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METHOD AND APPARATUS FOR AUTOMATED GAP CONTROL OF A SCARFING ROLL

Abstract

An assembly and method is provided for scarfing a fibrous material with an assembly that provides automated control of a scarf gap. The assembly includes a moveable mount, a driven scarfing roll coupled to the moveable mount, and a scarfing roll lifting assembly coupled to the moveable mount. A first sensor senses contact between the scarfing roll and an external surface and a second sensor senses position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the external surface has occurred. A control unit operates the scarfing roll lifting assembly to position the scarfing roll at a desired scarf gap measured from the contact position. The scarfing roll is positioned based on an identified high point of the external surface, such as the external forming surface of a forming drum.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application claims priority U.S. Provisional Application No. 63/507,839 filed Jun. 13, 2023, which is herein incorporated by reference in its entirety.

BACKGROUND OF THE DISCLOSURE
[0002] The disclosure herein relates to a method and an apparatus for controllably positioning a scarfing roll, which scarfs a fibrous web during the forming of disposable products such as diapers at very high speeds, relative to a forming drum. While the description provided relates to diaper manufacturing, the apparatus and method are easily adaptable to the manufacture of feminine hygiene and adult incontinence products, as well as other applications.
[0003] Generally, diapers comprise an absorbent insert or patch and a chassis, which, when the diaper is worn, supports the insert proximate a wearer's body. Additionally, diapers may include other various patches, such as tape tab patches, reusable fasteners and the like. The raw materials used in forming a representative insert are typically cellulose pulp and/or superabsorbent polymers, high internal phase emulsion (HIPE) foams, tissue paper, poly, nonwoven web, acquisition, and elastic, although application specific materials are sometimes utilized. Some of the insert raw materials are provided in roll form and unwound and applied in continuously fed fashion. Other insert raw materials such as superabsorbent polymers and curly fibers, as examples, are provided in non-roll form.
[0004] In the creation of a diaper, multiple roll-fed web processes are typically utilized. To create an absorbent insert, the cellulose pulp is unwound from the provided raw material roll and fiberized by a pulp mill. Pulp cores are created using a vacuum forming drum and placed on a continuous tissue web. Optionally, superabsorbent polymers may be added to the pulp core. In other embodiments, the core may be formed solely of superabsorbent polymers and/or of fibers that are provided to the forming system from bales. The cores may be formed on a rotary forming system, on a screen, or utilizing other air-laid technologies.
[0005] One or multiple nonwoven web layers may be wrapped around the absorbent material with adhesive optionally utilized to provide integrity and stabilization of the core structure. In other cases, the core is formed, unwrapped, on the vacuum forming assembly. Multiple cores, in wrapped or unwrapped form, may be stacked atop one another to form a multiple core assembly. The formed single or multiple core assembly is debulked by proceeding through a calendar unit, which at least partially compresses the fibrous web, thereby increasing its density and structural integrity. After debulking, the core is optionally passed through a segregation or knife unit, where individual inserts are cut. The inserts are conveyed, at the proper pitch, or spacing, to a combining unit where the inserts are enveloped within a diaper chassis.
[0006] In order to maintain the desired core thickness and ensure that the forming drum is not damaged during the scarfing operation via contact between the scarfing roll and the outer forming surface of the forming drum, the distance that the scarfing roll is positioned from the forming drum must be precisely set. Previously, an operator used a hand crank and a feeler gauge to set this

distance. This method is time-consuming and does not allow for the distances to be changed during operation.

BRIEF DESCRIPTION OF THE INVENTION

[0007] According to an aspect of the invention there is provided a scarfing assembly for a fibrous material. The assembly includes a moveable mount, a driven scarfing roll coupled to the moveable mount, and a scarfing roll lifting assembly coupled to the moveable mount. A first sensor is configured to sense contact between the scarfing roll and an external surface and a second sensor is configured to sense position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the external surface has occurred. A control unit is programmed to operate the scarfing roll lifting assembly to position the scarfing roll at a desired scarf gap measured from the contact position.

[0008] In embodiments of the invention, the scarfing roll is positioned at least partially within a housing and the scarfing roll lifting assembly causes movement of the scarfing roll relative to the housing.

[0009] The first sensor may be a load cell, an optical sensor, or a torque sensor according to embodiments. In embodiments of the invention, the second sensor is an encoder.

