical chamber 5, and the conical end 7 is with specified longitude s and is shaped under angle β; across its whole length there is a narrowing cylindrical slot 24;
b) the radius r1 of the conical end 7 is approximately equal to the internal radius r2 of the stationary spindle 10, and its cylindrical slot 24 is placed at a distance x and y from the beginning of the center of the spindle 10;
c) the access chamber 2 can be placed above the axis of drawing 0-0 and it has at the beginning an extension w with direction the rotation of the upper roller 4 and is formed by the sleeve 27 inside of which is placed the leading guiding element 8, that it has a form of crossed
cone with twisted a leading surface around the longitudinal axis with the direction of rotation of
the mechanical chamber 5; the conical end 7 represents the top of the additionally placed needle;
d) the mechanical twisting chamber is formed as turbo spindle 5 with a small diameter D and with formed
blades 15 on the surface for rotation with very high revolutions; the top of the micro spindle is shaped as an
internal cone with radial ribs or cuts 21 on its surface, as the access cone 20 comprises the end of the outlet
guiding cone 7 of the access chamber 2; the exit of the twisting spindle 5 is shaped as an internal cone as well,
inside of which enters the stationary spindle 10, and the whole micro turbo spindle 5 is placed at a bearing 13
created by two removable parts, inside of which there are formed holes 14 for feeding an air with high pressure
against the blades 15 and holes 22 and 28 for taking out the processed air, and the bearing is mounted in the
annular bearing body 23;
e) in the vortex spinning chamber 9 there are two separate access aerial holes 16 for feeding of high pressure
air to the tangential holes 18 and 19 for creation of an additional twisting vortex;
f) the whole micro turbo spindle 5 is placed in a case 23 of the aerial bearings in which the high pressure air 26
is supplied.

Application of the Invention

The method and the apparatus for spinning a yarn from staple fibers is performed when the front ends of the
fibers 1 reach the drawing line 0-0 between the drawing pair 4-4’ that is compacted in two fibrous streams
of main fibers n and fastening fibers m. The fibrous sliver 1 enters the access chamber 2, where the
spreading of the torques is restricted by the cone 7 and is located in the twisting zone µ, in the front end of
which the rear ends of the fastening fibers m are pulled as a result of the centrifugal forces caused by
the fast rotation of the mechanical chamber 5, and after entering the rear end of the twisting zone µ
the fastening fibers m are strongly twisted around the main ones n under the influence of the
mechanical twisting moment M created by the rotation with very high revolutions of the small
mechanical twisting chamber 5, as a result of which a yarn 3 is formed with structure similar to the
traditional and with very high speed of spinning.

It should be understood that the invention includes modifications and changes that could be made
similar to those described herein without departing from the scope and spirit of the invention as set
forth in those claims.

References:

1. Patent US No 5528895, d D 01 H 5/00.
CLAIMS

1. Method of spinning a yarn from staple fibers, which are delivered by a pair of rollers, pass through an access chamber (2), then are twisted and pulled as continuous yarn which is characterized by the fact that the movement of the fibers (1) is on a perforated surface (11) of a supplying drawing roller (4) and after a drawing line (O-O) the fibers (1) pass through a zone of preliminary compaction (η) of the main fibers (n) and of parallel movement with compaction of fastening fibers (m) to the main ones (n) and afterwards are jointly fed to the access chamber (2); then the fibers (1) enter a twisting zone (μ), in the front end of which the rear ends of the fastening fibers (m) are pulled resulting from the centrifugal forces caused by the fast rotation of a mechanical chamber (5); after entering in the rear end of the twisting zone (μ) the fastening fibers (m) are strongly twisted around the main ones (n) under the influence of the mechanical twisting moment (M) created by the rotation with high revolutions of the mechanical twisting chamber (5) in result of which is formed a yarn (3).

2. Method according to claim 1, wherein trajectory and compaction of the main fibers (n) and the fastening fibers (m) are determined and controlled by the shape of a diaphragm (6) and the force of the vacuum inside the feeding perforated drawing roller (4) and by the shape of the zone of compaction and transportation from the beginning (w) of the access chamber (2) to the end (7) of the access element (8) and by the size of the twisting moments (M and N) in the twisting chambers (5 and 9).

3. Method according to claim 1 or 2, wherein no zone for preliminary compaction (η) of the fibers with thick bottom drawing pair (4) is provided, wherein the trajectory and the compaction of the main fibers (n) and of the fastening fibers (m) are determined and controlled by the shape of the zone of compaction and transportation from the top (w) to the conical end (7) of the access chamber (2) and by the size of the twisting moments (M and N) in the twisting chambers (5 and 9).

4. Method according to any one of the previous claims, wherein the spreading of the torques to the fibrous sliver (1) is limited by the size of the conical end (7) of the access chamber (2) and from its centering (x and y) towards the top of the stationary spindle (10).

