



(51) International Patent Classification:

D01H 1/115 (2006.01) *D01H 5/00* (2006.01)
D01H 4/02 (2006.01) *D01G 19/18* (2006.01)
D01H 4/32 (2006.01)

(21) International Application Number:

PCT/BG2015/000004

(22) International Filing Date:

25 February 2015 (25.02.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

111715 5 March 2014 (05.03.2014) BG

(72) Inventor; and

(71) Applicant : **BAHOV, Dinko, Atanasov** [BG/BG]; Zelena Livada 21, ap. 2, 5300 Gabrovo (BG).

(72) Inventors: **BAHOV, Atanas**; Zelena Livada 21, ap. 2, 5300 Gabrovo (BG). **BAHOV, Dobromir**; Zelena Livada 21, ap. 2, 5300 Gabrovo (BG). **BAHOVA, Olga**; Zelena Livada 21, ap. 2, 5300 Gabrovo (BG).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

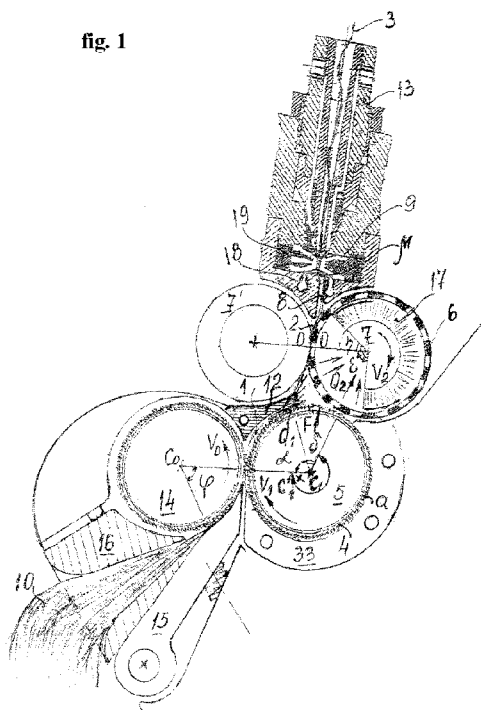
Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR SPINNING A YARN FROM STAPLE FIBERS

fig. 1



(57) Abstract: Method for producing a yarn from staple fibers, where the speed of movement of the fibers (1) is continuously increasing, and then the fibers are twisted by a high-speed twisting moment (M), thereby achieving the formation of the yarn (3) at high speed. The apparatus is formed by combing rollers (5 and 14) and drawing rollers (7 and 7'), close to it a fast rotating pneumatic micro spindle (9) is mounted, forming the spinning zone (μ) with twisting mechanical moment (M), after which additional vortex spinning chamber (13) is placed.



Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

METHOD AND APPARATUS FOR SPINNING A YARN FROM STAPLE FIBERS

Field of the 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 and 3/ for producing of yarn from staple fibers in a process of combing by separating the fibers, drawing and twisting in which the fibrous sliver is delivered by a feeding roller and a feeding table, then it is separated in bundles of fibers by a fast-rotating spiked roller, as the fibers are superimposed on a perforated roller as a continuous fibrous sliver which is then twisted by the vortex air chamber.

The disadvantage of the method and the device is that it is complicated technically and constructively.

Another disadvantage of this method lies in the fact that it disturbs the integrity of the fibrous sliver.

Another drawback of the method is that during the passage of the fibers the parallelism of the fibers is disturbed by the separating roller of the perforated assembling roller.

Another disadvantage of the method lies in the fact that it cannot achieve straightening of the fibers so that they can be retained in this condition.

Another drawback of the method lies in the fact that it cannot provide sufficient control of the movement of the fibers during the process of combing and drawing out.

There is another method and apparatus / 4 and 5/ for spinning yarn from staple fibers that are delivered by a pair of rollers, passes through specially designed access chamber, then are being twisted by rotating air flow and drawn through a hole of rotating spindle as continuous yarn. The main part of the fibrous strip receives a twist, and the other part from sticking out ends of fibers receives no twists. In this method the created loose ends of fibers are twisted before entering the main gate of the rotating spindle by the air vortex in the stationary chamber.

The disadvantage of this method consists in 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 consists in the fact that the twisting air vortex in the swirl chamber has a limit in the obtaining of more effective twists of the yarn due to slippage, which leads to high consumption of high pressure air.

Another significant disadvantage is the general movement in the access chamber of all fibers connected in a strip, which hinders the formation of more free ends from fibers.

Another significant disadvantage is that the method is sensitive to the foreign impurities present in the fibrous strip. These impurities distort the stability of the air vortex and cause disruption of the spinning process and pollute the small central hole of the spindle and the quality of the yarn.

Technical Character of the Invention

The aim of the invention is to create a method for producing a staple fiber yarn in a short technological process of combing, drawing and twisting, in which a fibrous sliver is produced without breaking the linkage between the fibers in order to keep their parallelism as a result of a constant increase of their speed. At the same time

a high drawing of the fibrous sliver is performed and a subsequent strong twisting of the cores around the wrapping fibers and as a result of this the yarn is produced, similar to the traditional, with high-speed of spinning.

The task is solved by a method for producing a staple fiber yarn according to claim 1. For example, the task is solved by a method wherein the fibrous sliver, supplied by a feed roller and feeding table is combed and recombined by a spiked roller, then it is pulled out by a pair of output rollers, and finally it is twisted strongly by a twisting element. According to an embodiment of the invention, after the feeding zone a continuous fibrous sliver is formed in a zone of combing and main drawing, after which the fibrous sliver passes through transfer and additional drawing zones, as the speed of the movement of the fibers increases continuously in the zones of combing and main drawing, transfer and additional drawing, thus constant control of the fiber movement is ensured, and after the drawing line the fibers are passing through the zones of sealing of the main fibers and the parallel movement with sealing of the supporting fibers to the main ones and then together they are delivered to the access chamber.

According to an embodiment of the invention, then the fibers enter the twisting zone, at the front end of which the rear ends of the supporting fibers are pulled as a result of the centrifugal forces caused by the rapid rotation of the mechanical chamber, and after entry into the rear end of the zone of twisting the supporting fibers strongly twist around the main ones under the influence of the mechanical torque created by the rotation with high speed rev. of the small mechanical twisting chamber as a result of which the yarn is formed with a structure similar to the traditional and with very high speed of spinning.

According to alternative embodiments of the present invention, one or more of the following steps, independently and/or in mutual combination, are achieved by this method:

- a) The feeding zone ensures secure clamping of the fibrous sliver till the fiber rear end leaves the zone that is formed depending on the fiber type ;
- b) During the combing and the main drawing in the zone, the front ends of the fibers are combed; the main drawing is performed as a result of which a continuous fibrous sliver is formed with the required thickness and constant control of the movement of the fibers is ensured by the clothing of the combing roller, by the created air vortex in which the speed of the air increases, and by the additional large centrifugal force, resulting from the high speed of the combing roller;
- c) in the transfer zone ,the fibrous sliver passes from the needle clothing of the combing roller on the nearby drawing zone formed by the perforated surface of the pulling roller, as a result of the centrifugal force of the combing roller and the air flows around its clothing and, and in some variants due to the action of the air flow passing through the perforated surface of the combing roller and drawn in by the strong vacuum inside the pulling roller, as the roller is moving faster than the combing roller and so the fibers are maintained in a tension condition;
- d) in the drawing zone the fibers are drawn further as their front ends reach the drawing line between the pair of rollers, thus the rear ends of the fibers are being combed, and along with the drawing the fibers are packed in two fibrous streams comprising main fibers and fastening fibers and at the end they are connected and packed together;
- e) the fibrous sliver enters the access chamber and in the twisting zone, and in the access chamber the distribution of the twists is limited, and in the twisting zone, the supporting fibers are strongly twisted around the main ones under the influence of the twisting moment created by rotation to high speed mechanical twist chamber as a result of this the yarn is produced with a structure similar to the traditional one and with high speed of spinning;
- f) a process of spinning with a twist may be carried out by the mechanical twisting moment of the rotating with high speed rev. small mechanical chamber along with the twisting moment of the twisting swirl chamber;
- g) the trajectory and the compaction of the main and the supporting fibers are controlled by the power of the vacuum inside the feeding drawing perforated cylinder, by the shape of the compaction zones and by the transportation in the access chamber, and by the size of the twisting moments in the twisting chambers;
- h) the trajectory and the compaction of the main fibers and the forces of pulling and winding the free ends may be changed independently of one another, and the access fibrous strip may

be composed of different types of fibers as well as the twisting process from the twisting chambers may be chosen according to the type of yarn, and after starting the operation of the spinning space ; the action of the twisting vortex of the additional twisting chamber may be excluded;

i) at the beginning of the combing zone, it may be formed zone for separation of the foreign impurities from the fibers, depending on their type and status;

j) at the end of the combing zone, zone for additional combing of the fibers can be formed, thus improving their parallelism.