[0010] In embodiments, a driven forming drum has an outer forming surface onto which a fibrous material is deposited and the scarfing roll is positioned proximate the outer forming surface of the driven forming drum.

[0011] In embodiments, the first sensor is configured to sense contact between the scarfing roll and the outer forming surface of a driven forming drum and the second sensor is configured to sense a contact position where the scarfing roll is in contact with the outer forming surface. The control unit is further programmed to control the scarfing roll lifting assembly to position the scarfing roll at the desired scarf gap measured off the contact position.

[0012] In embodiments the control unit is programmed to a) move the scarfing roll toward the forming drum; b) record a contact position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the outer forming surface has occurred; c) move the scarfing roll away from the forming drum; d) rotate the forming drum to a new rotational position relative to the scarfing roll; e) repeat a) through d) to acquire contact positions at a plurality of rotational positions around a circumference of the forming drum; f) identify a high point on the forming surface from the acquired contact positions; and g) move the scarfing roll to a desired scarf gap position based on the identified high point.

[0013] In some embodiments the control unit is programmed to acquire contact positions at a plurality of rotational positions around the entire circumference of the forming drum. In some embodiments the control unit is programmed to identify the high point as the minimum value of the acquired contact positions.

[0014] According to another aspect of the invention, there is provided a method of automated gap control of a scarfing roll assembly for a fibrous material comprising the steps of controlling a scarfing roll lifting assembly to move a driven scarfing roll toward a surface external the scarfing roll assembly; sensing contact between the scarfing roll and the surface external the scarfing roll assembly with a first sensor; upon the sensed contact, recording a contact position of the scarfing roll using feedback from a second sensor when information is received from the first sensor that contact of the scarfing roll with the surface external the scarfing roll assembly has occurred; and controlling the scarfing roll lifting assembly to position the scarfing roll at an offset from the contact position corresponding to a desired scarf gap.

[0015] In some embodiments the method includes sensing contact between the scarfing roll and the external surface with a load cell. In other embodiments the method includes sensing contact between the scarfing roll and the external surface with one of a torque sensor and an optical sensor. In some embodiments the method includes sensing the contact position of the scarfing roll with an encoder.

[0016] The method may include moving the driven scarfing roll toward an outer forming surface of a driven forming drum onto which a fibrous material is deposited and sensing contact between the scarfing roll and the external surface comprises sensing contact between the scarfing roll and the outer forming surface.
[0017] The method may include a) moving the scarfing roll toward the outer forming surface of a forming drum; b) recording a contact position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the forming surface has occurred; c) moving the scarfing roll away from the forming drum; d) rotating the forming drum to a new rotational position relative to the scarfing roll; e) repeating a) through d) to acquire contact positions at a plurality of rotational positions around a circumference of the forming drum; f) identifying a high point on the forming surface from the acquired contact positions; and g) moving the scarfing roll to a desired scarf gap position based on the identified high point.
[0018] In embodiments, the method includes controlling the scarfing roll lifting assembly to position the scarfing roll at an initial offset position from a surface external the scarfing roll assembly and subsequently move the driven scarfing roll to a contact position with the external surface.
[0019] The method may include controlling the scarfing roll lifting assembly to move the driven scarfing roll comprises moving the scarfing roll relative to a housing within which the scarfing roll is at least partially positioned.
[0020] In some embodiments, the method includes acquiring contact positions at a plurality of positions on the surface external the scarfing roll assembly, identifying a high point on the surface external the scarfing roll assembly from the acquired contact positions, and moving the scarfing roll to a desired scarf gap position based on the identified high point. In some embodiments the method includes identifying the high point as the contact position of the acquired contact positions corresponding to the minimum value.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0021] The drawings illustrate embodiments presently contemplated for carrying out the disclosure.
[0022] In the drawings:
[0023] FIG. **1** is a front plan view of a scarfing roll positioned adjacent a forming drum, which is only partially shown, and a controllable automated gap control apparatus according to an exemplary embodiment;
[0024] FIG. **2** is a perspective view of the scarfing roll and the controllable automated gap control apparatus;
[0025] FIG. **3** is a side elevation view of the scarfing roll and the controllable automated gap control apparatus;
[0026] FIG. **4** is a bottom plan view of the scarfing roll and the controllable automated gap control apparatus;
[0027] FIG. **5** is a flowchart of steps of method of operating the scarfing roll and the controllable automated gap control apparatus according to an exemplary embodiment; and
[0028] FIG. **6** is a schematic representation of a web processing apparatus incorporating a controllable automated gap control apparatus according to an exemplary embodiment.
DETAILED DESCRIPTION
[0029] While the present disclosure may be susceptible to embodiment in different forms, there is shown in the Figures, and will be described herein in detail, specific embodiments, with the understanding that the present disclosure is to be considered an exemplification of the principles of the present disclosure, and is not intended to limit the present disclosure to that as illustrated.

