

[54] **FIBER OPENING ROLL OF AN OPEN END SPINNING DEVICE**

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[58] Field of Search **57/58.89-58.95**

[56] **References Cited**

UNITED STATES PATENTS

3,624,997	12/1971	Didek et al.	57/58.91
3,624,995	12/1971	Rajnoha et al.	57/58.91

3,455,097	7/1969	Rajnoha et al.	57/58.95
3,626,681	12/1971	Naruse	57/58.95 X
3,434,184	3/1969	Doudlebsky et al.	57/58.91 UX

Primary Examiner—Donald R. Watkins

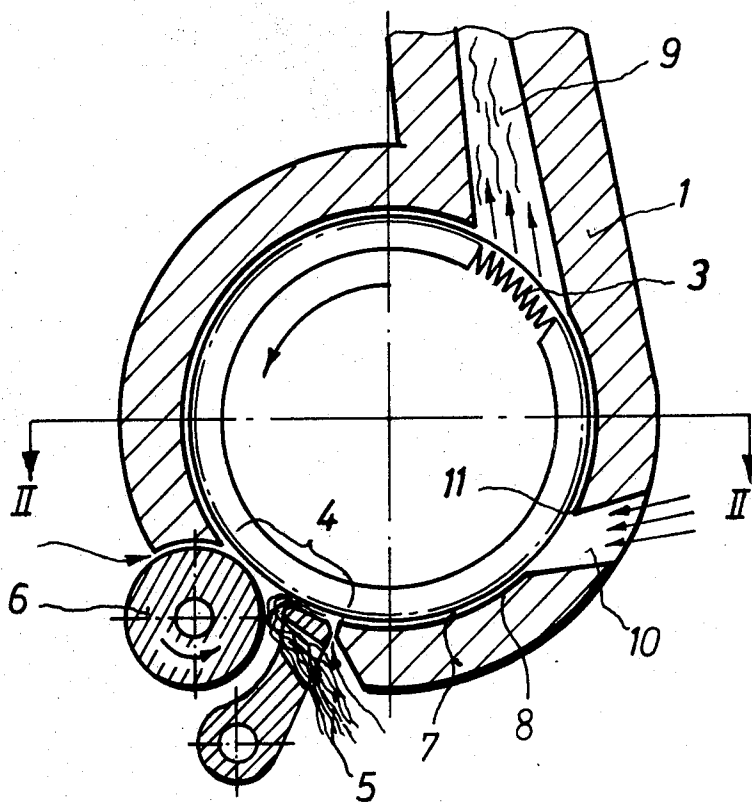
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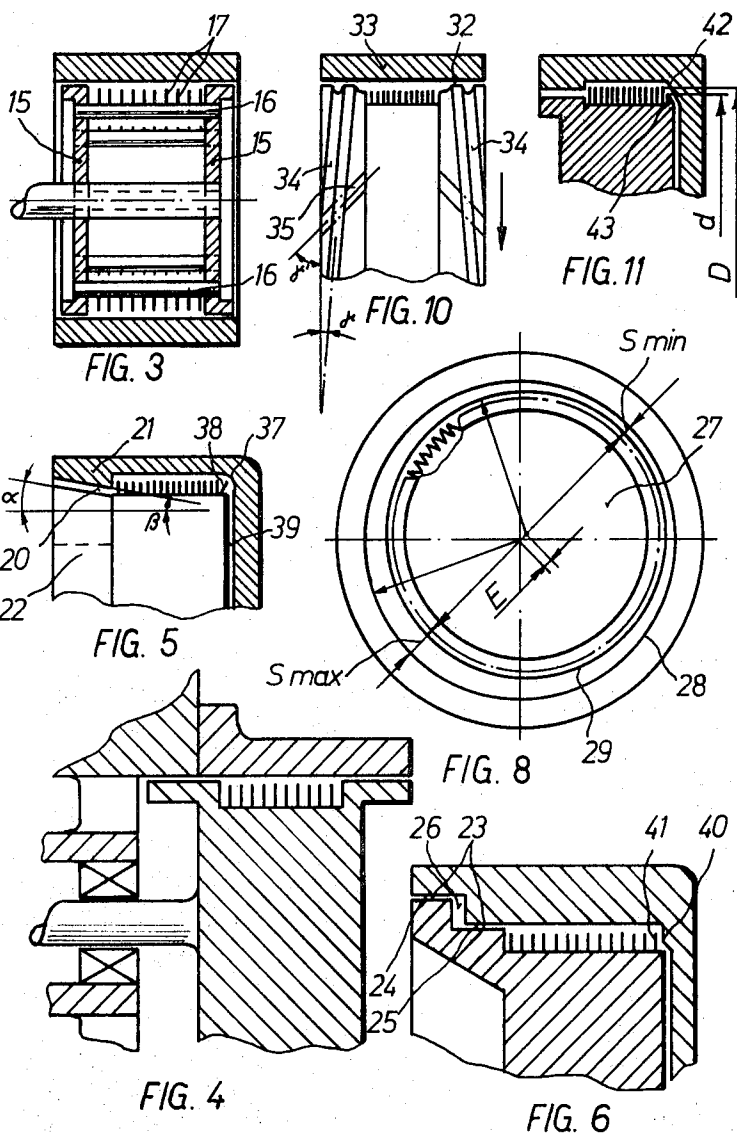
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ABSTRACT