According to a possible embodiment, an apparatus for carrying out the method comprises a feed zone, formed as a part of a common closed corpus, in which the zone for combing and main drawing are placed as well as the zone for transfer of the fibers from the needling surface of the pulling roller, and on that surface a zone for additional drawing is formed, and after the line of drawing a zone for pulling free ends of the fibers is formed which enters the access chamber, and the tapered end of the access chamber enters the twisting zone in which the rapidly moving micro spindle is mounted, in which a short stationary spindle with small axial hole is placed, and after the stationary spindle there is an additional vortex spinning chamber.

According to possible alternative embodiments, the zones in the apparatus are made of as following steps, independently and/or in mutual combination:

a) the feeding zone is formed by a feeding roller, a feeding table, a clamping device and inlet funnel mounted between them and limited by an adjusting bolt;

b) the zone for combing and main drawing is formed by the combing roller which has a smaller diameter and is covered with a needle clothing with an angle of the teeth, determined according to the type of the fibers, and , near to the clothing the concentric surface of the closing corpus is formed , and the end of the feeding zone is the access of the combing sector formed eccentrically on the clothing of the roller, as the width of its section decreases from the beginning to the end, and the length of the combing zone is determined by the length of the fibers;

c) the zone for the separation of the foreign impurities can be formed as a tangential channel;

d) the zone for additional combing of the fibers can be shaped like a cylindrical air chamber at the end of the combing sector that is laterally closed ;

e) the transfer zone is formed contracting from the end of the combing sector to the beginning of the body of the pneumatic chamber in the direction of the fiber movement , and in it enters the clothing of the combing roller and the nearby placed perforated surface of the drawing roller , the combing roller can have perforated surface and placed in it pneumatic nozzle, and the pneumatic chamber is connected to the stratospheric air, forming air

flow resulting from the vacuum created in the pulling roller and for this purpose a narrow slot is shaped ;

f) the combing sector, the body of the pneumatic chamber ,the closing case, the feeding table, the pressure apparatus, the access funnel and the limiting screw are mounted on an adjustable plate corresponding to the specified length of the processed fibers as in the plate there are through holes for the working rollers and holes for mounting ;

g) in the case for bearing threaded holes for mounting are formed as well as the hole for the bearing of the drawing roller , the hole for the bearing of the pressing roller and the hole for the bearing of the combing roller , and a hole for bearing of the feeding roller

with opportunity to change the balance, which is stationary at a certain angle from the bolt

h) the drawing zone is formed on the perforated surface of the drawing roller, under which the diaphragm is mounted, continuing a little bit after the drawing line in order to suck the fiber supporting ends and the length of the zone is determined by the fiber length;

i) the twisting zone is formed at the end of the access chamber, the inlet of which has an extension that is shifted downwards under the axis of the twisting zone, and at the end of it there are openings for vacuum creating and it ends with a needle which enters closely to the stationary spindle , with a small height, and it is placed at a distance from and below the drawing line, as it is mounted axially in the interior of a high-speed micro spindle, for example pneumatically, placed in a body and rotated by the high pressure air, as the high-speed spindle has a small diameter for moving and can be rotated at high speed, and after the stationary spindle , an additional twist vortex chamber is mounted eccentrically to the hole of the stationary spindle, it can be used for spinning the yarn at the beginning of the process or in case of breaking of the yarn ;

j) in the vortex spinning chamber there are formed two separate air inlet holes for feeding of high pressure air to the tangential openings in order to create additional twisting vortex.

k) the mechanical twisting chamber is formed as a micro turbo spindle with shaped on its surface blades rotating at very high revolutions, and which has a conical inlet with radial cuts or ribs, as the inlet cone of the twisting spindle scopes the outlet guiding cone of the access chamber , while the output of the twisting spindle is shaped like a cone in which enters the stationary spindle and the whole micro turbo spindle is placed in a housing comprising two parts, in which are formed inlet openings for feeding of high pressure air against the blades and the openings for the removal of exhaust air, and the housing is mounted in an annular supporting body.

The advantages of the proposed method for obtaining a staple fiber yarn according to the invention lie in the fact that the technological process of combing, drawing and twisting is short , and it forms fibrous sliver in a continuous process with a very high drawing, without disturbing the connection between the fibers.

Another advantage is that the fibers move with constantly increasing speed which achieves straightening of the fibers and their preservation in this condition, and the control of the fibers is very good, including the short fibers

and is followed by a strong twisting of the cores around the sheathed fibers, and a yarn similar to the traditional one is produced with high-speed of spinning.

Another advantage is that there is no crossing of the fibers on receiving surface, that could have lower speed and thereby disturb the parallelism of the fibers.

Another advantage is that the combing is performed in one zone by one roller, which provides better control of the fibers in a short process.

The advantage of the proposed method of spinning a yarn lies in the fact that the mechanical twisting moment of the micro spindle rotating at very high revs performs the main twisting of the yarn.

Another advantage of the proposed method for spinning a yarn lies in the fact that the mechanical twisting moment of the micro spindle creates more effective twists to the yarn due to the low sliding, while the air consumption for rotation of the spindle is smaller.

Another advantage lies in the fact that in the fibrous silver, supporting fibers are formed in advance and they protrude beyond basic fibers.

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

Brief description of the attached figures

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

Figure 1 – a schematic plan of the method and the apparatus

Figure 2 – a schematic plan of the process of the method and the apparatus in another variation

Figure 3 – a schematic plan of the process of combing and the main drawing of the fibers

Figure 4 – a schematic plan of the process of feeding, combing and main drawing of the fibers,

Figure 5 – a schematic plan of the process of additional combing of the fibers

Figure 6 – a schematic plan of the process of feeding, combing, main drawing, transferring and additional combing of the fibers

Figure 7 – a schematic plan of possible variation of the transferring zone of the fibers

Figure 8 – a schematic plan of possible variation of the cleaning zone

Figure 9 – a schematic design plan of the method and the apparatus

Figure 10 – a schematic plan of the cross-section of the high-speed micro spindle

Figure 11 – a schematic plan of longitudinal section of the high-speed micro spindle

Figure 12 – a pictorial view of the high-speed micro spindle

Figures 13a, 13b, 13c, 13d, 13e, 13f – possible variations of the radial profiles of the inlet cone of

the mechanical twist chamber

Figure 14 – a schematic design plan of vertical section of the apparatus

Figure 15 – a schematic plan of horizontal section of the apparatus

Figure 16 – a schematic design plan of the method and the apparatus

Figure 17 – a pictorial view of the body of the pneumatic cylinder chamber

Figure 18 – a pictorial view of the combing sector

Figure 19 – a schematic design plan of the regulating carrier plate

Figures 20, 20a and 20b – a schematic design plan of another variation of the apparatus, e.g. with vortex twisting chamber.

Examples for implementation of the invention

In the method for producing of staple fiber yarn after the feeding zone ϕ , continuous fibrous sliver 1 is formed in a zone of combing and main drawing α after that the fibrous sliver 1 passes through transfer zones δ and additional drawing ε , as the speed V_0 , V_1 and V_2 of the movement of the fibers 1 increases continuously in the zones of combing and main drawing α , transferring δ and additional drawing ε , and provides constant control of the fiber movement, and after the drawing line O-O the fibers 2 pass through zones of compaction of the main fibers n and parallel movement with compaction of the supporting fibers m to the main fibers n and after that they are delivered to the access chamber 8, after which the fibers 2 enter the twisting zone μ , in the front end of which rear ends of the supporting fibers m are pulled as a result of the centrifugal forces caused by the fast rotation of the mechanical chamber 9, and after entering the rear end of the twisting zone μ the supporting ends m are strongly twisted around the main fibers n under the influence of the mechanical twisting moment M created by the rotation with high revs of the small mechanical twisting chamber 9, as a result of which yarn 3 is formed with structure similar to the traditional and with very high speed of spinning.

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

- a) the feed zone ϕ provides a secure clamping of the fibrous sliver 10 till the rear end of the fibers 1 exits from the zone, and it is formed depending on the type of fibers 1;
- b) in the combing and main drawing in the zone α P the fiber front ends are combed, main drawing is performed $V_1 \gg V_0$ as a result of which one constant fibrous sliver 1 with the necessary thickness is formed and constant control of the fibers movement is ensured by the clothing of the combing roller 5, by the created

vacuum vortex Q1, where the speed of the air increases and by the large centrifugal force F, as a result of the high rev. of the combing roller 5 ;

c) in the transfer zone δ the fibrous sliver 1 passes from the needle clothing 4 of the combing roller 5 over the nearly located c zone of drawing ε , formed by the perforated surface 6 of the drawing roller 7, as a result of the centrifugal force F of the combing roller 5 and the air flows Q1, Q1' and Q2 around its clothing and in some variants as a result of the influence of the air flow 21, passing through the perforated surface 22 of the combing roller 5 and drawn by the strong vacuum Q2 inside the drawing roller 7, as the roller 7 moves faster than the combing roller 5 and thus the fibers 1 are maintained in tension condition;

d) in the drawing zone ε the fibers 1 are additionally drawn $V2 > V1$, when their front ends reach the drawing line O - O between the drawing pair 7-7', thus the fiber rear ends are combed 2, and simultaneously with the drawing the fibers 2 are packed in two fibrous streams comprising main fibers n and fastening fibers m, and at the end they are connected and packed together s ;