[0030] As such, references to a feature or aspect are intended to describe a feature or aspect of an example of the present disclosure, not to imply that every embodiment thereof must have the described feature or aspect. Furthermore, it should be noted that the description illustrates a number of features. While certain features have been combined together to illustrate potential system designs, those features may also be used in other combinations not expressly disclosed. Thus, the depicted combinations are not intended to be limiting, unless otherwise noted.
[0031] Referring first to FIGS. **1-4**, a controllable automated gap control apparatus **10** is provided for setting a separation or scarf gap **12** between a scarfing roll **14** and an external surface, which is referred to herein as an outer forming surface **16** of a driven forming drum **18**. The controllable automated gap control apparatus **10** is used to set an initial set position of the scarfing roll **14** relative to the outer forming surface **16** of the forming drum **18** such that a desired scarf gap **12** is provided during operation. While described herein with reference to a rotary forming drum **18**, it is contemplated that the automated gap control apparatus **10** may be utilized in alternative types of forming systems, including a mat or screen system or other known air-laid systems, and thus be provided for setting a scarf gap **12** between the scarfing roll **14** and an external surface of the alternative forming system.
[0032] As is known in the art, the scarfing roll **14** scarfs a layer of a fibrous material **20** of an insert **22** which may be used as an absorbent core of a disposable products such as a diaper. In an embodiment, the controllable automated gap control apparatus **10**, the scarfing roll **14** and the forming drum **18** are components of a forming apparatus **300** (FIG. **6**), described herein, that forms disposable products. One example embodiment of the forming apparatus **300** is shown and described herein, however, the components of the forming apparatus **300** are not limited to specifically the embodiment shown herein.
[0033] A method of positioning the scarfing roll **14** relative to the forming drum **18** using the controllable automated gap control apparatus **10** is also provided with reference to FIG. **5**. It is noted that the present controllable automated gap control apparatus **10** is described herein with respect to disposable hygiene products such as diapers, but as previously mentioned, can be applied to a wide variety of processes that utilize fiberized fluff mats including, as non-limiting examples, food pads and dry molded fiber products.
[0034] The outer forming surface **16** of the forming drum **18** is generally cylindrical and the forming drum **18** rotates about a rotational axis **24**. Suitable forming drums **18** for producing a fibrous material **20** are well known in the art. The forming drum **18** may include a continuous three-dimensional fluff receiving pocket or depression or a plurality of discrete, three-dimensional fluff receiving pockets or depressions extending inward from the outer forming surface **16** thereof. As is known, outer forming surfaces of such forming drums **18** are not entirely concentric about their axes of rotation. Such non-circular portions are commonly called runouts. The present controllable automated gap control apparatus **10** and method prevent the scarfing roll **14** from contacting the outer forming surface **16** during operation.
[0035] The scarfing roll **14** is housed within a scarfing housing **26** (FIG. **6**) and is movably positioned therewithin. Only the back wall **26***a* of scarfing housing **26** is shown in FIGS. **1-4** for clarity. The scarfing housing **26** provides an entrance opening **28** to allow the fibrous material **20** to enter into the scarfing housing **26** so that fibrous material **20** passes by the scarfing roll **14** and an opposite exit opening **30** to allow the fibrous material **20** to pass into the next component of the forming apparatus **300**. The scarfing roll **14** extends from the back wall **26***a* over the forming drum **18**.
[0036] The scarfing roll **14** has an a rotational axis **32**, and typically, the rotational axis **32** of the scarfing roll is aligned substantially parallel to the rotational axis **24** of the forming drum **18**. Scarfing rolls are well known in the art, and any conventional scarfing roll may be employed with the present invention. Suitable scarfing rolls are available from the Applicant. In the illustrated example, the scarfing roll **14** includes a plurality of scarfing pins or other scarfing elements **34**,