5. Method according to any one of the previous claims, wherein in the twisting zone (μ), the protruding ends of the fastening fibers (m) are strongly twisted around the main fibers (n) by the mechanical action of the twisting moment (M) created from the rotation with very high revolutions of the twisting chamber (5), and the number of the torques of the yarn (3) is determined by the number of revolutions of the mechanical chamber (5) and depends on the eccentricity (e) and the height (h) of the stationary spindle (10).
6. Method according to any one of the previous claims, wherein a process of spinning with twisting is performed by the mechanical twisting moment (M) of the rotating with high revolutions of the small mechanical chamber (5) independently or along with the twisting moment (N) of the twisting vortex chamber (9).

7. Method according to any one of the previous claims, wherein the trajectory and the compaction of the main fibers (n) and the forces of pulling and wrapping of the loose ends (m) is changed, and the access fibrous sliver (1) comprises natural fibers (1) or from mixtures with chemical fibers, as well as the process of twisting from the twisting chambers (5 and 9) is selected according to the type of yarn (3).

8. Method according to any one of the previous claims, wherein in switching the spinning place, the twisting of the yarn (3) is performed by the twisting moment (N) of the vortex twisting chamber (9), and after starting operation on the spinning place, the influence of the twisting vortex (N) of the additional twisting vortex chamber (9) can be switched off in accordance with the selected mode of spinning.

9. An apparatus for perforating the method according to any of the previous claims, comprising an outgoing perforated cylinder, a transport chamber of fibers and twisting chamber connected with tangential channels for feeding of pressurized air, characterized by the fact that the surface (11) of the outgoing drawing roller (4) is perforated and below it there is a placed sleeve (6), inside of which before and after the drawing line (O-O) zone (η) is formed for feeding and compaction of the fibers (1) of fastening fibers (m) and of main fibers (n) and above the surface (11) of the roller (4) the access chamber (2) is placed, which is formed by the leading guiding element (8) and initially it has an extension (w), and the conical end (7) of the guiding element (8) enter the twisting zone(8), where the high speed rotating micro spindle (5) is mounted and inside it a short stationary spindle (10) is placed with a small axial hole; after the stationary spindle (10) an additional vortex spinning chamber (9) is placed.

10. The apparatus according to claim 9, wherein the access chamber (2) is placed below the axis of drawing (O-O) and it has an extension (w) at the beginning in the direction of rotation of the roller (4) and is shaped by a sleeve (27) inside of which the leading guiding element (8) is placed, that has a shape of crossed cone with twisted (a) guiding surface around the longitudinal axis in the direction of rotation of the mechanical chamber (5), and the conical end (7) is with specified length (s) and it is shaped under angle (β) and trough its whole length there is a narrowing cylindrical slot (24).

11. The apparatus according to claim 9 or 10, wherein the radius (r1) of the conical end (7) is approximately equal to the internal radius (r2) of the stationary spindle (10), and its cylindrical slot (24) is placed at a distance (x and y) from the center of the top of the spindle (10).
12. The apparatus according to any one of claims 9 to 11, wherein the access chamber (2) is placed above the axis of drawing (O-O) and it also has an extension (w) at the beginning in the direction of rotation of the upper roller (4') and is shaped by a sleeve (27) inside of which the guiding element (8) is placed which has a shape of crossed cone with twisted (a) guiding surface around the longitudinal axis in the direction of the rotation of the mechanical chamber (5), and the conical end (7) is the top of the additionally placed needle.

13. The apparatus according to any one of claims 9 to 12, wherein the mechanical twisting chamber is formed as a turbo spindle (5) with a small diameter (D) and with formed on its surface blades (15) for rotation at very high speed revolutions, and the top of the micro spindle (5) is shaped as an internal cone (20) with radial ribs or cuts (21) on its surface, as the internal cone (20) comprises the end of the guiding cone (7) of the access chamber (2), and the exit of the twisting spindle (5) is shaped as an internal cone too, inside of which enters the stationary spindle (10), and the whole micro turbo spindle (5) is placed at a corpus (13) created by two removable parts, inside of which there are holes (14) for supply of high pressure air against the blades (15) and holes (22 and 28) for removal of the processed air, and the corpus (13) is mounted in the annular supporting body (23).

14. The apparatus according to any one of claims 9 to 13, wherein in the vortex twisting chamber (9) there are shaped two separated access aerial holes (16 and 17) for feeding an air with high pressure to the tangential holes (18 and 19) for creating of an additional twisting vortex (N).

15. The apparatus according to any one of claims 9 to 14, wherein the whole micro turbo spindle (5) is housed in a corpus (23) of the aerial housings (25) where the high pressure air (26) is delivered.
INTERNATIONAL SEARCH REPORT

PCT/BG2015/000006

A. CLASSIFICATION OF SUBJECT MATTER

INV. D01H1/115 D01H4/02

B. FIELDS SEARCHED

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

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NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040; Fax: (+31-70) 340-3016

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