The spinning roll and housing are constructed to define a small laterally extending clearance which communicates the annular space between the clothing on the roll and the inside surface of the housing with a space of higher pressure. The clearance acts as a pneumatic seal to prevent lateral outward passage of fibers from the housing while, at the same time, allowing sufficient air to pass into the housing to ensure against too large an ingress of air at the waste separation opening.

25 Claims, 11 Drawing Figures





FIBER OPENING ROLL OF AN OPEN END SPINNING DEVICE

This invention relates to a fiber opening roll of an open end spinning device.

As is known, open end spinning devices have used fiber opening rolls for opening a staple fiber sliver into individual fibers which subsequently are transferred into a spinning rotor for twisting into a yarn. In some instances, the opening roll has been equipped with a clothing (needles or clothing wire provided with points) and mounted in a housing or a sleeve which is closed on all sides. The housing has usually had a fiber feed point and a fiber transfer duct for guiding the fibers into the spinning rotor after leaving the clothing of the opening roll. The housing or sleeve has also been provided with lateral covers arranged in very close proximity to the face sides of the opening roll in order to concentrate the air flow into the annular space immediately around the clothing. In practical use, however, it was found that a small airstream flows along the face sides of the opening roll, as a pressure differential prevails between the fiber feed point and the entry into the fiber transfer duct. This small airstream can indeed carry on fibers leaving the clothing laterally. Thus, agglomerations of these fibers in the narrow face side clearance space frequently occur. Eventually, these agglomerations have reached the fiber transfer duct in the form of bundles or lumps which, once spun into the yarn, result in undersirable thick places in the yarn. Due to the necessarily small clearances at the face sides of the opening rolls, such fiber agglomerations or accumulations frequently cause varying braking of the opening roll and, in extreme cases, the opening rolls have been blocked entirely.

If elimination of these symptoms is attempted, e.g., by further narrowing the clearances at the face sides, this would involve other severe disadvantages. For example, the axial position of the opening roll would have to be maintained very exactly in order to avoid any grinding contact of the opening roll face sides on the corresponding lateral wall of the housing or cover. Maintenance of the axial position within very small tolerances would also require the use of longitudinally pretensioned bearings of zero axial play which, at the high rotational speeds of 5000 to 8000 r.p.m. of opening rolls, cause very substantial premature wear. Also, a tendency of lap formation on the drive shaft of the opening roll would be observed, particularly in case the bearing is arranged adjacent to, or in close vicinity of, the opening roll housing for design reasons, so that lubricants can creep along the drive shaft into the housing.