such as saw tooth blades, brushes, bars, and wire-wrapped saw tooth structures as non-limiting examples, which are operatively mounted and attached to a core member **36**. The core member **36** may be generally cylindrical and the outer diameter of the scarfing roll **14** at the distal free tips **38** of the scarfing pins or other scarfing elements **34** define a generally cylindrical shape. The scarfing roll **14** may include a selected pattern array of scarfing pins or other scarfing elements **34** distributed along the outer surface of the core member **36**. The scarfing pins or other scarfing elements **34** may be arranged in rows that extend along the axial direction of the scarfing roll **14**, and may be distributed around the circumference of the scarfing roll **14** at substantially, equally spaced intervals. The scarfing roll **14** is operatively rotated by a suitable drive mechanism **40**, such as an electrical motor, and can be rotated at any operative speed that is sufficient to provide the desired scarfing operation.

[0037] The controllable automated gap control apparatus **10** controls the position of the scarfing roll **14** and the drive mechanism **40** relative to the forming drum **18**. The controllable automated gap control apparatus **10** includes a mount **42**, which may be formed of a plate, on which the drive mechanism **40** and scarfing roll **14** are fixedly mounted, a slidable coupler **44** between the mount **42** and the back wall **26***a* of the scarfing housing **26**, a lifting assembly **46** for raising or lowering the mount **42**, the drive mechanism **40** and the scarfing roll **14** and a first sensor **48** which senses contact of the scarfing roll **14** with the outer forming surface **16** of the forming drum **18**. The drive mechanism **40** is operatively coupled to a control unit **52** that is programmed to operate the lifting assembly **46** to position the scarfing roll **14** at a desired scarf gap. The drive mechanism **40** extends through an elongated opening **54** through the back wall **26***a* and the scarfing roll **14** and drive mechanism **40** can translate relative to the back wall **26***a* along an axis **56** of the opening **54** which extends radially from the rotational axis **24** of the forming drum **18** and which is defined along the length of the opening **54**. In the illustrated embodiment, the scarfing roll **14** is cantilevered from the mount **42** and extends over the forming drum **18**. Scarfing roll **14** may be simply supported in alternative embodiments. The scarfing roll **14** translates toward or away from the forming drum **18** when the controllable automated gap control apparatus **10** is activated.

[0038] In the embodiment as shown in FIGS. **1-4**, the slidable coupler **44** (FIG. **4**) is provided by rails **60** extending from the back wall **26***a* on each side of the elongated opening **54** and which are parallel to the axis, and mating channels **62** in the mount **42**. As an alternative, the channels **62** can extend into the back wall **26***a* on each side of the elongated opening **54** parallel to the axis of the elongated opening **54**, and the rails **60** extend from the mount **42**. Other means for slidably coupling the back wall **26***a* and the mount **42** are within the scope of the present disclosure.

[0039] In an embodiment as shown in FIGS. **1-4**, the lifting assembly **46** includes a piston **64** mounted within a cylinder **66** that can be raised or lowered under actuation by a driving mechanism **68**, such as an electric motor, and a coupler assembly **70** between the end of the end of the piston **64** and the mount **42**. The driving mechanism **68** is operatively coupled to the control unit **52**. The control unit **52** is programmed to control the position of the piston **64** in response to information received from the first sensor **48**. The piston **64** may be a screw. The cylinder **66** and the driving mechanism **68** are fixedly mounted to the back wall **26***a*. While described above as an electric motor, driving mechanism **68** may be any type of driving mechanism that converts rotary motion to linear motion or may be a linear motor in alternate embodiments.

[0040] In the embodiment as shown in FIGS. **1-4**, the coupler assembly **70** includes the first sensor **48** which is operatively connected to the control unit **52** and provides information to a processor **74** of the control unit **52** when contact is registered. In the illustrated embodiment, first sensor **48** is a conventional load cell positioned between a shaft **72** forming part of the mount **42** and the end of the piston **64**. The load cell, as is known in the art, registers when a load is placed thereon. In this embodiment, the first sensor **48** registers a load when a force is created when the scarfing roll **14** is moved into contact with the outer forming surface **16** of the forming drum **18**. The first sensor **48** may alternatively be a sensor that detects contact between the scarfing roll **14** and the outer forming