e) the fibrous sliver 2 enters the access chamber 8 and in the twisting zone μ , as in the access chamber the distribution of the twists is limited 29, and in the twisting zone μ , the fastening fibers m are strongly twisted around the main fibres n under the influence of the twisting moment M, created by the high speed rotation of the mechanical twisting chamber 9, as a result of which yarn 3 is formed with structure similar to the traditional one and with high speed of spinning;

f) a process of spinning may be performed with twisting from the mechanical twisting moment M of the rotating with high revs small mechanical chamber 9 along with the twisting moment N of the twisting vortex chamber 13 ;

g) the trajectory and the compaction of the main fibers n and of the supporting fibers m are controlled by the force of the vacuum inside the feeding perforated drawing cylinder 7, by the form of the zones of compaction and transportation in the access chamber 8, and by the size of the twisting moments M и N in the twisting chambers 9 and 13 ;

h) the trajectory and the compaction of the main fibers n and the forces of pulling and wrapping of the free ends m may be changed independently from one another, while the inlet fibrous silver 10 may comprise different by type fibers, as well as the process of twisting of the twisting chambers 9 and 13 can be selected according to the type of the yarn 3, and after starting the work the spinning place can turn off the influence of the twisting chamber N of the additional twisting chamber 13;

i) at the beginning of the combing zone α a zone for separation of the foreign impurities from the fibers can be formed 1, depending on their type and condition;

j) at the end of the combing zone an additional zone for combing P2 of the fibers 1, can be formed thus improving their parallelism.

The apparatus for performing of the method may comprise a feed zone φ , formed as a part of a common closed case 33, where the zones for combing and main drawing α is placed as well as the transfer zone δ of the fibers of the needling surface 4 of the combing roller 5 on the surface 6 of the drawing roller 7, and on that surface 6 a zone for additional drawing ε is formed and after the drawing line 0-0 a zone η for pulling the free ends of the fibers m is formed that enters the access chamber 8 and the conical end 29 of the access chamber 8 enters the twisting zone μ where the micro spindle 9 is mounted, in which is placed a short unmovable spindle 46 with a small axial hole, and after the stationary spindle 46 is placed additional vortex spinning chamber 13.

The zones in the apparatus may comprise one or more of the following parts, independently and/or in mutual combination:

- a) the feeding zone φ is formed by a feeding roller 14, a feeding table 15, a pressing device 38, and an inlet funnel 16, mounted between them and limited by the adjusting bolt 37;
- b) the zone for combing and main drawing α is formed by the combing roller 5, which has a smaller diameter and is covered with needle clothing 4, with an angle of the teeth β , determined according to the type of the fibers 1, and nearby at a distance a to the clothing
- 4 the concentric surface C1 of the closing case 33 is formed; after the end of the feed zone φ the entry of the combing sector 12 is located, and it is formed eccentrically C2 on the roller clothing 5, as the width of its section decreases from the beginning t to the end f , and the length of the combing zone α is determined by the length of the fibers 1;
- c) the zone for separation of the foreign impurities can be formed as a tangential channel 20;
- d) the zone for additional combing P2 of the fibers 1 can be formed as a cylindrical air chamber 34 at the end of the combing sector 12, that is laterally closed;
- e) the zone for transfer δ is formed by narrowing from the end of the combing sector 12 to the beginning of the body 35 of the pneumatic chamber 11, in the direction of the movement of the fibers 1, and the clothing 4 of the combing roller 5 enters in it and placed nearby with perforated surface 6 of the drawing roller 7; the combing roller 5 can have perforated surface 22 and placed inside pneumatic nozzle 23, while the pneumatic chamber 11 is connected with the atmospheric air, for the formation of the airflow Q1 resulting from the vacuum Q2 created in the drawing roller 7, and for this purpose a narrow slot 36 is formed;
- f) the combing sector 12, the body 35 of the pneumatic chamber 11, the closing case 33, the feeding table 15, the pressing device 41, the inlet funnel 16 and the stop screw 37 are mounted on an adjustable plate 40 corresponding to the determined length of the processed fibers 1, and in plate 40 passage holes are formed for the working rollers 14 and 5 and holes 41 for mounting;
- g) in the bearing case 39 threaded holes for mounting for the bearing of the drawing roller 7, the hole for

bearing of the pressing roller 7' and the hole for the bearing of the combing roller 5, and hole for the bearing of the feeding roller 14 with possibility for changing the centering d , that is fixed to specified angle τ by the bolt 47;

h) the drawing zone ε is formed on perforated surface 6 of the drawing roller 7, below which the diaphragm 17 is mounted, and which lasts a little η after the drawing line O-O, in order to intake the fastening ends m of the fibers 1, and the length of the zone ε is determined from the length of the fibers 1;

i) the twisting zone μ is formed at the end of the access chamber 8, and the access chamber entry has an extension w and is displaced downward below the axis o-o of the twisting zone μ ; at the end there are holes 18 for creating vacuum and ends with a needle 29, that enters closely the stationary spindle 46, with small height h and is placed at a distance l and b from and below the drawing line O-O, as is axially mounted in the interior of the high-rev spindle 9, e.g. pneumatic, placed in a body 19 and rotated by air with high pressure 26, and that spindle 9 has a small diameter, 28, and it can rotate with high rev, and after the stationary spindle 46 an additional vortex twist chamber 13 is mounted, placed eccentrically on the spindle 46, and the chamber 13 can be used for spinning of the yarn 3 at the beginning of the process or in case of breaking of the yarn;

j) in the vortex spinning chamber 13, two separate access aerial holes 31 and 24 are formed for supplying air with high pressure to the tangential openings 32 and 25, for creating of another twisting vortex N;

k)

the mechanical twisting chamber 8 is formed as a micro turbo spindle 14 with blades on the surface 28, rotating with very high rev and with conical entrance 49 with radial cuts or ribs 36, as the inlet cone 49 of the twisting spindle 9 covers the outlet guiding cone 29 of the access chamber 8, while the outlet of the twisting spindle 9 is formed as cone in which the stationary spindle 46 enters, while the whole micro turbo spindle 9 is placed in bearing 19 comprising two detachable parts where inlet holes 26 are formed for supplying air with high pressure against the blades 28 and holes 30 for removal of the exhaust air while the bearing 19 is mounted in an annular bearing body 48.

Application of the invention

The method and apparatus for producing a staple fiber yarn is performed in a process of combing, drawing and twisting and operates in the following manner. The combing and the main drawing of the fibers 1 from the fibrous sliver 10 is performed in the zone α , set up by the combing surface 12 and the needle clothing 4, as a result of the high-speed of rotation of the roller 5, as the fibers are strongly compressed and continuously supplied by the roller 14. When the fiber rear end leaves the compression line due to the friction force between the fibers themselves and the friction force with the clothing 4, the fibers are being drawn. The fibers with the

combed front ends remain in the clothing 4 and form the continuous fibrous sliver 1, pressed by the small alignment with the end of the combing surface 12, after which, because of the large centrifugal force F and the air flows $Q1$, $Q1'$ and $Q2$ they are pressed to the perforated surface of the drawing roller 7, and in some variants by the air 20 passing through the perforated surface 21 of roller 5 as a result of the strong vacuum inside the drawing roller 7. The fibrous sliver 1 passes in zone δ from the needle clothing 4 of the roller 5 over the nearby perforated surface 6 of the drawing roller 7, that moves faster than the combing one 5 and thus the fibers are kept stretched and in parallel condition. When the front ends of the fibers 1 reach the drawing line $O - O$ between the drawing pair of rollers $7 - 7'$ in the zone ϵ , the fibers 1 are pulled, and along with this the rear ends are being combed in addition, after that the fibrous sliver 2 is packed in two fibrous streams comprising main fibers n and fastening fibers m , and finally they are connected and packed together s . The fibrous sliver 2 enters the access chamber 8 of the twisting zone μ , as in the chamber 8 the spreading of the torques is limited by the needle 29, and in the beginning of the twisting zone μ the rear ends of the fastening fibers m are pulled as a result of the centrifugal forces caused by the quick rotation of the mechanical chamber 9 and after entering the rear end of the twisting zone μ fastening fibers m strongly twist around the main fibers n under the influence of the twisting moment M produced by the rotation with high revs of the mechanical twisting chamber 9 or in another variant by the vortex air chamber 13, as a result of this yarn 3 is formed with structure similar to the traditional one and with high speed of spinning.

References:

1. Patent CH 694 332, cl. D 01 H 005/28
- 2 Patent US 6058693, cl. D 01 H 4/00
- 3 Patent WO 03/018887, cl. D 01 H 1/115.
4. Patent US No 5528895, cl. D 01H 5/00.
5. Patent US No 5647197, cl. D 01 H 5/00.