Attempts have been made to keep the negative effects of the vacuum away from the opening roll face side space, which effects would otherwise assist the fibers leaving the clothing laterally, by providing air inlet openings in the walls covering the face sides, or in the covers respectively. These openings allow air to be sucked in and thrown radially towards the outside with air transporting grooves, acting as a fan, also being provided on the periphery of the roll. Such measures, however, cannot be very effective, as the increased quantity of air, moved at the expense of additional power consumption exceeds the sucking capacity of the space between the clothing and the housing as well as of the ad-

jacent rotor. This quantity of air cannot be increased without inducing other disadvantages.

Accordingly, it is an object of the invention to effectively prevent fibers from leaving a clothing of an opening roll laterally without affecting the technologically optimal air throughput quantity at the opening roll and without exaggerated requirements for the opening roll bearings.

It is another object of the invention to construct an opening roll in such a manner that the housing for the roll need not be closed by a wall or a cover so that easy lateral removal is possible.

It is another object of the invention to construct an opening roll in such a manner that the bearing side as well the opposite non-bearing side of the opening roll can be mounted in a housing without lateral covers.

It is another object of the present invention to ensure that no detrimental fiber accumulations can form on an opening roll not covered on one side.

It is another object of the invention to eliminate as far as possible the influence of fan action of an opening roll onto the air throughput of the opening roll.

Briefly, the invention provides a fiber opening roll for an open end spinning device, which cooperates with a housing to define a pneumatic sealing clearance extending laterally of the confines of the housing. The roll is rotatably mounted in the housing and is provided with a peripherally mounted clothing thereon. The housing, in turn, has a first surface which cooperates with the clothing to define an annular space for guiding an air stream under vacuum from a fiber feed point past a waste separation point to a fiber transfer duct. The clearance is formed at at least one side of the clothing by a second surface of the housing and a peripheral surface of the roll which extends laterally from the clothing.

The housing is formed so that the fiber feed point, waste separation point and transfer duct each communicates the inside of the housing with the exterior of the housing so that air can pass into and through the housing under a suction force created, e.g., by a rotor, downstream of the transfer duct.

The clearance between the roll and the housing may take various forms such as cylindrical or conical and may be defined by smooth or interrupted surfaces as by a stepped configuration or a recessed configuration. In addition, the clearance is sized to prevent ingress of fibers laterally from within the housing while, at the same time, allowing sufficient air to pass into the housing to ensure against too large an ingress of air at the waste separation point. To this end, the radial size of the clearance is of from 0.3 millimeters (mm) to 0.5 millimeters (mm) while the width b is less than $d^2/a \cdot k$ wherein d is the diameter of the surface of the roll, a is the working width of the clothing and k a constant of from 0.02 to 0.12. Depending on the type of clothing used, k may vary from 0.02 to 0.12 for rolls with an unperforated clothing or 0.09 to 0.12 for a clothing made up of individual rods which support radial needles.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a view taken on line I—I of FIG. 2 of a housing and opening roll according to the invention;

FIG. 2 illustrates a view taken on line II—II of FIG. 1;

FIG. 3 illustrates a cross-sectional view of an open-sided housing with an opening roll composed of circumferentially spaced rods constructed according to the invention;

FIG. 4 illustrates a cross-sectional view of a further modified structure according to the invention;

FIG. 5 illustrates a view of an embodiment of the invention utilizing a conical sealing clearance;

FIG. 6 illustrates a view of another embodiment of the invention utilizing a clearance of stepped configuration;

FIG. 7 illustrates a labyrinth type of clearance according to the invention;

FIG. 8 illustrates a plan view of an eccentrically mounted roll within a housing according to the invention;

FIG. 9 illustrates a cross-sectional view of a modified clearance according to the invention;

FIG. 10 illustrates a roll having a grooved sealing surface according to the invention; and

FIG. 11 illustrates a cross-sectional view of a clearance which is within the plane of the clothing in accordance with the invention.

