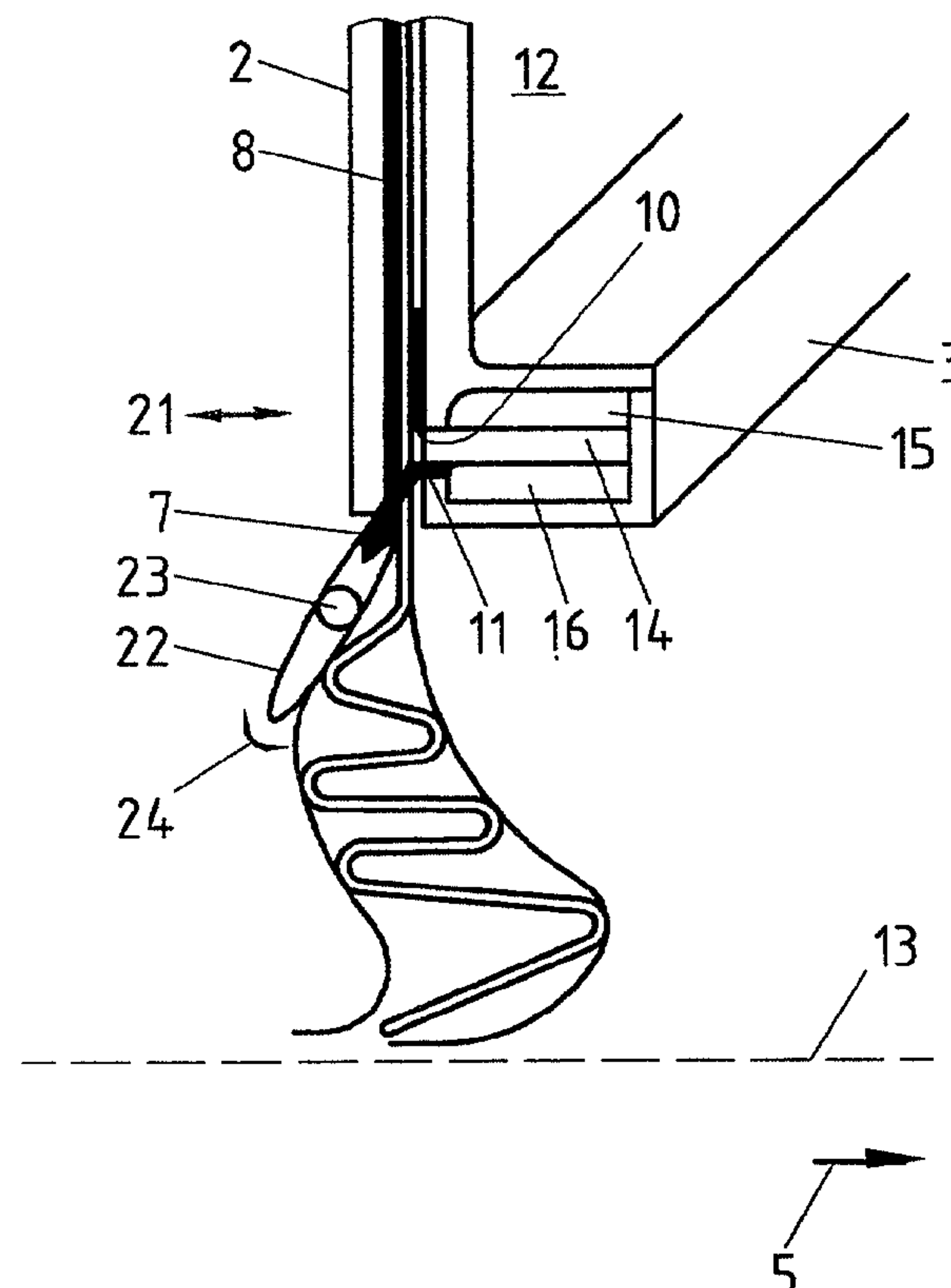


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(54) Title: PROCESS AND APPARATUS FOR THE MANUFACTURE OF A NON-WOVEN FABRIC



Process for the manufacture of a non-woven fabric by spinning of tow in the form of a linear group of filaments forming a curtain from a plurality of spinnerets by aerodynamically drawing off and stretching of the tow, whereby the tow exiting the stretching channel or drawn off a reel is moved laterally transversely by an air stream of periodically changing direction whereby the air stream in a horizontal plane is oriented obliquely relative to the tow.

