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(54) **SYSTEM AND A METHOD FOR MANUFACTURING SUBSTRATES FOR COATED FABRICS**

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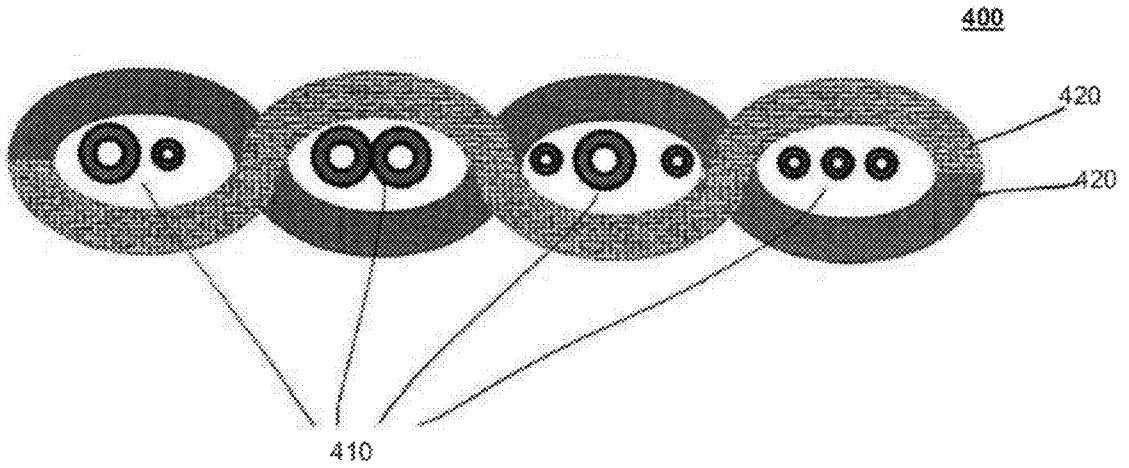
(57) **ABSTRACT**

A system and a method are disclosed for weaving SC fabrics using multiple weft insertion. The system and method may be used to increase the thread count of the SC fabric while reducing fabric costs.