Referring to FIGS. 1 and 2, the open end spinning device substantially consists of a cup-shaped housing 1 in which an opening roll 2 is rotatably arranged. The roll 2 is provided at the periphery with a clothing 3 of needles or points. Fibers are supplied to the roll 2 in the form of a fiber sliver 5 via a fiber feed opening 4 in the housing 1. The clothing 3 is spaced from a cylindrical inside surface 8 of the housing 1 to define an annular space 7 so that individual fibers which are detached from the sliver 5 by the points of the clothing 3 can be carried on until reaching a fiber transfer duct 9 leading from the interior of the housing 1 into a space in which a spinning rotor (not shown) is arranged and in which a vacuum prevails. The housing 1 also contains a waste separator opening 10 between the feed roll 6 and the fiber transfer duct 9 through which air can be drawn into the space 7 and added to the air taken in via the opening 4. The periphery of the roll 2, as shown at the left hand side, is provided with an axially extending rim 12, the outside surface 13 of which in combination with an inside surface 13' of the surrounding housing 1 forms a small annular clearance 14 which communicates the inside of the housing 1 with the space of atmospheric pressure p_a . This clearance 14 is of a radial width, e.g., for roll diameters in the range of about 60 to 70 millimeters (mm) of at least 0.3 millimeters (mm), and as a rule, about 0.5 millimeters (mm). Smaller clearances cannot be considered due to manufacturing reasons.

During operation, air flows from the opening 4 via the space 7, in which a subatmospheric pressure prevails, to the duct 9. As shown, the housing 1 on the left hand side is not enclosed and, thus, atmospheric pressure p_a prevails on the face side of the roll 2.

Depending on the speed at which the air is taken in via the waste separator opening 10, more or less waste and short fibers are eliminated. That is, the waste and fiber particles loosened by centrifugal force and by an edge 11 (FIG. 1) of the opening 10 move in opposition to the air flowing into the opening 10 towards the inside of the housing 1. If the air speed at this place is too

high, the particles are taken back into the fiber flow flowing in space 7.

The throughput quantity of the air flowing from the outside of the housing 1 towards the inside of the housing 1 can be influenced by suitably choosing the width b of the clearance 14. Investigations have shown that an advantageous relation for choosing the width of the clearance 14 roughly is:

$$b \geq d^2/a \cdot k$$

where d is the diameter of the surface 13 of the roll 2, a the width of the active part of the roll periphery, i.e., the working width of the clothing 3 and k is a constant depending on the construction of the roll 2. The ranges of values of k are:

$$k = 2/100 \text{ to } 12/100$$

i.e., 0.02 to 0.12 for rolls of unperforated clothing support surface according to FIG. 1, and

$$k = 9/100 \text{ to } 12/100$$

i.e., 0.09 to 0.12 for rolls, the clothing of which consists of individual rods supporting radial needles 18 (FIG. 3), which rods are uniformly distributed along the circumference of the face side walls of the roll.

It can be seen that if the width of the clothing zone is large (i.e., if a is large) the width b of the clearance 14 can be chosen smaller, i.e., that more air may enter from the outside. That is, by using a large clothing, a large quantity of air is transported in the surrounding annular space 7 (FIG. 1) so that the air quantity penetrating via the clearance 14, and added, may also increase without severely affecting the air throughput conditions. The connection of the clearance 14 with the space in which the atmospheric pressure p_a , and thus a higher pressure than in the space 7 (pressure p_i), prevails is of great importance. This is because a determined small air current from the outside to the inside is created, which not only prevents the fibers from leaving the clothing laterally and penetrating into the clearance 14, but also ensures that no excessive air quantities are sucked in via the opening 10 which would otherwise cause, amongst other effects, a deterioration of the waste separation.

The intake of excessive quantities of air to the opening roll 2 via the clearance 14 can cause a reduction of the air intake via the waste separator opening 10. In such a case, too many good fibers can fly against the weakened countercurrent of air in the opening 10 and can be eliminated. Also, if the clearance 14 is too wide, too high a pressure can result at the opening 4 of the feed point, so that fibers can leave and cause undesirable fly. Accordingly, a correct choice of the dimensions of the sealing clearance 14 is thus of decisive importance for good performance of the opening roll 2 and of the waste separator opening 10.