ABSTRACT

Process for the manufacture of a non-woven fabric by spinning of tow in the form of a linear group of filaments forming a curtain from a plurality of spinnerets by aerodynamically drawing off and stretching of the tow, whereby the tow exiting the stretching channel or drawn off a reel is moved laterally transversely by an air stream of periodically changing direction whereby the air stream in a horizontal plane is oriented obliquely relative to the tow.

PROCESS AND APPARATUS FOR THE MANUFACTURE OF A NON-WOVEN FABRIC

Field of the Invention

The invention relates to the manufacture of non-wovens and especially to suitable methods and apparatus for the manufacture of non-woven fabrics.

Background Art

Different processes are known for the manufacture of non-woven fabrics as well as apparatus suitable therefor. Thermoplastic polymers are used as starting materials which are melted and spun into fine filaments. The filaments are most often aerodynamically stretched and thereby obtain the desired strength. The filaments are deposited after the spinning process or by way of intermediate draw-off reels onto a deposition belt on which they are laid down on top of one another and form the non-woven fabric.

A process for the manufacture of non-wovens is known from DE-AS 1 303 569 in which the filaments are guided through a channel, are aerodynamically stretched therein and thereafter deposited in non-woven form on a perforated, continuously moving support. In order to guarantee the statistically random deposit of the filaments, a zone of turbulence is provided below the air guiding channel, which supports a crosswise laying-down of the threads. A very irregular non-woven pattern is generated. A high uniformity of the non-woven fabric is achieved in that several guide channels are provided one after the other and in that the tows exiting therefrom are layered one above the other into a non-woven.

In order to be able to control the desired uniformity of the non-woven and its strength in longitudinal and transverse direction, it is known from DE 39 07 215 A1 to construct the spinning

beams as well as the fibre pulling arrangement to be rotatable. This is also intended to overcome the disadvantages which occur in the so called curtain processes which can lead to the superimposition of individual filaments in certain regions. In the curtain process, the non-woven has a preferred strength in a longitudinal direction, which means in the direction of production while the strength values in transverse direction are lower. This is intended to be compensated by obliquely positioning the spinning beams together with the depositing and stretching devices.

It is further known from DE 35 42 660 C2 to achieve a deflection of the air stream below the drawing-off channel by way of a swivelling device positioned in parallel and to thereby achieve an oscillating movement of the filaments. The swivelling movement is carried out in direction of advance of the depositing belt in direction of production; so called coander shells can be used among others as described, for example, in DE 24 21 401 C3. The provided measures are however relatively sluggish so that only slow oscillations of the tow are possible.

Summary of the Invention

It is now an object of the invention to provide a process and associated apparatus for the manufacture of a non-woven fabric of high uniformity in non-woven structure and surface weight distribution. It is a further object to enable the manufacture of a non-woven with a preselected longitudinal or transverse strength. For example, the transverse strength should be the same as the strength in longitudinal direction.

This object is achieved in accordance with the invention by a process wherein a tow in the form of a linear group of filaments and forming a curtain is laterally moved by a stream of air of periodically changing direction.

The invention is based on a process for the manufacture of a non-woven fabric by spinning a linearly oriented group of spaced apart parallel filaments in the form of a curtain from a plurality of

spinnerets by aerodynamic drawing-off and stretching of the group of filaments or tow. According to the process of the invention, the tow exiting the stretching channel or drawn-off by way of a reel is transversely moved by an air stream of periodically changing direction, whereby the air stream relative to a horizontal plane is oriented alternately obliquely to the group of fibres. Individual blasts of air of changing directions have the effect that the tow is oscillated transverse to the direction of production which leads to the desired non-woven structure, or a high uniformity in the structure.

The airstreams can be alternately directed from left and right. It has proven advantageous when air pauses are inserted between the individual air blasts in which pauses no air blast is present and which allow for a perpendicular re-orientation of the tow between the air blasts.

The general blast direction of the air streams is oriented perpendicular to the group of fibres. A blast angle in a horizontal plane of 15° is thereby selected. Of course, other blast angles are also possible, as desired. It is also possible to orient the blast direction in the vertical plane obliquely downward onto the tow. The blast angle in the vertical plane can be 15° .

It is sufficient when the air streams are directed onto the front face of the tow. However, this does not preclude a method or apparatus in which the air stream is also directed onto the rear face of the tow or onto both faces. This is dependent, among other things, on the thickness of the individual filaments and on the existing flow parameters for the air blast. If necessary, the deposition process can be additionally assisted by periodically moving flow directing surfaces, such as pivoting flaps, coander shells or the like. They are positioned as known in the art so that they are additionally oscillating the tow in the direction of production.