CLAIMS

1. Method for producing of staple fiber yarn, where the fibrous sliver is supplied by a feeding roller and feeding table, then it is separated to individual fibers by a needle roller and it is pulled by an outgoing pair of rollers and twisted by twisting element, which is characterized by the fact that after the feeding zone (ϕ) a continuous fibrous sliver (1) is formed in a zone for combing and main drawing (α), then the fibrous sliver (1), passes through transfer zones (δ) and additional drawing (ϵ), as the speed (V_0, V_1 и V_2) of the fiber movement (1) increases constantly in the zones for combing and main drawing (α), transfer (δ) and additional drawing (ϵ), thus constant control of the fiber movement is ensured and after the drawing line (O-O) the fibers (2) pass through zones of compaction of the main fibers (n) and of parallel movement with compaction of the supporting fibers (m) to the main ones (n) and then are fed to a spinning system for high speed.
2. Method according to claim 1 wherein main fibers (n) are fed to an access chamber (8), after which the fibers (2) enter the twisting zone (μ), in the front end of which the rear ends of the supporting ends (m) are pulled in result of the centrifugal forces caused by the fast rotating of the mechanical chamber (9), and after entering the rear end of the twisting zone (μ) the supporting fibers (m) are strongly twisted around the main ones (n) under influence of the mechanical twisting moment (M) created by the rotation with high speed revs of the small mechanical twisting chamber(9), and the yarn is formed (3) with structure similar to the traditional and with very high speed of spinning.
3. Method according to claim 1 or 2, wherein the feeding zone (ϕ) ensures secure tightening of the fibrous sliver (10) until the exit of the rear end of the fibers (1) from the zone that is formed according to the type of the fibers (1).
4. Method according to any one of claims from 1 to 3 wherein during in the combing and the main drawing in the zone (α) the front ends of the fibers (P) are combed and main drawing is performed ($V_1 \gg V_0$) as a result of this continuous fibrous sliver (1) is formed with the necessary thickness and constant control of the fiber movement is ensured by the clothing of the combing roller (5), by the created air flow (Q1), where the speed of the air increases as well as by the large centrifugal force (F), as a result of the high rev. of the combing roller (5).
5. Method according to any one of the previous claims wherein in the transfer zone (δ) the fibrous sliver (1) passes from the needle clothing (4) of the combing roller (5) over the nearby (c) zone for drawing (ϵ), formed by the perforated surface (6) of the drawing roller (7), as a result of the centrifugal force (F) of the combing roller (5) and the air flows (Q1, Q1' and Q2) around its clothing,
6. Method according to claim 5, wherein from the influence of the air flow (21), passing through the perforated surface (22) of the combing roller (5) and drawn in by the strong vacuum (Q2) inside the drawing roller (7),

as the roller (7) moves faster than the combing roller (5) and thus the fibers are kept in (1) in tense condition.

7. Method according to any one of the previous claims wherein in the drawing zone (ϵ) the fibers (1) are drawn additionally ($V_2 > V_1$), when their front ends reach the line of drawing (O - O) between the drawing pair of rollers (7 - 7'), thus the rear ends of the fibers are combed (2), and along with the drawing the fibers (2) are packed in two fibrous streams comprising main fibers (n) and fastening fibers (m), and at the end they are connected and packed together (s).

8. Method according to any one of the previous claims wherein the fibrous sliver (2) enters the access chamber (8) and the twisting zone (μ), and in the access chamber the distribution of the torques is limited by a conical needle (29), while in the twisting zone (μ), the fastening fibers (m) strongly twist around the main fibers (n) under the influence of the twisting moment (M), produced by the rotation with high rev. of the mechanical twisting chamber (9), as a result of which the yarn is formed (3) with high-speed of spinning,

9. Method according to any one of previous claims in combination with claim 2 wherein

a process of spinning is performed with twisting from the mechanical twisting moment (M) of the rotating with high-speed revs small mechanical chamber (9) along with the twisting moment (N) of the twisting vortex chamber (13);

10. Method according to any one of the previous claims in combination with claim 2 wherein the trajectory and the compaction of the main fibers (n) and of the supporting fibers (m) are controlled by the vacuum force inside the feeding perforated drawing cylinder (7), by the shape of the zones for compaction and transportation in the access chamber (8), and by the size of the twisting moments (M and N) in the twisting chambers (9 and 13).;

11. Method according to any one of the previous claims in combination with claim 2 wherein the trajectory and the compaction of the main fibers (n) and the forces of pulling and wrapping of the free ends (m) may be changed independently from one another, while the access fibrous silver (10) can comprise different type of fibers as well as the process of twisting by the twisting chambers (9 and 13) can be selected according the type of the yarn (3), and after starting the work on the spinning place, the influence of the twisting vortex (N) of the additional twisting chamber (13) can be turned off;

12. Method according to any one of the previous claims wherein at the beginning of the combing zone (α) a zone is formed for separation of the foreign impurities from the fibers (1), according to their type and state;

13. Method according to any one of the previous claims wherein at the end of the combing zone (α) a zone for additional combing (P2) of the fibers (1) is formed, thus improving their parallelism.

14. An apparatus for implementing the method according to any one of the previous claims, comprising a feeding roller and a feeding table placed near the needle roller and having mounted drawing pair, after which

twisted chamber is placed, characterized by the fact that the feed zone (φ) is formed as a part of a common closed case (33), where the following zones are placed: the zone for combing and main drawing (α) and the transfer zone (δ) of the fibers of the needle surface (4) of the combing roller (5) over the surface (6) of the drawing roller (7), and in that surface (6) the zone for additional drawing (ε) is formed, and after the drawing line (O-O) is formed zone (η) for pulling the free ends from the fibers (m), that enters the access chamber (8), and the conical end (29) of the access chamber (8) enter the twisting zone (μ), where is mounted the high-speed micro spindle (9), inside of which is placed short stationary spindle (46) with short axial hole, and after the stationary spindle (46) is placed an additional vortex spinning chamber (13).

15. The apparatus according to claim 14 is characterized that the feeding zone (φ) is formed by a feeding roller (14), a feeding table (15), pressing device (38), and an inlet funnel (16), mounted between them and limited by an adjuster bolt (37);

16. The apparatus according to claim 14 or 15 wherein the zone for combing and main drawing (α) is formed by the combing roller (5), which has small diameter and is covered by needle clothing (4), with an angle of the teeth (β), determined according to the type of the fibers (1), and near (a) to the clothing (4) the concentric surface (C1) of the closing corpus (33) is formed, and after the end of the feed zone (φ) the inlet of the coming sector (12) is located, eccentrically shaped (C2) on the clothing of the roller (5), as the width of its section decreases from the beginning (t) to the end (f), and the length of the combing zone (α) is determined by the length of the fibers (1);

17. The apparatus according to any one of claims from 14 to 16 wherein the zone of separation of the foreign impurities is formed as a tangential channel (20);

18. The apparatus according to any one of claims from 14 to 16, wherein the zone for additional combing (P2) of the fibers (1) is formed as a cylindrical air chamber (34) at the end of the combing sector (12), that is laterally closed;

19. The apparatus according to any one of claims from 14 to 18 wherein the transfer zone (δ) is formed narrowing from the end of the combing sector (12) to the beginning of the body (35) of the pneumatic chamber (11), in the direction of the fiber movement (1), and inside of it enters the clothing (4) of the combing roller (5) and the nearly placed (c) perforated surface (6) of the drawing roller (7), while the combing roller (5) has perforated surface (22) and placed inside pneumatic nozzle (23); wherein the pneumatic chamber (11) is connected to the atmospheric air for the forming of the air flow (Q1') resulting from the vacuum (Q2) created in the drawing roller (7), as for the purpose a narrow section is formed (36).

20. The apparatus according to any one of claims from 14 to 19 wherein the combing sector (12), the body (35) of the pneumatic chamber (11), the closing case (33), the feeding table (15), the pressing device (41), the inlet

funnel (16) and the restrictive screw (37) are all mounted on one regulating plate (40) corresponding to the determined length of the processed fibers (1), as in the plate (40) through holes for the working rollers (14 and 5) and holes (44) for mounting are formed.