As shown in FIG. 1, the provision of a sealing clearance 14 on one side only is entirely sufficient, as small air quantities are sufficient to influence the air throughput conditions as desired. The housing 1 is left open on the side of the bearing 18, and on the opposite side the roll 2 is completely surrounded by the housing 1. The bearing 18 maintains the axial position of the roll 3. The support of the bearing 18 is constructed in such a manner that enough passage space is available for the air under atmospheric pressure p_a to reach the entry of the clearance 14 without obstacles. The critical fly and

dust conditions usually found at the bearing caused by currents through the bearings are eliminated in this manner, as atmospheric pressure prevails on both sides of the bearing 18.

Referring to FIG. 4, the roll housing can be open at both ends. This implies the requirement of larger rims in order to keep the quantities of air entering within the limits required. As shown, also, the roll 15 is constructed of a plurality of circumferentially spaced rods 16, each of which carries radiating pins 17. Also, a sealing clearance is formed on each side of the roll 15 in cooperation with the housing.

Referring to FIG. 5, the air throughput conditions of the opening roll also can be influenced by the position of the sealing clearance. Thus, as shown, the surfaces forming the sealing clearance 20 are conical so that under the same pressure differential somewhat less air flows through the clearance 20 towards the inside than in a cylindrical arrangement. The clearance additionally converges somewhat towards the inside, the cone angle of the housing 21 being β and the cone angle of the roll 22 being α where α is less than β . This ensures the technological advantage that, at the same mean clearance width, the air speed is maximum at the exit to the clothing so that the danger of fiber penetration into the clearance 20 is reduced.

Referring to FIG. 6, a clearance 23 can also be formed in step form. In this case, the widths of the axial zones 24 and 25 are very narrow and the radial intermediate zone 26 is much larger due to the longitudinal play of the bearing (not shown). Further, for mounting space requirements, a labyrinth sealing effect is achieved which improves the sealing effect. The sealing effect, of course, can be further increased if a multiple labyrinth sealing is chosen, as shown in the symmetrical construction shown in FIG. 7 wherein like reference characters indicate like parts as above. In this latter case, each sealing surface 13 is interrupted by a pair of circumferential grooves 27.

A further means of influencing the air throughput quantities flowing through the clearance towards the inside is the choosing of suitable diameters. In the arrangement according to FIG. 5, the clearance 20 merges into the inside space at the outside diameter of the opening roll, i.e., at the base of the clothing. In the arrangement shown in FIGS. 1, 2, 6 and 7, each clearance projects into the space radially outside the outside diameter of the clothing, i.e., at the circle of points of the clothing. In the arrangement according to FIG. 11, the clearance projects about at the midpoint between the base and the circle of points of the clothing.

In view of the fact that the same pressure does not prevail at all the places along the circumference of an opening roll, the pressure differential between the outside space (under atmospheric pressure p_a) and the inside space above the clothing or the roll (under the lower pressure p_i) can be influenced locally at a determined place along the circumference or over a determined portion of the circumference. To this effect, the roll 27 (FIG. 8) can be arranged eccentrically with respect to the housing inside surface 28, the eccentricity being e . In this way, a maximum clearance width S maximum between the housing inside wall 28 and the outer rim 29 of the roll results. This clearance width is reduced over half the roll circumference to S minimum.

Alternatively, as shown in FIG. 9, the sealing effect can be varied only over a determined portion of the circumference. For example, the clearance 30 is enlarged along the circumference of the housing 3 over an angular sector B. Also, a labyrinth arrangement which extends only over a sector of the circumference can be possible.