The apparatus for carrying out the process in accordance with the invention includes a spinning beam with a multitude of aligned spinnerets with a cooling air duct and a stretching channel and a deposition belt. Below the stretching channel before and/or behind the group of fibres at least one

blast duct is positioned in accordance with the invention having air exit nozzles which are oriented obliquely to the tow in a horizontal plane. The air exit nozzles are positioned in such a way that they can alternately blow an air stream in different directions, namely onto the tow from left or right. It is thereby advantageous when at least two mutually parallel air exit nozzle rows are provided whereby the nozzles of one row are oriented opposite to the nozzles of the other row. The air is sequentially supplied to the nozzles so that the nozzles to the left and the nozzles to the right are alternately supplied with air. The air supply to the nozzles of respectively one row is therefor shut off by a damper. However, it is also possible to provide the nozzles themselves with dampers so that the nozzles of respectively one row can be closed and those of the other row opened.

A rotatable shaft is preferably provided for the selective closure of the nozzles, which shaft is of hollow construction and provided with longitudinal slits.

The nozzles can be formed by corrugated steel type inserts with corrugations extending obliquely to their longitudinal direction, which inserts are inserted into the nozzle wall. They are preferably exchangeable so that the volume flow there through or even the direction or angle of flow can be easily changed.

The nozzle wall is provided with longitudinal slits positioned one above the other which correspond to the longitudinal slits in the shaft. In an especially preferred embodiment, an air reservoir chamber is provided in the blast duct which is positioned between the nozzle wall and a sealing wall positioned at the shaft. This provides for a very even air supply to the nozzles. The air storage chamber is divided into two chambers by an intermediate plate, which chambers are respectively associated with the upper and lower longitudinal slits of the sealing wall and the upper and lower nozzles in the nozzle wall. The shaft is thereby positioned in a longitudinal channel filled with pressurized air which is connected to a pressurized air reservoir.

A rotating roller has the advantage that an even pressure is present up the nozzle over the hole production with even larger production widths.

The ejection angle of the nozzles of both nozzle rows is preferably the same, whereby the same deflection of the tow is achieved in both directions. The ejection angles are preferably 10-60°, most preferably 45°.

To further support the non-woven laying down process, an adjustable mechanical air guide for control of the direction of the airflow can be provided below the blast duct. This air guide can consist of pivotable damper vanes or coander shells, by which the tow can be oscillated in direction of production.

In support of the air control, an air guide plate is provided in the preferred embodiment opposite the blast duct and on the other side of the tow which is adjustable in direction to and fro the blast duct. The direction of the lateral air flow is supported by this air guide plate and the lateral oscillation movement of the tow can be adjusted to be more or less pronounced, by bringing the air guide plate closer to the blast duct or moving it away therefrom.

Brief Description of the Drawings

The invention will now be further described by way of example only and with reference to the drawings wherein:

Figure 1 schematically illustrates the process of the invention;

Figure 2 schematically illustrates the blast duct with a deflected tow;

Figure 3 is a plan view of the air ejection nozzles of the blast duct;

Figure 4 is a partial perspective view of the stretching channel with blast duct and air guides; and

Figure 5 is a cross section through the blast duct and air storage chamber in accordance with the preferred embodiment.

Detailed Description of the Preferred Embodiment

Figure 1 schematically illustrates the four individual steps A, B, C and D of the preferred process in accordance with the invention. The perpendicular lines 1 illustrate the front wall of a blast duct 3 and lines 2 refer to an air baffle. The dots 4 represent the individual filaments of the tow. The direction of movement of the deposition belt is illustrated by the arrow 5. The curved arrows 6 and 7 illustrate the direction of flow of the air stream.

In the exemplary process, the tow including the filaments 4 is moved in production direction to the right, see step B, and to the left, see step D. Between these movements, the air stream is stopped so that the tow can re-orient perpendicularly as illustrated in steps A and C. From the blast duct 3, which is positioned in direction of production opposite the rear face of the tow, air is periodically ejected from the nozzles provided therefor towards the right, see step B, and towards the left, see step D. The air baffle 2 is positioned opposite the front face of the tow and an adjustment mechanism is provided for adjustment of the distance of the baffle from the blast duct 3.

The deposition of an individual filament 4 is schematically illustrated at the bottom of Figure 1 and it is apparent that the filament 4 upon its deposition carries out a movement which results approximately in the shape of a number 8.

