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PROCESS FOR PREPARATION OF CONTINUOUS FILAMENT NONWOVEN WEBS

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FIG. 1

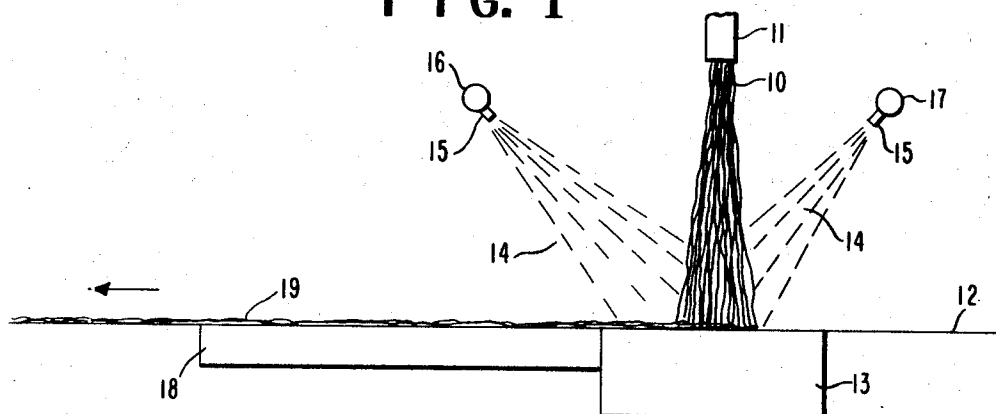


FIG. 2

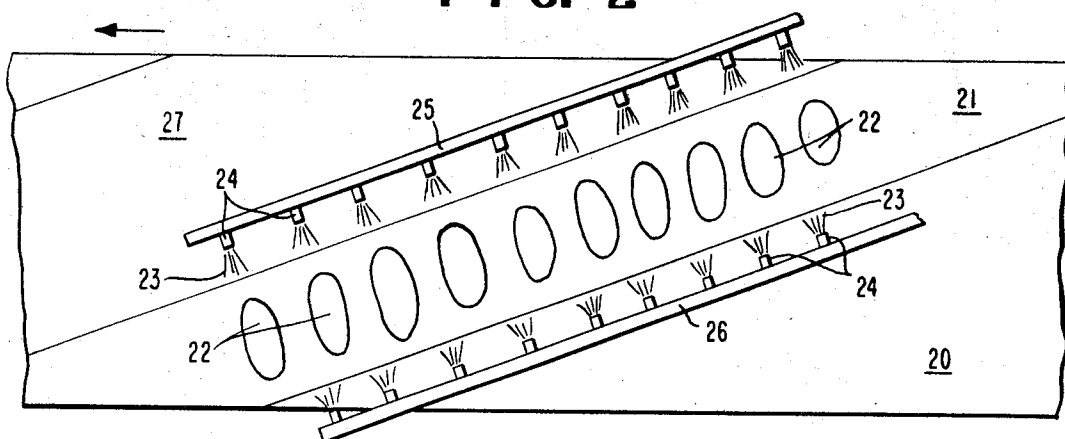
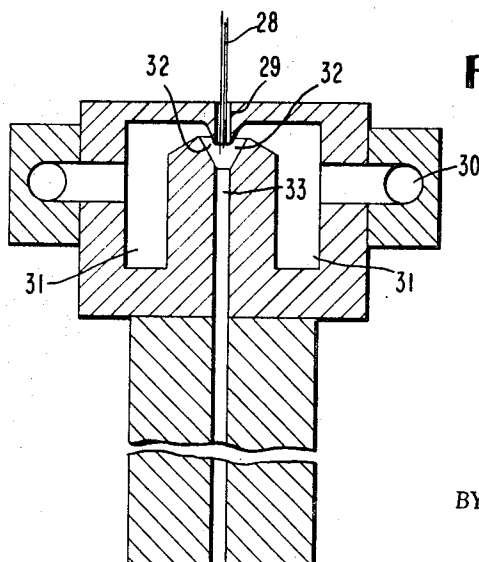


FIG. 3



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PROCESS FOR PREPARATION OF CONTINUOUS FILAMENT NONWOVEN WEBS

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Int. Cl. D02g 1/16; D04h 3/00

U.S. Cl. 28—76

4 Claims

ABSTRACT OF THE DISCLOSURE

In a process for preparing a nonwoven web wherein electrostatically charged continuous filaments are forwarded by jets to a receiving area which comprises a moving foraminous receiver covering a suction laydown zone at least at the point of initial filament deposition, the filaments are treated with water in the forwarding jets and/or in the receiving area to improve the pinning of the web to the foraminous receiver.