21. The apparatus according to any one of claims from 14 to 20 wherein in the bearing case (39) are formed threaded holes for mounting of the drawing roller (7) the hole for the bearing of the combing roller (5), and hole for the bearing of the feeding roller (14) with possibility for change of the centering (d), that is fixed on specific angle (τ) from the bolt (47)

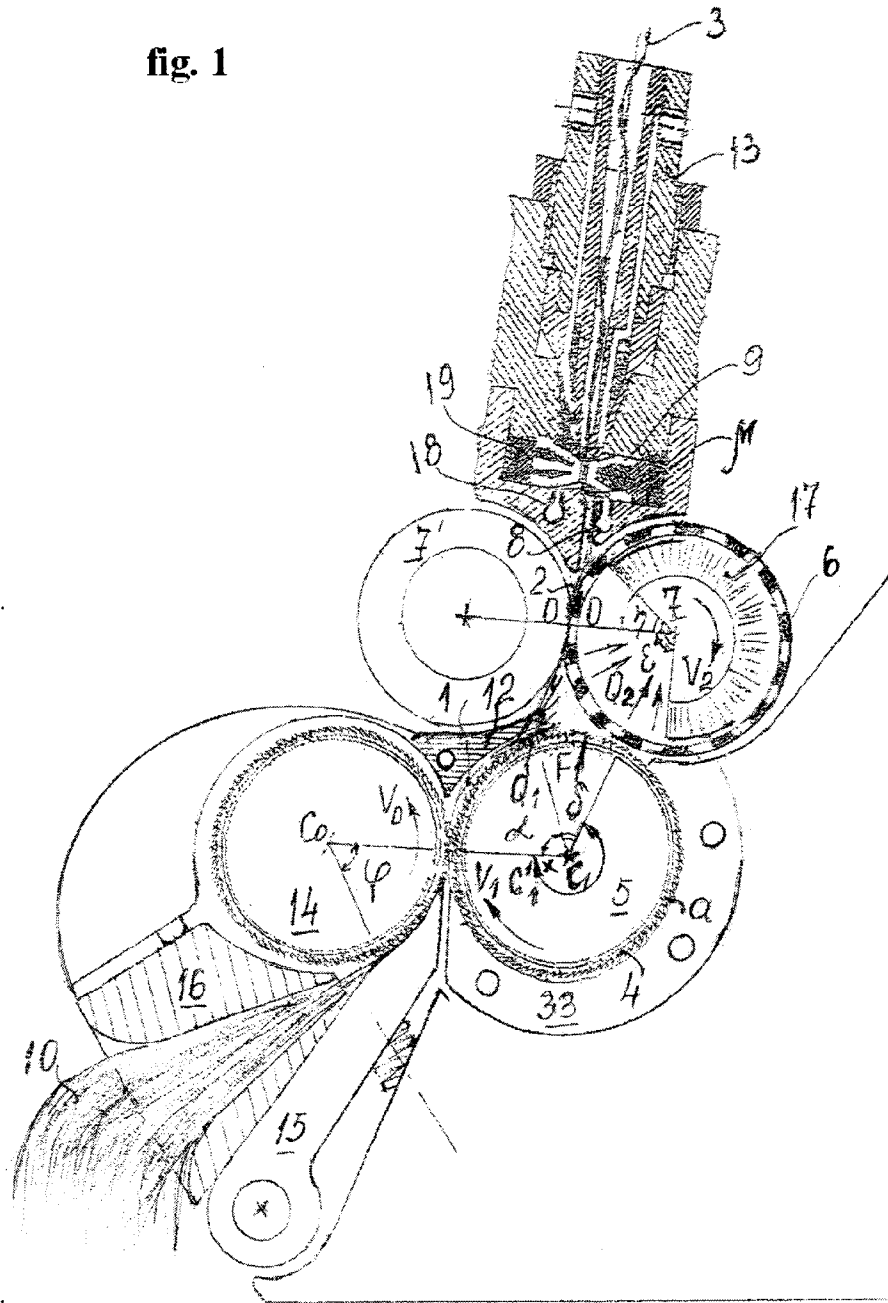
22. The apparatus according to any one of previous claims from 14 to 21 wherein the drawing zone (ε) is formed on the perforated surface (6) of the drawing roller (7), below which the diaphragm is mounted (17), and that goes on a little (η) and after the drawing line (O-O), in order to suck the fastening ends (μ) of the fibers (1), and the length of the zone (ε) is determined by the fiber length (1).

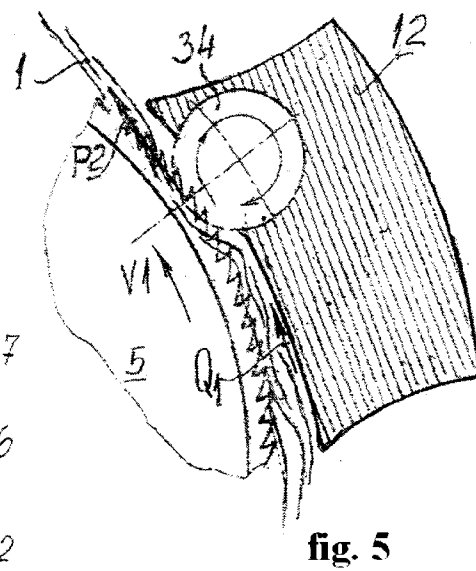
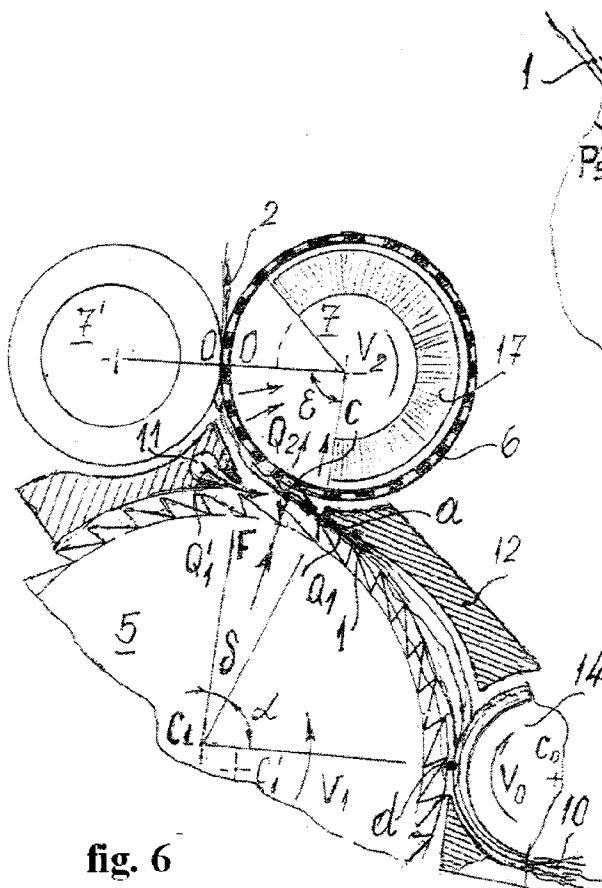
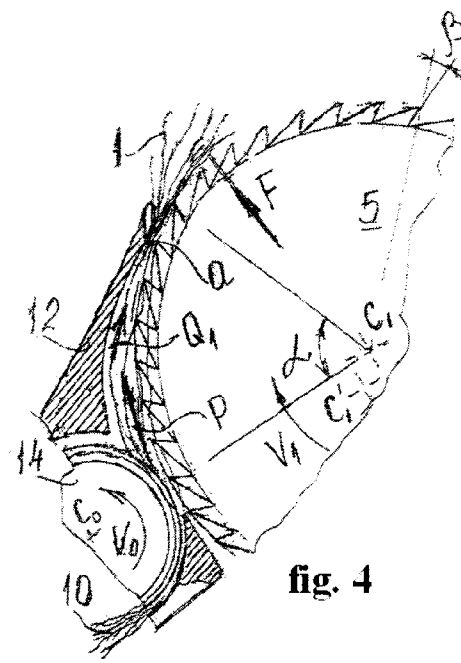
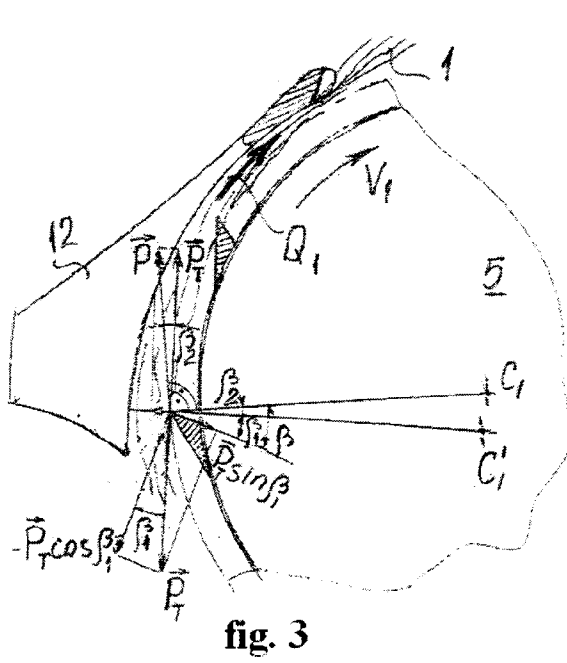
23. The apparatus according to any one of claims from 14 to 22 wherein the twisting zone (μ) is formed at the end of the access chamber (8), the inlet of which has an extension (w) and that is shifted below the axis (o-o) of the twisting zone (μ), and at the end it has holes (18) for creating of vacuum and ends with a needle (29), which enters near the stationary spindle (46), with small height (h) and is placed at a distance (l and b) from and below the drawing line (O-O), as it is axially mounted in the interior the high-rev micro spindle (9), e.g. pneumatic, placed in a body (19) and rotating from high pressure air (26), as the high-speed micro spindle (9) has small diameter (28) may rotate with high rev. and after the spindle (46) an additional vortex twisting chamber is mounted (13), eccentrically placed (e) on hole of the spindle (46), and the chamber (13) can be used for spinning of the yarn (3) at the beginning of the process or in the breaking of the yarn.