Figure 2 illustrates the blast duct 3 with two rows of air ejection nozzles 10 and 11 oriented in rows and positioned one above the other. The tow 8 exiting the stretching channel 12 is initially deflected to the right by the air current exiting from the nozzles 10, which is illustrated by the continuous lines representing the tow 8. After shutting off the air stream, the tow re-orient itself perpendicularly under the force of gravity (not illustrated). In a further step, the tow is deflected in the opposite direction by an air stream exiting the air ejection nozzles 11, which is indicated by the

broken lines representing the tow 8. It is pointed out that this illustration only schematically shows the principle of the process.

The orientation of the nozzles 10 and 11 of the blast duct 3 as seen from the top is shown in Figure 3. Arrows 6 and 7 indicate the direction of flow of the air stream. The blast duct 3 is provided with an intermediate plate which separates the respective air chambers for the nozzles 10 and 11 from one another. It is possible in this manner to separately supply each chamber of the blow duct 3 with pressurized air.

The combination of the stretching channel 12, the blast duct 3 and the deposition belt 13 is illustrated in cross-section in Figure 4. The blast duct 3 has the nozzles 10 and 11 from which the air streams 6 and 7 are ejected. The blow duct 3 is separated by the intermediate plate 14 into two chambers 15 and 16 from which the nozzles 10 and 11 are respectively supplied with pressurized air. The air baffle 2 is positioned opposite the blast duct 3 and can be moved by suitable adjustment mechanisms in direction to and fro the blast duct 3, which is illustrated by double arrow 21. The rotatable vane 22 is provided below the air baffle 2 and can be rotated around an axis 23 as illustrated by the arrow 24. The tow 8 exiting the stretching channel 12 is laterally oscillated back and forth by the air streams exiting the air nozzles 10 and 11. By way of the rotatable vein 22, the group of fibres is additionally oscillated back and forth in the direction of production. The resulting non-woven formed on the deposition belt 13 has an extraordinary high uniformity and even surface weight distribution.

Figure 5 illustrates a preferred embodiment wherein a hollow shaft 30 provided with slits 31 is positioned within the blast duct 3 in a separate longitudinal channel 40. An air storage chamber 32 is defined between the nozzle wall 33 of the blast duct 3 and a sealing wall 34 engaging the shaft 30. The air storage chamber 32 is divided into two chambers 15 and 16 by the intermediate plate 14. The

nozzles 10 and 11 are positioned in two rows positioned one above the other in the nozzle wall 33. They are formed by corrugated steel-type inserts 35 having corrugations extending obliquely to their longitudinal direction (to the machine width). See also the orientation of the nozzles in Figure 3. The inserts 35 are exchangeable for variation of at least one of the air flow rate and the blast angle. The sealing wall 34 has longitudinal slits 36 positioned one above another which correspond with the longitudinal slits 31 in the shaft 30. The longitudinal slits 31 and 36 are respectively constructed in such a way that the pressurized air can only be provided from the shaft to either the upper chamber 15 or the lower chamber 16. Intermediate pauses in the air stream can be achieved by covering the slits 36 with the shaft wall, which pauses allow a perpendicular re-orientation of the filaments 8. The relationship in size and location of the longitudinal slits 31 in the shaft wall and the slits 36 in the sealing wall 34 determines the airflow from the longitudinal channel 40 into the chambers 15 and 16. The longitudinal channel 40 is connected through several connection flanges 42 with a pressurized air reservoir 41 extending parallel to the longitudinal channel 40.

Changes and modifications to the above described preferred embodiment are within the scope of the present invention which is defined solely by the appended claims.

CLAIMS:

1. Process for the manufacture of a non-woven fabric, comprising the steps of spinning a spaced apart parallel tow in the form of a linear group of filaments forming a curtain from a plurality of spinnerets by aerodynamically drawing-off and stretching the tow, and laterally transversely moving the stretched tow, which emerges from a stretching channel or is drawn off a reel, by an air stream of periodically changing direction, the air stream as viewed in a horizontal plane being oriented obliquely relative to the tow, and pauses being inserted between the changes in direction of the air stream, to permit perpendicular orientation of the tow.
2. Process for the manufacture of a non-woven fabric according to claim 1, wherein the plane of the air stream is oriented perpendicular to the tow.
3. Process for the manufacture of a non-woven fabric according to claim 2, wherein the blast angle of the air stream relative to the tow is 15° in the horizontal plane.
4. Process for the manufacture of a non-woven fabric according to claim 3, wherein the blast direction of the air stream is oriented in a vertical plane obliquely downwardly onto the group of fibres.
5. Process for the manufacture of a non-woven fabric according to claim 4, wherein the blast angle in the vertical plane is 15° .
6. Process for the manufacture of a non-woven fabric according to any one of claims 1-5, wherein the air stream is directed onto at least one of the front and back of the tow.
7. Process for the manufacture of a non-woven fabric according to any one of claims 1-6, including the further step of deflecting the tow subsequent to the air stream deflection by a periodically moved flow directing surface.
8. Apparatus for carrying out the process according to any one of claims 1-7, comprising a spinning beam with a multitude of spinnerets aligned in a row, a cooling air duct, a stretching channel, a deposition belt, and at least one air blast duct positioned below the stretching channel opposite at least one face of the tow and having air exit nozzles