surface **16** via a detected flow of electricity therebetween.
[0041] In another embodiment, the first sensor **48** is a torque sensor that senses contact between the scarfing roll **14** and the forming drum **18** via a change in torque applied to the scarfing roll **14** while either the scarfing roll **14** or forming drum **18** are rotating, as further described with respect to the method below. Alternatively, first sensor **48** may be a sensor that visually determines that contact between the scarfing roll **14** and the outer forming surface **16** has occurred. Such a sensor can be a photo eye sensor, or similar optical sensor, operatively coupled to the processor **74**. This first sensor **48** may be mounted on the back wall **26***a* of the scarfing housing **26**, mounted within the tip of the scarfing pins or other scarfing elements **34**, or mounted at an alternative advantageous location so that the contact of the scarfing roll **14** with the outer forming surface **16** of the forming drum **18** is sensed in each indexed position.
[0042] In yet another embodiment, the first sensor **48** is a calibrated distance sensor
[0043] Referring again to FIGS. **1-4**, the controllable automated gap control apparatus **10** tracks the relative position of the scarfing roll **14** using a second sensor **50** that detects motion of the scarfing roll **14**. Second sensor **50** may be any known sensor capable of creating a distance signal from motion, such as, for example, an encoder. The second sensor **50** is operatively connected to the control unit **52** and provides information used by the processor **74** regarding the linear travel distance of the scarfing roll **14**. The controllable automated gap control apparatus **10** is used to set a predetermined desired offset or scarf gap **12** between the scarfing roll **14** and the outer forming surface **16**, and the scarf gap **12** is arranged to produce a desired thickness in the scarfed fibrous material **20**.
[0044] A method **100** of operating the controllable automated gap control apparatus **10** is now described in accordance with an embodiment and in reference to FIG. **5**. In step **102**, the scarfing roll **14** is positioned at an initial offset distance from the outer forming surface **16** that is greater than any anticipated eccentricity of the outer forming surface **16**.
[0045] Optionally, the control unit **52** may send a signal to actuate the drive mechanism **40** to position the scarfing roll **14** in a top dead center (TDC) position relative to the outer forming surface **16**, step **104**. In the TDC position, the scarfing pins or other scarfing elements **34** are positioned such that the TDC of the tip of at least one of the scarfing pins or other scarfing elements **34** is aligned with and positioned facing the forming drum **18**. Next, the control unit **52** sends a signal to actuate the lifting assembly **46** to lower the mount **42**, the drive mechanism **40**, and the scarfing roll **14** toward the outer forming surface **16**, step **106**. In embodiments where first sensor **48** is a torque sensor, step **106** further includes slowly rotating one of the scarfing roll **14** or the forming drum **18** while holding the other component stationary. When the first sensor **48** senses contact of the distal free tips **38** of the scarfing pins or other scarfing elements **34** in the TDC position with the outer forming surface **16** (by force, optics, torque, conductivity, or other sensing means), step **108**, a signal is sent to the processor **74**.
[0046] The contact position of the scarfing roll **14**, which is tracked based on output of second sensor **50**, is then placed into memory **84**, step **110**, along with the current rotational position of the forming drum **18**, which is determined by known means, such as an encoder [not shown] operatively coupled to the processor **74**. This initial contact position is indicated as contact position CP1. The control unit **52** then sends a signal to actuate the lifting assembly **46** to raise the mount **42**, the drive mechanism **40**, and the scarfing roll **14** away from the outer forming surface **16** and back to the initial offset position, step **112**. A check is then made to determine whether the contact position CPn of the scarfing roll **14** has been determined around the entire circumference of the outer forming surface **16** of the forming drum **18**, step **114**.
[0047] If indexing is not complete, **116**, the control unit **52** sends a signal to index the forming drum **18** to rotate the forming drum **18** around its rotational axis **24** a predetermined amount, step **118**. For example, the forming drum **18** may be indexed to rotate ten degrees. In another example, the forming drum **18** may be indexed to rotate one degree or any other predetermined rotational

distance. With the scarfing roll **14** in the TDC position relative to the outer forming surface **16**, the control unit **52** again sends a signal to actuate the lifting assembly **46** to lower the mount **42**, the drive mechanism **40**, and the scarfing roll **14** toward the outer forming surface **16**, step **106**. When the first sensor **48** again senses a force which indicates contact of the distal free tips **38** of the scarfing pins or other scarfing elements **34** in the TDC with the outer forming surface **16**, step **108**, another signal is sent to the processor **74**. The contact position of the scarfing roll **14** along with the current rotational position of the forming drum **18**, determined in the same manner described above, is then placed into memory **84**, step **110**. The second contact position is indicated as contact position CP2. The control unit **52** then sends a signal to actuate the lifting assembly **46** to raise the mount **42**, the drive mechanism **40**, and the scarfing roll **14** away from the outer forming surface **16** and back to the initial position, step **112**.