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of copending application Ser. No. 676,815, filed Oct. 20, 1967, and now abandoned.

This invention relates to an improved process for the preparation and handling of continuous filament nonwoven webs.

Processes for the preparation of continuous filament nonwoven fabrics utilizing electrostatic charging of the filaments to separate and distribute the filaments on a laydown receiver are known in the art. For example, British patent specification 932,482 describes a process wherein a multi-filament strand of continuous filaments under tension is electrostatically charged by known techniques, for example by passing the filaments through a corona discharge zone the charged filaments are forwarded by means of a jet device toward a web laydown zone; the tension on the filaments is released at the exit of the jet device thereby permitting them to separate as a result of the repelling effect of the applied electrostatic charge; and the filaments while thus separated are collected as a nonwoven web.

The preparation of commercially desirable wide webs requires the blending of the output of a plurality of jet devices in such a process. A blending process to form wide webs is described in British patent specification 1,067,039 wherein the jet devices are so spaced to provide 50–80% overlap of the areas of initial filament deposition on a moving foraminous receiver covering a suction area withdrawing air at a rate at least five times as great as the flow of air from the jet devices. Movement of air across the web surface caused by withdrawal of the large quantities of air necessary for adequate blending of the filaments exiting from the plurality of jet devices causes disturbance of the nonwoven web as it moves away from the initial laydown zone. This disturbance causes undesirable fold-backs or curl of portions of the web resulting in visual blemishes and weight variation. This

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problem can be somewhat alleviated by providing a decreasing suction gradient beyond the initial web laydown zone to help pin the nonwoven web to the laydown receiver, and can be further improved by providing a grounded plate beneath the laydown receiver. However, these latter techniques do not completely prevent fold-backs and curl.

It is known in the art (e.g. British patent specification 932,482) to relax fibers by treatment with steam or hot water in processes for the preparation of continuous filament nonwoven webs. The art does not teach, however, the use of steam or hot water in such a manner as to have any effect on web pinning beyond the suction laydown zone in such a process. In fact, in view of the known anti-static properties of water, one skilled in the art would predict that filament separation dependent on applied electrostatic charge as well as electrostatic pinning on the laydown receiver would be ineffectual in the presence of water.

DISCUSSION OF THE INVENTION

The present invention provides in the process for preparing a nonwoven web wherein electrostatically charged, continuous filaments are forwarded by jets to a receiving area which comprises a moving foraminous receiver covering a suction laydown zone at least at the point of initial filament deposition, the improvement comprising treating said filaments with sufficient water in said forwarding jets and/or in said receiving area so that the resulting web has adhered thereto 7 to 50% water based on the weight of said web. This invention effectively pins the web to the receiver at and beyond the initial laydown zone without additional loss of electrostatic charge or interference with the filament separation process. Thus, use of this process to form webs from both negatively and positively charged continuous filaments allows the preparation of nonwoven webs free of defects caused by movement of air toward the initial suction laydown zone.

As indicated, there are several points in the process at which the water treatment can be effected. The water may be introduced as steam into a filament forwarding jet, or it may be sprayed onto the filaments during or after deposition on the foraminous receiver. If desired, the water may be applied at more than one of these points. Preferably, the water is sprayed onto the filaments as they are deposited onto the foraminous receiver over the initial suction laydown zone. Where a water spray is used, the spray preferably should be finely divided to avoid filament entanglement or web distortion caused by the impact of large droplets of water.

This invention is especially adapted to the use of polyester and polypropylene filaments. After the nonwoven web has been prepared in accordance with this invention, it may be further treated by known means. Thus, the web may be consolidated and bonded by passing it into the nip between heated rolls.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a representation of an apparatus suitable for carrying out the process of this invention.