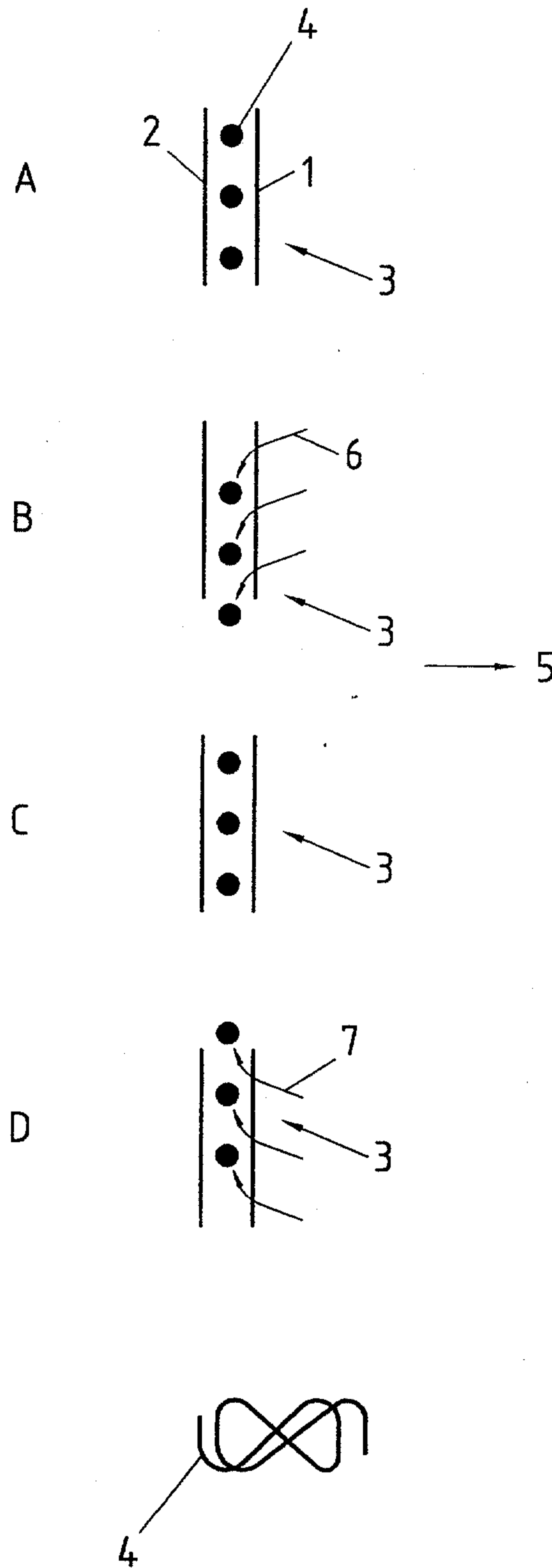
oriented in a horizontal plane obliquely relative to the face of the tow for generating the air stream oriented obliquely relative to the tow as viewed in a horizontal plane and permitting perpendicular orientation of the tow.

9. Apparatus according to claim 8, wherein the air blast has at least two substantially parallel rows of air exit ejection nozzles, whereby the nozzles of one row are positioned opposite the nozzles of the other row.
10. Apparatus according to claim 9, further comprising means for selectively shutting off the air supply to the nozzles of respectively one row.
11. Apparatus according to claim 9, wherein further comprising means for selectively closing the nozzles of respectively one row.
12. Apparatus according to claim 11, wherein the means for closing is a rotatable shaft for closing the nozzles.
13. Apparatus according to claim 12, wherein the shaft is hollow and has longitudinal slits for selective communication with the nozzles.
14. Apparatus according to claim 12 or 13, wherein the blast duct has a nozzle wall and the nozzles are formed by corrugated steel type inserts with corrugations extending obliquely to the longitudinal direction, which inserts are inlaid into the nozzle wall.
15. Apparatus according to claim 14, wherein the inserts are exchangeable for varying at least one of air flow rate and blast angle.
16. Apparatus according to claim 15, wherein the blast duct has a sealing wall for sealing engagement with the shaft, the sealing wall being provided with longitudinal slits positioned one above the other for selective communication with one of the longitudinal slits in the shaft.
17. Apparatus according to claim 12, wherein the blast duct includes an air storage chamber positioned between the nozzle wall and the sealing wall for the supply of pressurized air to the nozzles.