[0048] This sequence of steps **106-118** is repeated until indexing is complete, **120**, meaning that the contact position CPn of the scarfing roll **14** has been determined around the entire circumference of the outer forming surface **16**. Thereafter, the control unit **52** references contact positions CP1 through CPn and identifies the drum location corresponding to the minimum contact position value as the drum high point (“HP”) of the circumference of the outer forming surface **16**, step **124**. Processor **74** then references a desired scarf gap, which may be stored within memory **84**, entered by a user, or otherwise input to the system, and control unit **52** sends a signal to actuate the lifting assembly **46** to position the scarfing roll **14** at a set operating position OP set at the desired scarf gap measured off the drum HP.

[0049] In use, the scarfing roll **14** rotates at a relatively high rate of speed to provide an operative scarfing motion. The scarfing roll **14** is rotated to contact the scarfing pins or other scarfing elements **34** with excess thickness of the fibrous material **20**. Since the set position of the scarfing roll **14** is set relative to the determined high point of the circumference of the outer forming surface **16**, the scarfing pins or other scarfing elements **34** will not contact the forming surface **16** during operation.

[0050] In use, the thickness of fibrous material **20** can be varied by programming the control unit **52** to lift the scarfing roll **14** away from the set operating position OP and then move the scarfing roll **14** back to the set operating position OP. The above-described sequence of lifting and lowering the scarfing roll **14** may also be to selectively vary the height of the formed fibrous material **20** (e.g., to form three-dimensional core structures) or to avoid material jams due caused by splices in the incoming web materials by providing feedback of known splice locations to the control unit **52**.

[0051] The above-described method senses physical contact between the scarfing roll **14** and the external forming surface **16** and identifies the high point of the forming drum **18** by referencing the positional location of the scarfing roll **14** at each of a series of physical contact points on the forming drum **18**. In yet another embodiment, the high point of the forming drum **18** may be determined using non-contact means, such as first sensor **48** provided in the form of a calibrated distance sensor (for example, an optical scanner) capable of detecting a distance to a given surface and/or mapping the topology of the outer forming surface **16** and identifying the high point of the forming drum **18** therefrom. In such an embodiment, steps **102-120** of method **100** would be omitted and the scanner utilized in step **122** to identify the high point of the forming drum **18**.

[0052] An example of the forming apparatus **300** which forms the insert **22** is shown in FIG. **6**. In an embodiment, the insert **22** includes a first sheet formed of a form-on web **302** material such as nonwoven material, tissue paper, or acquisition distribution layer (ADL), as non-limiting examples, a first adhesive layer (not shown), a layer of the absorbent fibrous material **20**, a second adhesive layer (not shown), and a second sheet formed of a cover web **304** such as nonwoven material, tissue paper, or ADL, as non-limiting examples. The first adhesive layer is provided between the first sheet formed by the form-on web **302** material and the fibrous material **20**, and the second adhesive layer is provided between the fibrous material **20** and the second sheet formed by the cover web **304**. Longitudinally extending edge portions of the respective first and second sheets are adhesively secured to each other by the second adhesive layer. In other embodiments, forming apparatus **300** may form insert **22** as an unwrapped core structure comprising the fibrous material **20** absent the form-on web **302**, cover web **304**, and adhesive layers, which may be further processed downstream of the forming apparatus **300**, or as a wrapped core structure comprising the fibrous material **20** with a single, wider web layer of which a portion of is positioned directly on the forming apparatus **300** during the forming process and another portion thereof is wrapped around the absorbent fibrous web **20** as the fibrous material **20** is formed.

[0053] With continued reference to FIG. **6**, the form-on web **302** has a planar first surface and an opposite planar second surface, and the cover web **304** has a planar first surface and an opposite planar second surface. Each web **302**, **304** defines a longitudinal axis which is parallel to the direction of movement of each web **302**, **304** through the forming apparatus **300** and a lateral axis which is transverse to the direction of movement of each web **302**, **304** through the forming apparatus **300**.