FIG. 2 is a plan view representation of an apparatus suitable for carrying out the process of this invention.

FIG. 3 is a cross-section of a forwarding jet suitable for use in carrying out the process of this invention.

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In FIG. 1, electrostatically charged continuous filaments 10 are forwarded from jet 11 onto receiver 12 which is a foraminous nonconducting continuous belt receiver moving in the direction shown by the arrow. The filaments are deposited in a suction laydown zone which is defined by the area of suction trough 13. The filaments are sprayed with water 14 from spray nozzles 15 supplied by headers 16 and 17. The water spray from header 16 is directed toward the downstream side of the suction laydown zone while the water spray from header 17 is directed toward the center of the suction laydown zone from the upstream side of the zone. Auxiliary suction trough 18 assists in pinning the web to the receiver. Troughs 13 and 18 are constructed of metal and are grounded, thus providing an electrostatic force to further assist in pinning the web to the receiver. The resulting nonwoven web 19 moves away from the suction laydown zone for further processing.

In FIG. 2, filaments are forwarded from jets (not shown) and deposited onto a moving foraminous receiver 20 in a suction laydown zone defined by suction trough 21 which is arranged diagonally across the receiver 20. The areas 22 represent the patterns in which the filaments initially contact the receiver. Water 23 is sprayed onto the filaments from nozzles 24 supplied by headers 25 and 26 which are arranged parallel to suction trough 21. Auxiliary suction trough 27 is correspondingly arranged parallel to suction trough 21.

In FIG. 3, filaments 28 are drawn into entrance orifice 29 by steam under pressure supplied from manifold 30 through plenums 31 and passing through jet nozzle openings 32 into jet throat 33.

The following examples illustrate preferred embodiments of the invention:

EXAMPLE I

Poly(ethylene terephthalate) matrix filaments and poly(ethylene terephthalate/isophthalate) (79/21) copolyester binder filaments are spun through spinnerets having 410 holes for the homopolymer and 82 holes for the copolymer. The spinneret holes are so spaced to uniformly blend the binder and matrix filaments. Spinning is at a rate of 46 lbs. (20.8 kg.) of polymer per hour per spinneret. Ten spinnerets are used with ten corresponding forwarding jets positioned to provide 67% overlap of adjacent swaths of filaments deposited onto a moving foraminous belt receiver. This receiver is a Formex Co. Design 70 belt comprising a woven fabric with poly(ethylene terephthalate) multifilament yarn in the machine direction and 66 nylon multifilament yarn in the cross-machine direction, the fabric being coated with a phenolic resin. Before entrance into the jets, the filaments are given a negative electrostatic charge of 14 microcoulombs/m.² using a corona charging device such as that described in DiSabato and Owens U.S. 3,163,753. Filament forwarding slot jets of the type described in Cope et al. U.S. 3,302,237 are used driven by compressed air at 27 p.s.i.g. (1.9 kg./cm.² gauge) and 260° C. An upstream water header, represented in FIG. 1 as header 17, is a ½ inch (1.27 cm.) diameter pipe fitted with Spray Systems Co. No. 400050 nozzles at each jet position and is positioned about 15 inches (38 cm.) above the receiver with the nozzles directed at the center of a suction trough, represented by suction trough 13 in FIG. 1, at points in between the swaths of filaments exiting from the jets. The distance of the spray nozzles from the receiver from the center of the suction troughs is about 24 inches (61 cm.). The downstream header, represented by header 16 in FIG. 1, is a ½ inch (1.27 cm.) diameter pipe fitted with Spray Systems Co. No. 400017 nozzles at each jet position and is positioned about 14 inches (35.5 cm.) above the receiver with the spray nozzles directed at the downstream edge of the suction trough at the centers of the swaths of filaments exiting from the jets. The distance of the spray nozzles from the receiver at the downstream edge of the suction trough is about 24 inches (61 cm.). Air is withdrawn from the suction trough

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at a rate of 400 standard cubic feet per minute (s.c.f.m.) per square foot of surface (12.2 l./min. per square centimeter of surface). Air is withdrawn from an auxiliary suction trough, represented by trough 18 in FIG. 1, at a rate of 400 s.c.f.m. per square foot of surface 12.2 l./min. per square centimeter of surface) on the upstream side of the auxiliary trough which is decreased stepwise to 50 s.c.f.m. per square foot of surface (1.525 l./min. per square centimeter of surface) on the downstream side of the auxiliary trough. The two suction troughs are positioned at an angle of 19.5° with the direction of belt receiver travel. The forwarding jets are positioned along the centerline of the suction trough as shown in FIG. 2.