18. Apparatus according to claim 17, wherein the air storage chamber is divided into a pair of chambers by an intermediate plate, which chambers are respectively associated with the upper and lower longitudinal slits of the sealing wall and the upper and lower nozzles of the nozzle wall.
19. Apparatus according to any one of claims 12-18, wherein the shaft is positioned in a longitudinal channel filled with pressurized air.
20. Apparatus according to claim 19, wherein the longitudinal channel is connected to a pressurized air reservoir.
21. Apparatus according to any one of claims 8-20, characterized in that the nozzles in each nozzle row have the same blast angle.
22. Apparatus according to claim 21, wherein the blast angle is 10-60°.
23. Apparatus according to claim 22, wherein the blast angle is 45°.
24. Apparatus according to any one of claims 8-23, further comprising an adjustable air guide plate positioned opposite the blast duct and opposite the respectively other face of the tow from the blast duct.
25. Apparatus according to any one of claims 9-24, further comprising an adjustable mechanical air guide means positioned below the blast duct for controlling the direction of the air flow.
26. Apparatus according to claim 25, wherein the air guide means is a pivotable damper.
27. Apparatus according to claim 25, wherein the air guide means is a coander shell.
28. Non-woven fabric manufactured by the process according to any one of claims 1-7.

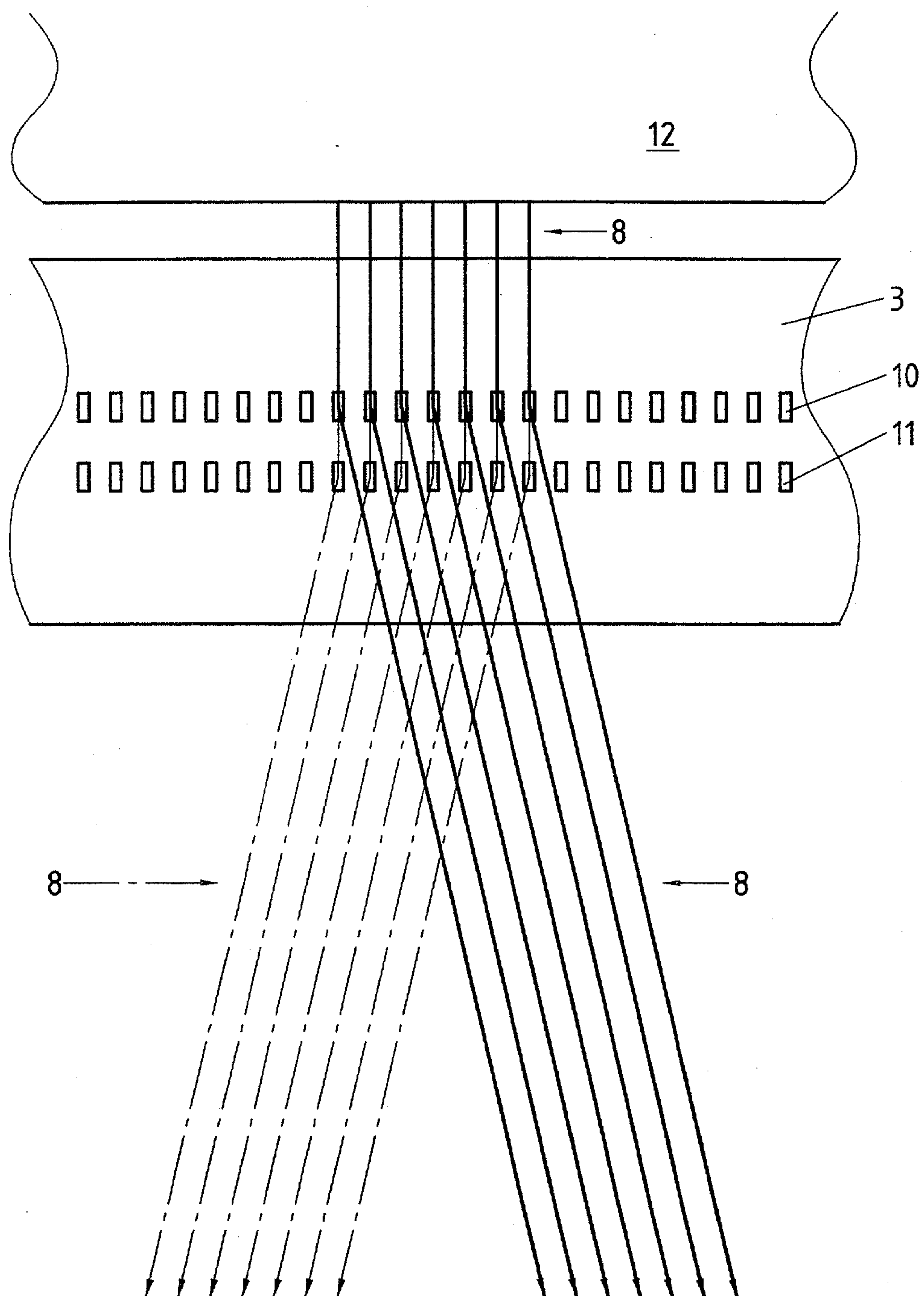
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Fig.1