Referring to FIG. 10, the surface rim forming the clearance 32 together with the housing 33 can also be provided with grooves 34 which, with respect to a given sense of rotation of the roll (indicated by an arrow) are directed towards the outside. If a very small angle γ is chosen, a helix extending over the full circumference of the roll is created. If a large angle γ' is chosen, a short groove 35 only is created as indicated with dash-dotted lines. The depth of the groove 35 can be chosen so as to decrease towards the inside. In the first case, two advantages result. On the one hand, a labyrinth type seal with improved sealing effects is achieved, and on the other hand, any fibers which penetrate from the clothing to the clearance, in spite of the air flow, tend to be transferred back. In the second case, only the fibers are transferred back.

In order to prevent the formation of fiber accumulations at the side opposite the open side where the clearance arrangement is provided, precautions are taken there to reduce the space between the clothing and the adjacent corner of the housing without detrimentally influencing the air throughput conditions of the roll. As air also flows between the face side of the roll and the housing wall, which can carry fibers, precautions are to be taken to ensure that such fibers can move back into the normal flow of fibers without meeting obstacles. For example, in order to prevent clinging of fibers in the housing corner, the corner space not acted upon by the clothing is reduced, as shown in FIG. 1, by providing an inclined corner 36. Alternatively, as shown in FIG. 5, a rounded corner 37 can be provided with the outermost points 38 of the clothing inclined towards the outside. The cross-sectional area of a width of about 0.5 millimeters (mm), if roll diameters ranging from 60 to 70 millimeters (mm) are used, remains unchanged in these arrangements.

Similarly, as shown in FIG. 6, the corner not acted upon by the clothing can be reduced by providing a protrusion 40 of the housing to reach into close proximity to the outermost points 41 of the clothing. A further alternative is shown in FIG. 11, in which the corner is reduced by means of a conical portion 42 of the housing wall and by an inclined rim 43 of the roll which is adapted to the conical portion 42. In this case, however, the diameter of the rim 43 is chosen noticeably smaller than the one of the circle of the points of the clothing so that the fibers can easily move onto the clothing.

The present invention results in a number of substantial advantages. Manufacturing, assembling and checking in operation are facilitated and made more economical by the advantageous constructions. In particular, the antifriction bearings can be chosen without longitudinal pretensioning and within normal tolerances. The bearings are also less exposed to wear, as no lubricants are drained off laterally. Technological conditions are also markedly improved. In particular, sufficient sealing effects from the outside towards the inside are achieved in spite of the width of the clearance which is not chosen extremely narrow, so that the air

intake capacity of the subsequent elements is not exceeded and that the waste extraction is not impaired. Furthermore, the number of ends down is reduced by more than 20 percent and, primarily, a reduction of the dreaded fiber bundle or packet formation down to about one twentieth of the previous level is achieved. As a result, the number of thick places in a processed yarn as well as blocking of the device are reduced drastically to a practically insignificant level.

What is claimed is:

1. In an opening end spinning device
 - a housing having a first cylindrical inside surface, a second inside surface, a fiber feed point communicating the inside of said housing with the exterior of said housing, a fiber transfer duct communicating the inside of said housing with the exterior of said housing and a waste separating point between said feed point and said duct communicating the inside of said housing with the exterior of said housing; and
 - a fiber opening roll rotatably mounted in said housing, said roll having a clothing peripherally disposed thereon within said first cylindrical inside surface for combing out fibers from a delivered sliver, said roll and said first cylindrical inside surface defining an annular space for guiding an air stream under vacuum from said feed point past said waste separating point to said transfer duct, said roll having a peripheral surface at at least one side of said clothing defining a laterally extending clearance with said second inside surface of said housing to communicate said annular duct with a space of higher pressure.
2. In an open end spinning device as set forth in claim 1 wherein said roll has a second peripheral surface on an opposite side of said clothing defining a second laterally extending clearance with a further inside surface of said housing.
3. In an open end spinning devices set forth in claim 1 wherein said clearance has a width (b) of