[0054] The form-on web **302** is continuously fed from a source **306**, such as a roll of material, to a core former **308**. The form-on web **302** may be fed around a series of rollers as it proceeds from the source **306** to the core former **308**. A first adhesive application station **310** is provided between the source **306** and the core former **308** and applies an adhesive layer to at least a portion of the second surface of the form-on web **302**.

[0055] The material which forms the absorbent fibrous material **20** layer is fed into the core former **308**. In the illustrated embodiment, the form-on web **302**, having the adhesive layer applied thereto, passes between an outlet of a forming duct **312** of the core former **308** and the forming drum **18**, which is rotating relative to the core former **308**. As the form-on web **302** passes by the outlet, the fibrous material **20** layer is deposited onto the adhesive layer on the form-on web **302**. The vacuum of the forming drum **18** is drawn through holes in the forming drum **18** and holds the form-on web **302** and fibrous material **20** layer against the forming drum **18**.

[0056] The scarfing roll **14**, which is now set to the desired scarf gap **12** relative to the outer forming surface **16** of the forming drum **18** via the controllable automated gap control apparatus **10**, is downstream of the outlet of the forming duct **312** of the core former **308**. The scarfing roll **14** continuously scarfs the fibrous material **20** layer to level the top thereof as the fibrous material **20** layer passes through the scarfing housing **26**.

[0057] The cover web **304** is continuously fed from a source **314**, such as a roll of material, downstream of the exit opening **30** of the scarfing housing. The cover web **304** may be fed around a series of rollers as it proceeds from the source **314** to the exit opening **30** of the scarfing housing **26**. A second adhesive application station **316** is provided between the source **306** and the scarfing roll **14** and applies an adhesive layer to at least a portion of the first surface of the cover web **304**.

[0058] The form-on web **302**/fibrous material **20** layer/cover web **304** pass through a combining station **318** which is downstream of the exit of the scarf housing **26**. In the embodiment as shown, the combining station **318** includes a drum and a nip roller. The nip roller rotates in coordination with the drum and the form-on web **302**/fibrous material **20** layer/cover web **304** pass through the nip formed between the drum and the nip roller and this bonds the adhesive layer on the cover web **304** to the fibrous material **20** layer.

[0059] The bonded form-on web **302**/fibrous material **20** layer/cover web **304** then moves onto and passes between the forming drum **18** and a conveyor **320**, and translates along the conveyor **320** to an edge bonding unit **322** which is downstream of the combining station **318** which bonds longitudinally extending edge portions of the form-on web **302** and the cover web **304** together by the adhesive layer on the cover web **304**. The edge bonding unit **322** may be movable roller(s) that press down onto the conveyor **320**.

[0060] Thereafter, the combined form-on web **302**/fibrous material **20** layer/cover web **304** passes through a debulking station **324** which may or may not include an embossing roll and which is downstream of the edge bonding unit **322** to debulk, which at least partially compresses the fibrous

material **20** layer, thereby increasing its density and structural integrity.
[0061] The combined form-on web **302**/fibrous material **20** layer/cover web **304** exits the debulking station **324** and is conveyed to a cutting unit **326** by a conveyor **328** which is downstream of the debulking and embossing station **324**. The cutting unit **326** severs the combined form-on web **302**/fibrous material **20** layer/cover web **304** by cutting in the transverse direction to form individual inserts **22**. Thereafter, the individual inserts **22** are transported for example by a conveyor **330** to another apparatus (not shown) for completion of the disposable product in which the inserts **22** are encapsulated between a back sheet formed of an impermeable material and at least one hydrophilic top sheet. Other layers may be provided in the final disposable product.
[0062] The foregoing is considered as illustrative only of the principles of the disclosure. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the disclosure to the exact construction and operation shown and described. While the preferred embodiment has been described, the details may be changed without departing from the disclosure, which is defined by the claims.