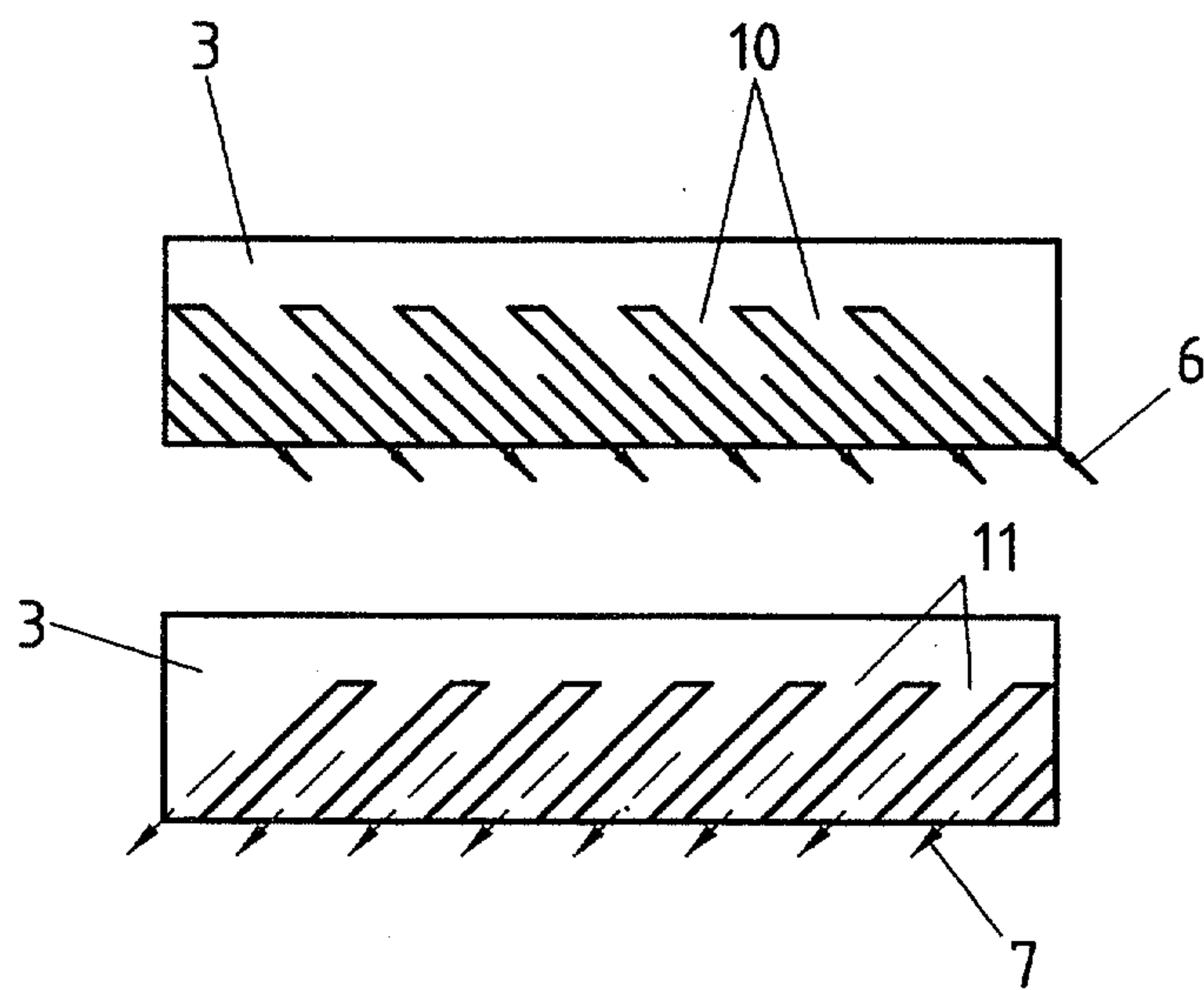
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Fig.2