$$b \geq d^2/a \cdot k$$
 wherein d is the diameter of said peripheral surface, a is the width of said clothing and k is a constant larger than 9/1000.
4. In an open end spinning device as set forth in claim 1 wherein said clearance is cylindrical.
5. In an open end spinning device as set forth in claim 1 wherein said clearance is conically disposed outwardly from said roll.
6. In an open end spinning device as set forth in claim 1 wherein said clearance merges with the base of said clothing.
7. In an open end spinning device as set forth in claim 1 wherein said clearance extends radially outside said clothing.
8. In an open end spinning device as set forth in claim 1 wherein said clearance extends intermediately of said clothing.
9. In an open end spinning device as set forth in claim 1 wherein said clearance includes a plurality of laterally extending narrow zones and a radially extending wider zone arranged between said narrow zones.
10. In an open end spinning device as set forth in claim 9 wherein the diameters of said laterally extending zones are stepped.

11. In an open end spinning device as set forth in claim 10 wherein said second inside surface is stepped to form said wider zone.

12. In an open end spinning device as set forth in claim 9 wherein said roll has grooves in a rim thereof forming said wider zone, said grooves extending from the outside towards the inside in opposition to the direction of rotation of said roll.

13. In an open end spinning device as set forth in claim 12 wherein said groove forms a very small angle with respect to the lateral limitation of said roll and extends over at least a substantial part of the circumference of said roll.

14. In an open end spinning device as set forth in claim 12 wherein said groove forms a large angle with respect to the lateral limitation said roll and extends only over a small fraction of the circumference of said roll.

15. In an open end spinning device as set forth in claim 1 wherein said clearance is of variable width.

16. In an open end spinning device as set forth in claim 15 wherein the width of said clearance decreases from the outside towards the inside.

17. In an open end spinning device as set forth in claim 15 wherein said roll is eccentrically mounted with respect to said second inside surface to vary the width of said clearance.

18. In an open end spinning device as set forth in claim 15 wherein said housing has a recess of circumferentially limited extension to vary the width of said clearance.

19. In an open end spinning device as set forth in claim 1 wherein said housing has a reduced corner space on the side of said roll opposite to the side of said clearance.

20. In an open end spinning device

- a housing defining a first inside surface and a second inside surface;
- a fiber opening roll rotatably mounted in said housing, said roll having a clothing peripherally disposed thereon within said first inside surface to define an annular duct and a peripheral surface at at least one side of said clothing to define a laterally extending pneumatic sealing clearance with said second inside surface of said housing.

21. In an open end spinning device as set forth in claim 20 wherein said sealing clearance is of a radial size of from 0.3 millimeters (mm) to 0.5 millimeters (mm).

22. A fiber opening roll for an open end spinning device having a clothing peripherally mounted thereon and a peripheral surface at at least one side of said clothing extending laterally away from said clothing, said surface having a width (b) $\geq d^2/a \cdot k$ wherein d is the diameter of said surface, a is the working width of said clothing and k is a constant of from 0.02 to 0.12.

23. A fiber opening roll as set forth in claim 22 wherein said surface is disposed radially outwardly of said clothing.

24. A fiber opening roll as set forth in claim 22 wherein said surface includes at least one circumferential groove therein.

25. A fiber opening roll as set forth in claim 22 wherein said surface is conical and merges with the base of said clothing.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,800,520 Dated April 2, 1974

Inventor(s) Adolf Schiltnknecht

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

Column 4, line 21, " $K = 9 \frac{7}{8} / 100$ " should be

-- $K = 9/100$ --.

Column 5, line 21, "agnle" should be --angle--.

Column 5, line 57, "cothing" should be --clothing--.

Column 6, line 4, "3" should be --31--.

Column 6, line 21, "to" should be --into--.

Column 6, lines 62-63, "lubricatns" should be --lubricate--.

Column 7, line 13, "seocnd" should be --second--.

Column 8, line 16, "said roll" should be --of said roll--.

The priority particulars of the patent are omitted.

Switzerland Patent Application 8417/72
filed June 7, 1972 to which the right of priority is claimed.

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
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C. MARSHALL DANN
Commissioner of Patents