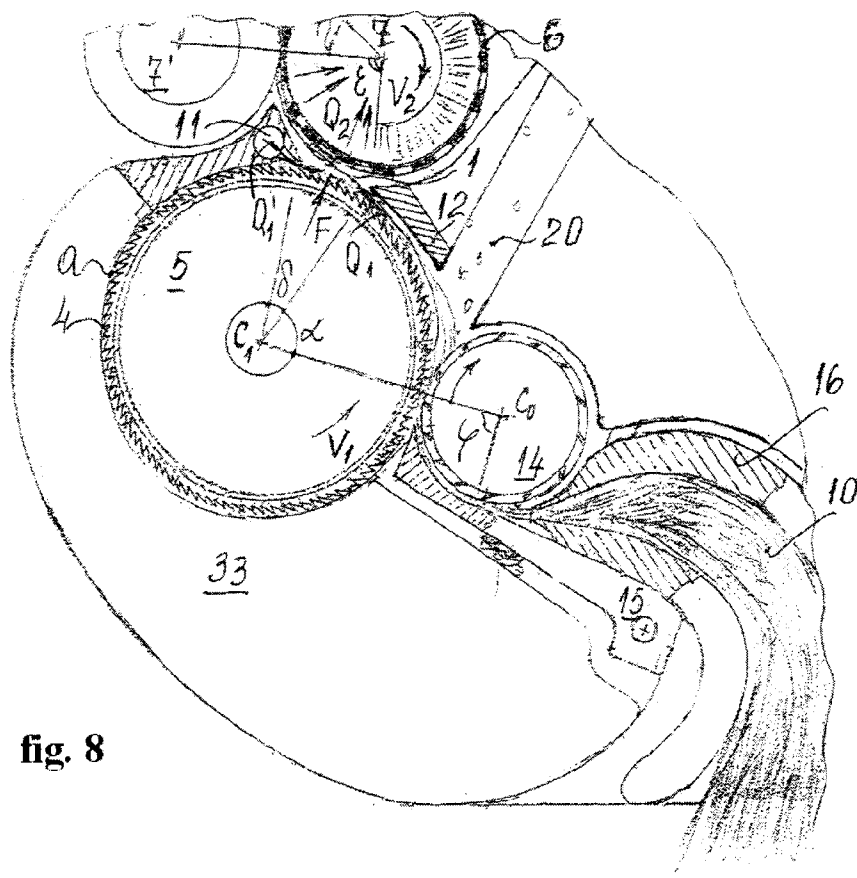
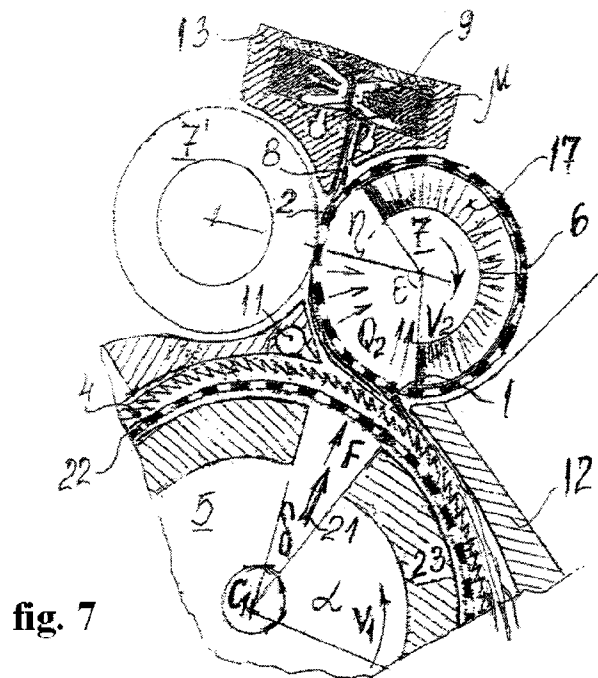
24. The apparatus according to any one of claims from 14 to 23 wherein in the vortex spinning chamber (13), two separate inlet aerial holes (31 and 24) for feeding with high pressure air to the tangential holes (32 and 25), for creation of additional twisting vortex (N) are formed;

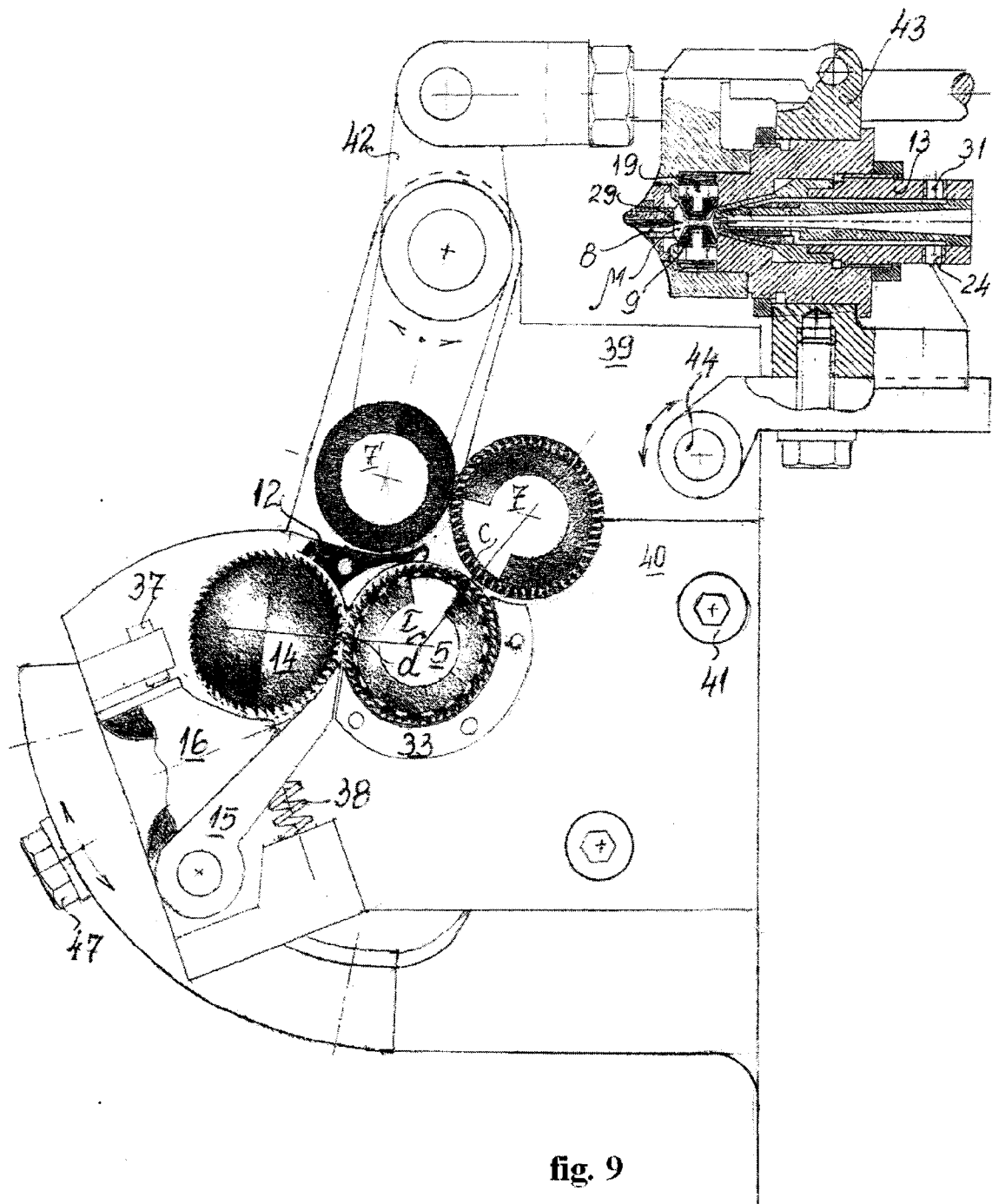
25. The apparatus according to any one of claims from 14 to 24 wherein the mechanical twisting chamber (8) is formed as micro turbo spindle (14) with blades on the surface (28), the spindle rotates with very high revs and it has conical entrance (49) with radial cuts or ribs (36), as the inlet cone (49) of the twisting spindle (9) scopes the outlet guiding cone (29) of the access chamber (8), while the exit of the twisting spindle (9) is formed as cone, too, in which enters the stationary spindle (46), and the whole micro turbo spindle (9) is placed in bearing (19) comprised of two detachable parts, where there are access holes (26) for feeding high pressure air against the blades (28) and holes (30) for removal of the exhaust air, and the housing (19) is mounted in an annular supporting body (48).