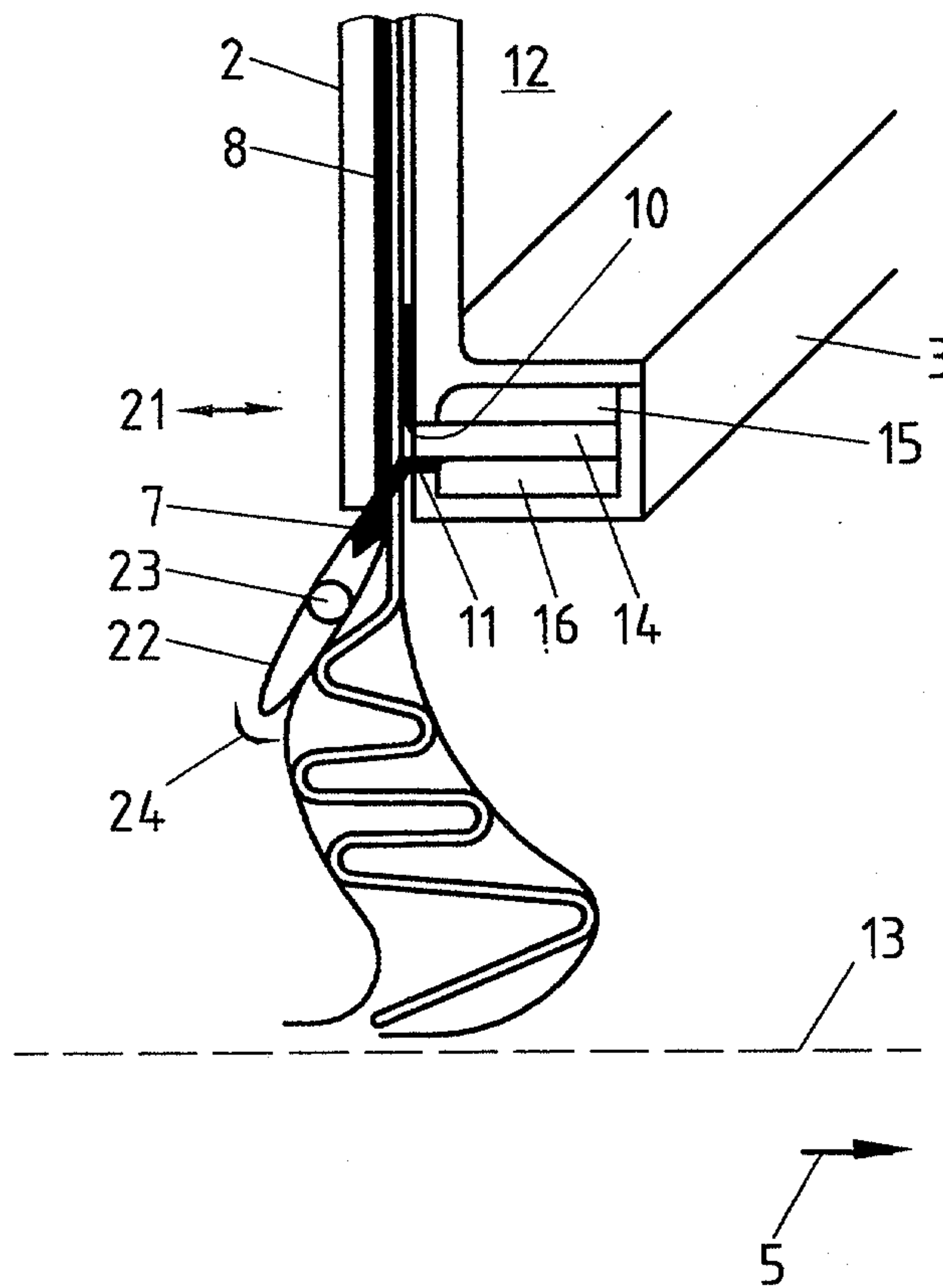
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Fig.3



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Fig.4



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Fig.5