With water supplied to the downstream header at 40 p.s.i.g. (2.8 kg./cm.² gauge), approximately .017 gallon (64.5 cm.³) of water per minute is sprayed from each nozzle. No water is supplied to the upstream header. At a polymer throughput of 46 lbs./hour/position (20.8 kg./hour/position) and a belt receiver speed of 35 y.p.m. (32 m./mm.) a monwoven web of 2.5 oz./yd.² (84.6 g./m.²) is produced. Thus water is sprayed on the nonwoven web in the amount of 19% of the web weight, and the nonwoven web was found to contain about 7% adhered water after leaving the auxiliary suction zone. The web is adequately pinned to the receiver, and no web defects caused by web fold-back or curl are observed.

EXAMPLE II

Example I is repeated except water at 20 p.s.i.g. (1.4 kg./cm.² gauge) is supplied to the downstream header. With this water pressure 0.012 gallon (45.5 cm.³) of water are sprayed from each nozzle of the downstream header to provide 14% water based on the nonwoven web weight. After leaving the auxiliary suction laydown zone the nonwoven web was found to contain 4% moisture. There is insufficient pinning of the web to the receiver with the result that web fold-back and curl are observed.

EXAMPLE III

Example I was repeated except water was also provided at 40 p.s.i.g. (2.8 kg./cm.² gauge) to the upstream header. At 40 p.s.i.g. (2.8 kg./cm.² gauge) each nozzle of the upstream header delivers 0.050 gallon (189 cm.³) of water per minute. At a polymer throughput of 46 lbs./hour (20.8 kg./hour) per position on ten positions, the water added to the nonwoven web by the upstream header is 56% of the web weight. Since the downstream header adds 19% of water based on web weight, the total amount of water added is 75% of the web weight. On leaving the auxiliary suction zone, the web is found to contain 25% water. No fold-back or curl appears in the web.

Using a rotating vane coulombmeter to determine the charge on the nonwoven web above the auxiliary suction zone, it is found that the electrostatic charge level is the same whether or not water is supplied to the headers. With no water supplied to the headers, the web contains defects due to fold-back or curl.

EXAMPLE IV

Poly(ethylene terephthalate) matrix filaments and poly(ethylene terephthalate/isophthalate) (79/21) binder filaments are spun from a common spinneret at 46 lbs./hour (20.8 kg./hour). The spinneret holes (250 matrix filament holes and 50 binder filament holes) are arranged so as to uniformly blend matrix and binder filaments. Using laydown geometry similar to that shown in FIG. 2, and with no water supplied from the headers but with saturated steam at 45 p.s.i.g. (3.2 kg./cm.²) supplied to the forwarding jets shown in FIG. 3, no fold-back or curl is observed on the belt receiver. Fibers emerging from the jets are found to contain 15% water on the average.

What is claimed is:

1. In the process for preparing a nonwoven web where- in electrostatically charged continuous synthetic filaments

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are forwarded in a separated condition by jets to a receiving area which comprises a moving foraminous receiver covering a suction laydown zone, the improvement for improved pinning of the web to the foraminous receiver comprising treating said filaments with sufficient water above said receiving area while filament separation is maintained so that the resulting web has adhered thereto 7 to 50% water based on the weight of said web.

2. The process according to claim 1 wherein the water is sprayed onto the filaments over said suction laydown zone.

3. The process according to claim 1 wherein steam is applied to the filaments in said forwarding jets.

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4. The process according to claim 1 wherein said filaments are polyester.

References Cited

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U.S. Cl. X.R.

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