fig. 1









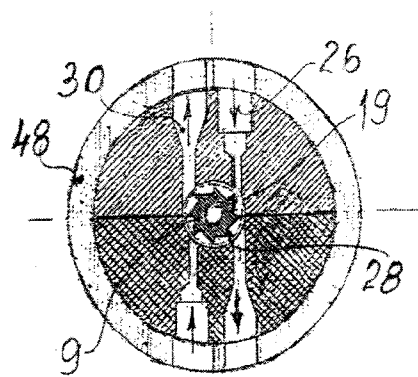


fig. 10

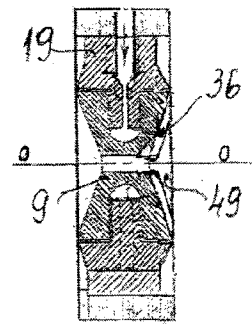


fig. 11

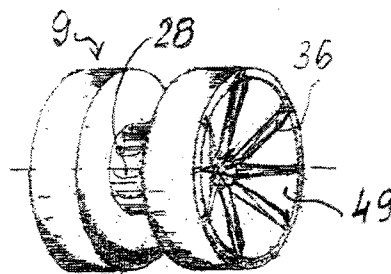


fig.12

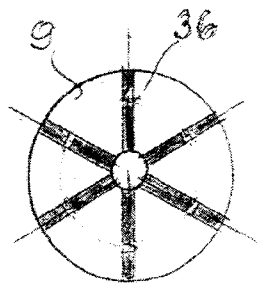


fig. 13a

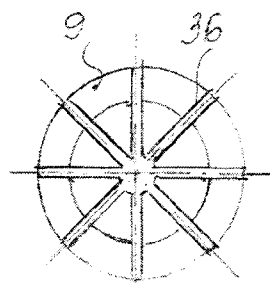


fig.13b

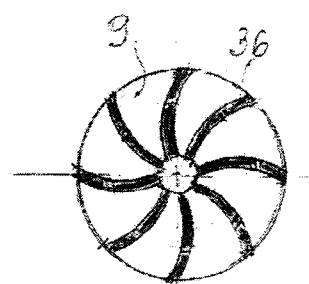


fig.13c

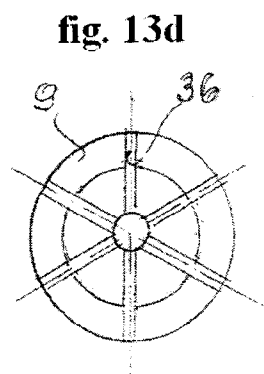


fig. 13d

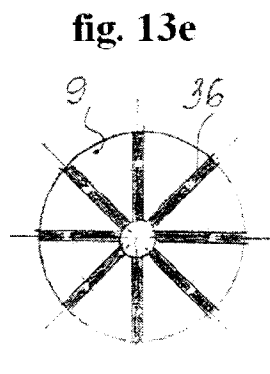


fig. 13e

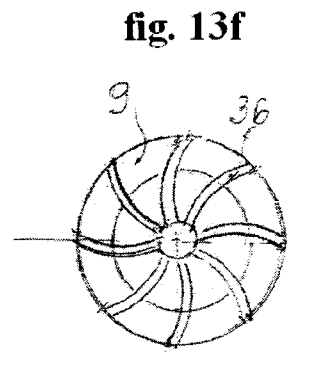


fig. 13f

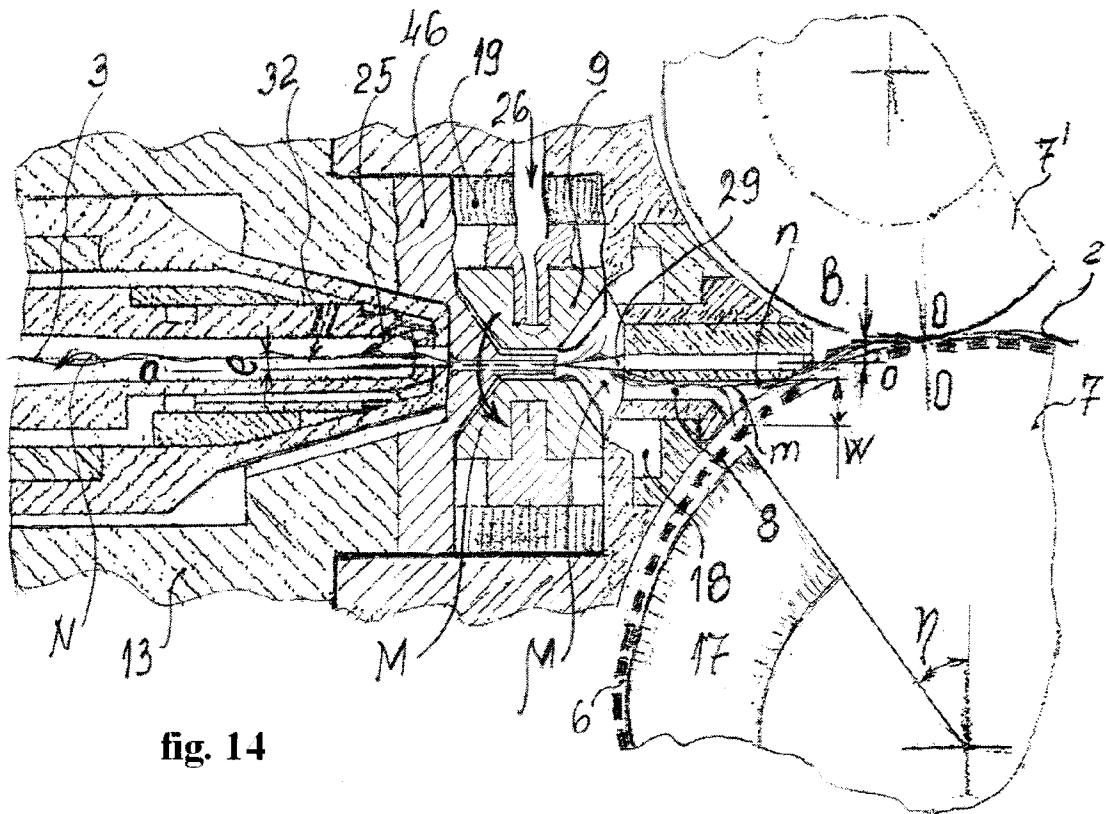


fig. 14

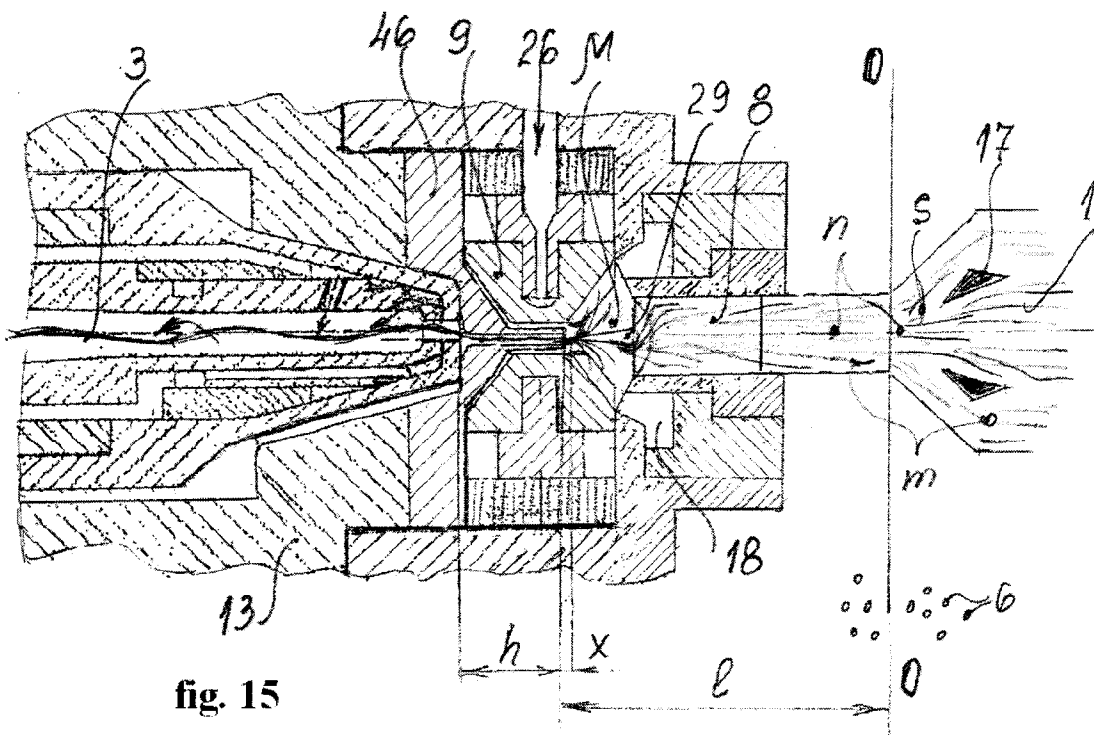


fig. 15

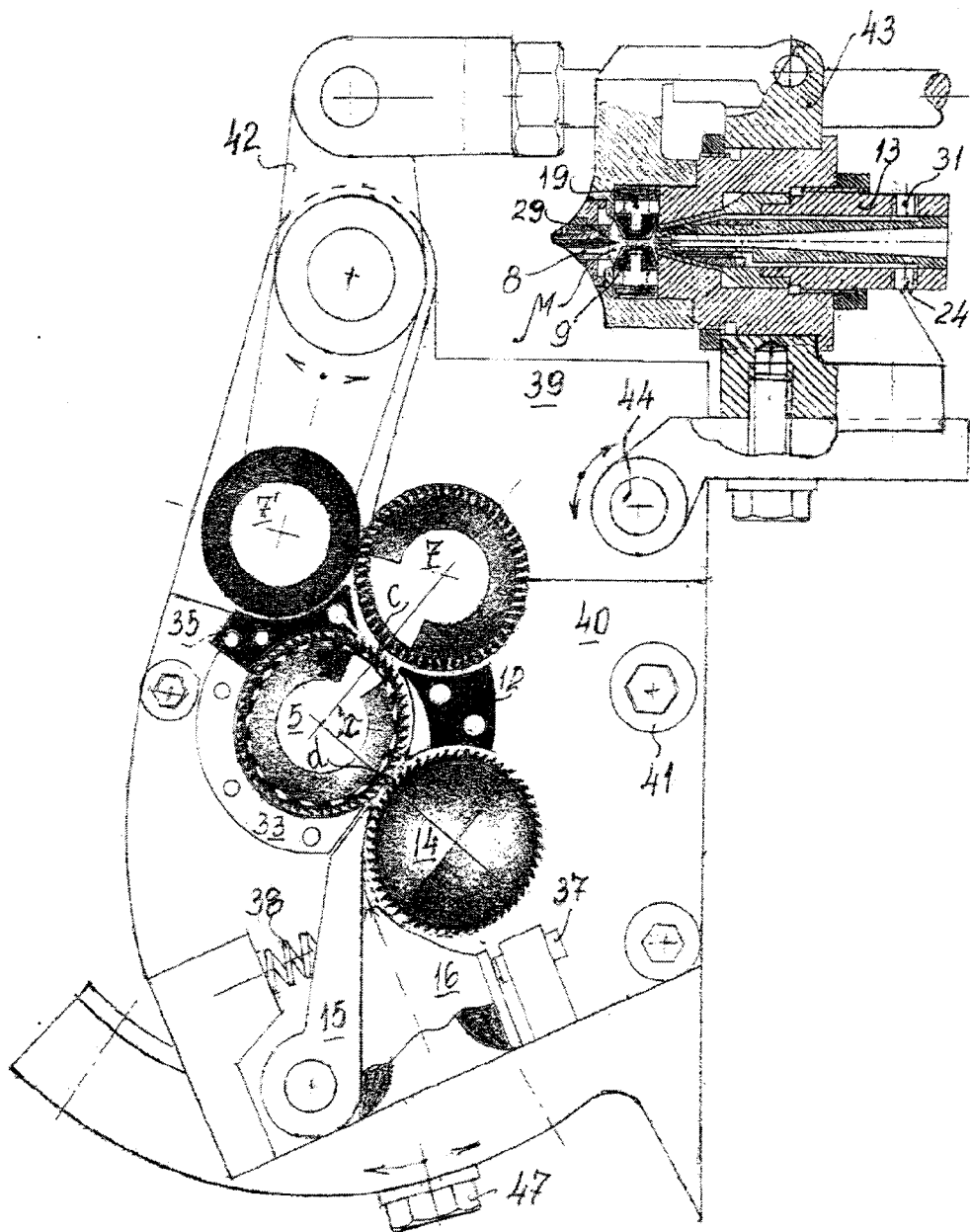


fig. 16

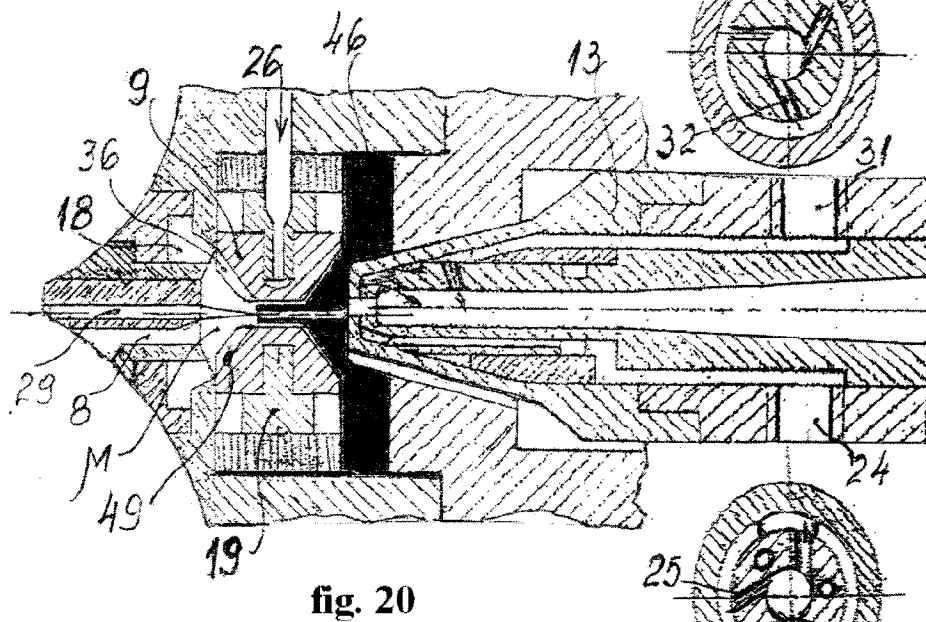
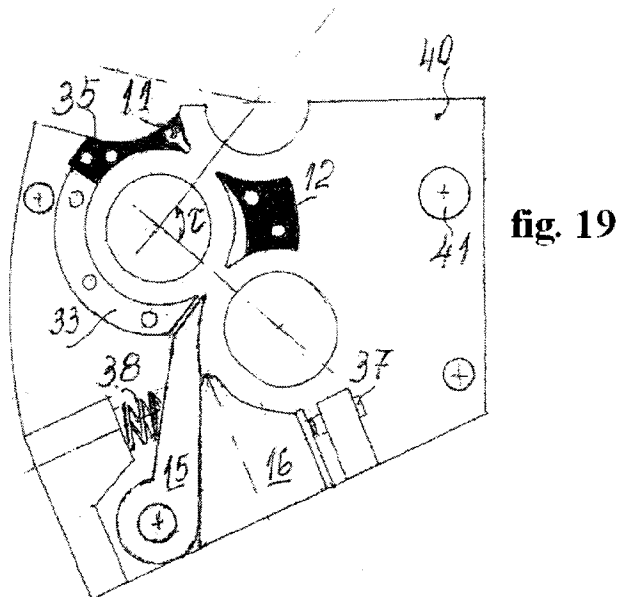
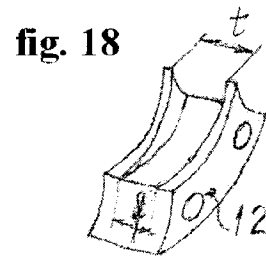
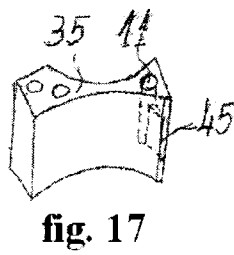


fig. 20a

fig. 20b

INTERNATIONAL SEARCH REPORT

International application No
PCT/BG2015/000004

A. CLASSIFICATION OF SUBJECT MATTER INV. D01H1/115 D01H4/02 D01H4/32 D01H5/00 D01G19/18 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) D01H D01G		
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		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/029123 A1 (D A DINKO BAHOV ET [BG]; BAHOV DINKO [BG]; BAHOV ATANAS [BG]; BAHOV D0) 7 March 2013 (2013-03-07)	1-7,13
Y	page 4, paragraph 5 page 5, paragraph 5 page 5, paragraph 8 page 6, paragraph 1 figure 1	8-12, 15-25