Claims

1. A scarfing assembly for scarfing a fibrous material, the scarfing assembly comprising: a moveable mount; a driven scarfing roll coupled to the moveable mount; a scarfing roll lifting assembly coupled to the moveable mount; a first sensor configured to sense contact between the scarfing roll and an external surface; a second sensor configured to sense position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the external surface has occurred; and a control unit programmed to operate the scarfing roll lifting assembly to position the scarfing roll at a desired scarf gap measured from the contact position.
2. The scarfing assembly of claim 1, wherein the scarfing roll is positioned at least partially within a housing; and wherein the scarfing roll lifting assembly causes movement of the scarfing roll relative to the housing.
3. The scarfing assembly of claim 1, wherein the first sensor comprises a load cell.
4. The scarfing assembly of claim 1, wherein the first sensor comprises one of an optical sensor and a torque sensor.
5. The scarfing assembly of claim 1, wherein the second sensor comprises an encoder.
6. The scarfing assembly of claim 1, further comprising a driven forming drum positioned proximate the scarfing roll and having a forming surface onto which a fibrous material is deposited; and wherein the external surface is an outer forming surface of the driven forming drum.
7. The scarfing assembly of claim 6, wherein the first sensor is configured to sense contact between the scarfing roll and the outer forming surface; wherein the second sensor is configured to sense a contact position where the scarfing roll is in contact with the outer forming surface; and wherein the control unit is further programmed to control the scarfing roll lifting assembly to position the scarfing roll at the desired scarf gap measured off the contact position.
8. The scarfing assembly of claim 7, wherein the control unit is further programmed to: a) move the scarfing roll toward the forming drum; b) record a contact position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the outer forming surface has occurred; c) move the scarfing roll away from the forming drum; d) rotate the forming drum to a new rotational position relative to the scarfing roll; e) repeat a) through d) to acquire contact positions at a plurality of rotational positions around a circumference of the forming drum; f) identify a high point on the forming surface from the acquired contact positions; and g) move the scarfing roll to a desired scarf gap position based on the identified high point.
9. The scarfing assembly of claim 7, wherein the control unit is programmed to acquire contact positions at a plurality of rotational positions around the entire circumference of the forming drum.
10. The scarfing assembly of claim 7, wherein the control unit is programmed to identify the high

point as the minimum value of the acquired contact positions.
11. The scarfing assembly of claim 1, wherein the desired scarf gap is a thickness of an absorbent core.
12. A method of automated gap control of a scarfing roll assembly for a fibrous material, the method comprising: controlling a scarfing roll lifting assembly to move a driven scarfing roll toward a surface external the scarfing roll assembly; sensing contact between the scarfing roll and the surface external the scarfing roll assembly with a first sensor; upon the sensed contact, recording a contact position of the scarfing roll using feedback from a second sensor when information is received from the first sensor that contact of the scarfing roll with the surface external the scarfing roll assembly has occurred; and controlling the scarfing roll lifting assembly to position the scarfing roll at an offset from the contact position corresponding to a desired scarf gap.
13. The method of claim 12, further comprising sensing contact between the scarfing roll and the external surface with a load cell.
14. The method of claim 12, further comprising: moving the driven scarfing roll toward an outer forming surface of a driven forming drum onto which a fibrous material is deposited; and wherein the step of sensing contact between the scarfing roll and the external surface comprises sensing contact between the scarfing roll and the outer forming surface.
15. The method of claim 14, further comprising: a) moving the scarfing roll toward the forming drum; b) recording a contact position of the scarfing roll when information is received from the first sensor that contact of the scarfing roll with the forming surface has occurred; c) moving the scarfing roll away from the forming drum; d) rotating the forming drum to a new rotational position relative to the scarfing roll; e) repeating a) through d) to acquire contact positions at a plurality of rotational positions around a circumference of the forming drum; f) identifying a high point on the forming surface from the acquired contact positions; and g) moving the scarfing roll to a desired scarf gap position based on the identified high point.
16. The method of claim 12, further comprising controlling the scarfing roll lifting assembly to: position the scarfing roll at an initial offset position from a surface external the scarfing roll assembly; and subsequently move the driven scarfing roll to a contact position with the external surface.
17. The method of claim 12, wherein controlling the scarfing roll lifting assembly to move the driven scarfing roll comprises moving the scarfing roll relative to a housing within which the scarfing roll is at least partially positioned.
18. The method of claim 12, further comprising: acquiring contact positions at a plurality of positions on the surface external the scarfing roll assembly; identifying a high point on the surface external the scarfing roll assembly from the acquired contact positions; and moving the scarfing roll to a desired scarf gap position based on the identified high point.
19. The method of claim 18, further comprising identifying the high point as the contact position of the acquired contact positions corresponding to the minimum value.
20. The method of claim 12, further comprising sensing the contact position of the scarfing roll with an encoder.
21. The method of claim 12, further comprising sensing contact between the scarfing roll and the external surface with one of a torque sensor and an optical sensor.