X	WO 2012/139178 A2 (D A DINKO BAHOV ET [BG]; BAHOV DINKO [BG]; BAHOV ATANAS [BG]; BAHOV D0) 18 October 2012 (2012-10-18)	1-7,13
Y	page 5, paragraph 5 - page 6, paragraph 1 figures 1,2,9	9-12, 14-25
	----- -/-	
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 14 July 2015		Date of mailing of the international search report 24/07/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Humbert, Thomas

INTERNATIONAL SEARCH REPORT

International application No

PCT/BG2015/000004

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2013/026107 A1 (D A DINKO BAHOV ET [BG]; BAHOV DINKO [BG]; BAHOV ATANAS [BG]; BAHOV DO) 28 February 2013 (2013-02-28) page 4, paragraph 4 - page 5, paragraph 1 page 6, paragraph 3 figures 2,3 -----	8
Y	US 5 768 879 A (STAHLECKER FRITZ [DE]) 23 June 1998 (1998-06-23) column 3, line 12 - line 16 column 4, line 60 - line 63 figure 1 -----	14
Y	US 2002/152739 A1 (ANDEREGG PETER [CH]) 24 October 2002 (2002-10-24) paragraph [0013] paragraph [0042] - paragraph [0044] figures 3, 3a -----	14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/BG2015/000004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013029123 A1	07-03-2013	NONE	
WO 2012139178 A2	18-10-2012	NONE	
WO 2013026107 A1	28-02-2013	NONE	
US 5768879 A	23-06-1998	DE 19601958 A1 US 5768879 A	24-07-1997 23-06-1998
US 2002152739 A1	24-10-2002	EP 1217110 A2 JP 2002201535 A US 2002152739 A1	26-06-2002 19-07-2002 24-10-2002