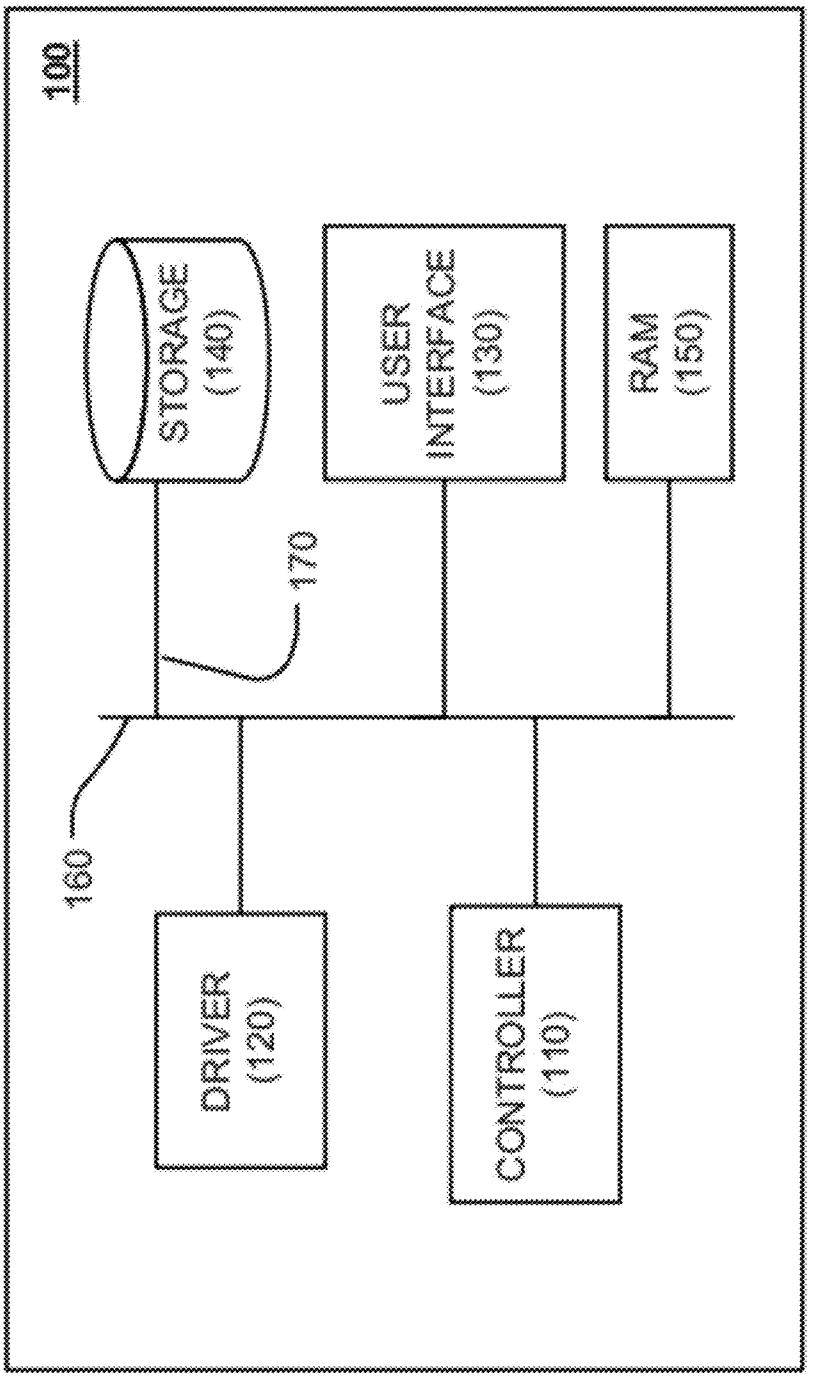

100
STORAGE (140)
USER INTERFACE (130)
RAM (150)
170
160
DRIVER (120)
CONTROLLER (110)

FIG. 1

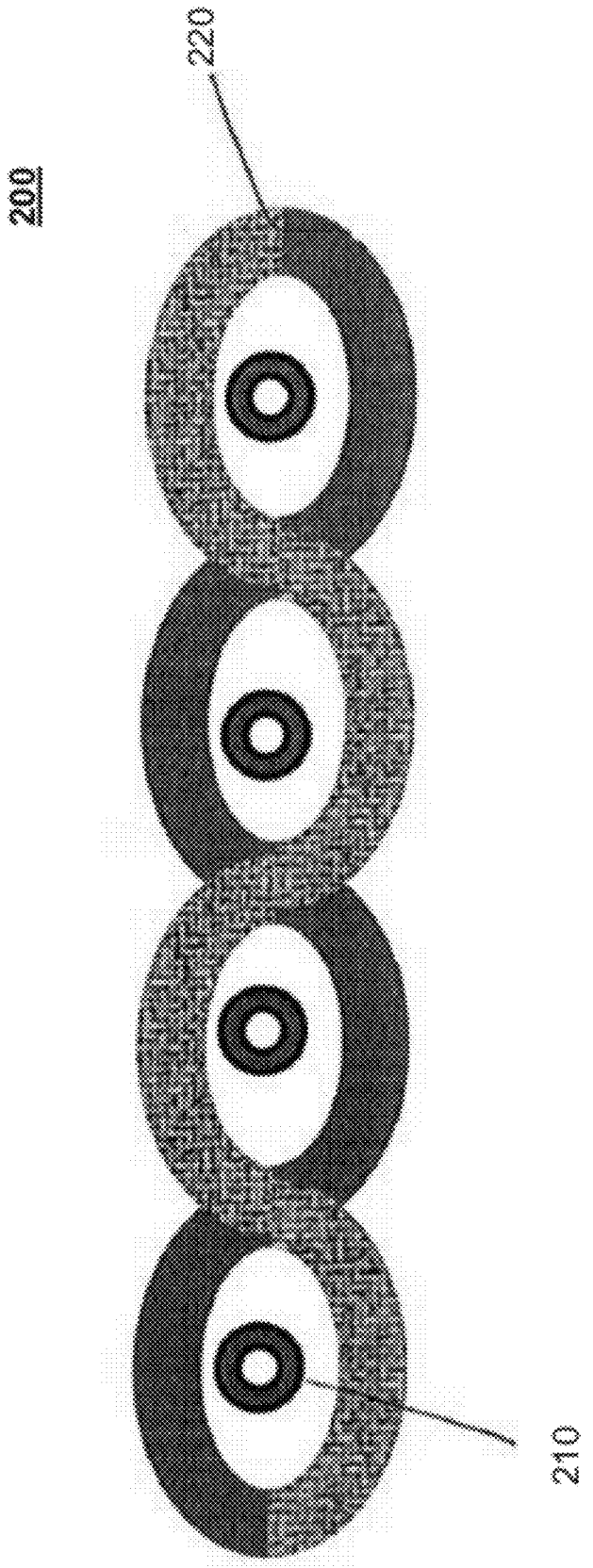


FIG. 2

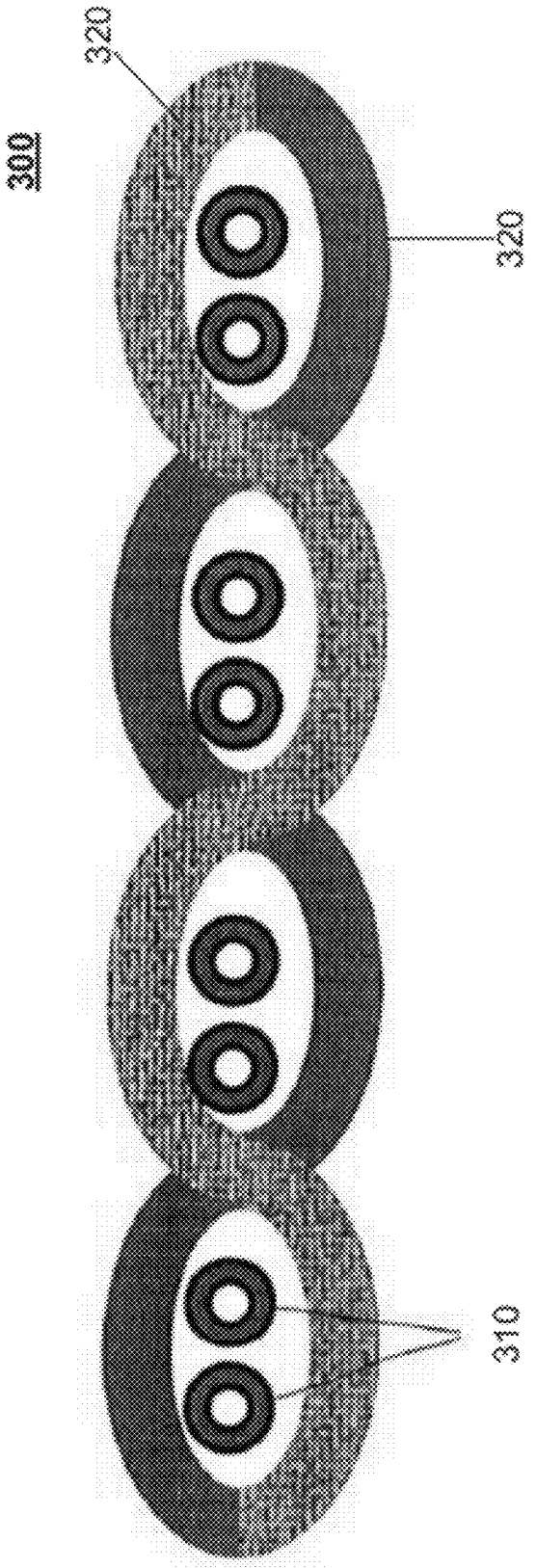


FIG. 3

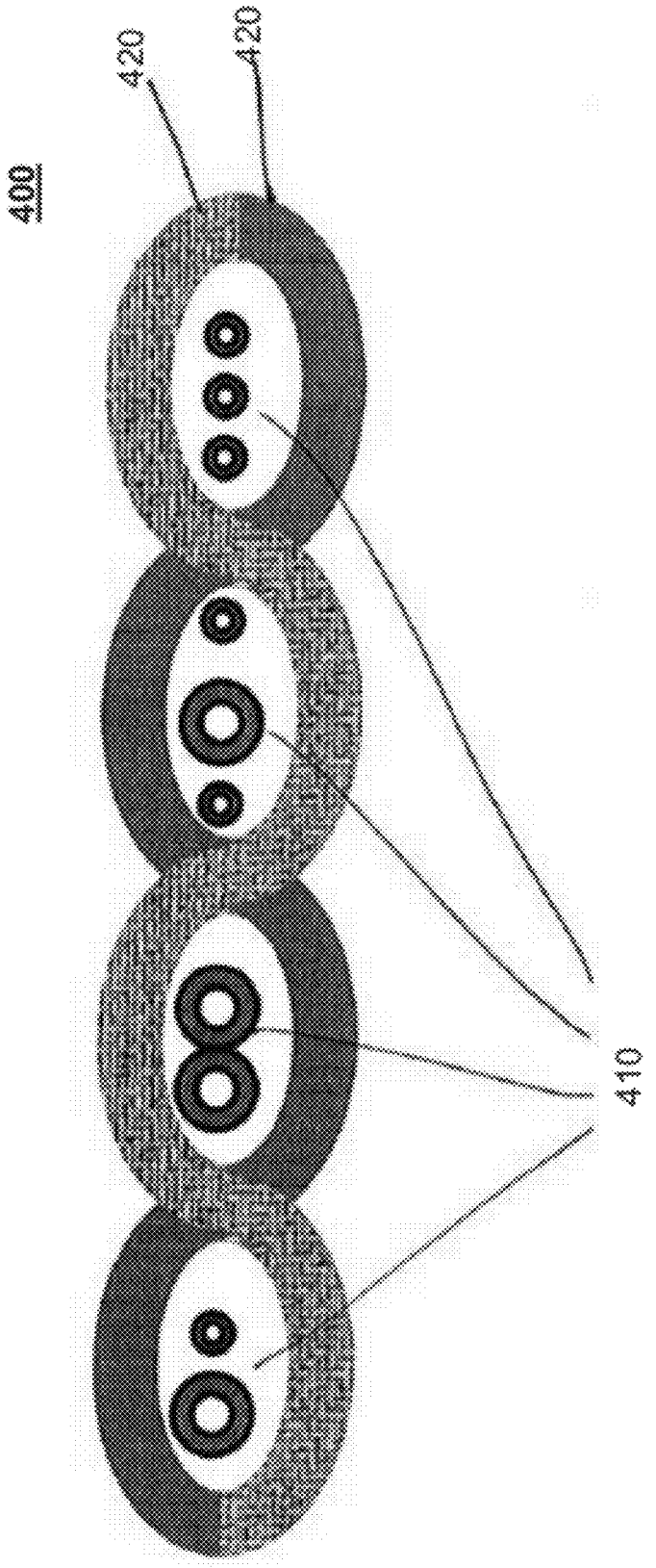


FIG. 4

SYSTEM AND A METHOD FOR MANUFACTURING SUBSTRATES FOR COATED FABRICS

CROSS REFERENCE TO PRIOR APPLICATIONS

[0001] This application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Patent Application No. 61/470,248, filed Mar. 31, 2011, and titled "SYSTEM AND A METHOD FOR MANUFACTURING SUBSTRATES FOR COATED FABRICS," the disclosure of which is expressly incorporated by reference herein in its entirety.

FIELD OF THE DISCLOSURE

[0002] The present disclosure relates to a system and a method for manufacturing substrates for coated fabrics.

BACKGROUND OF THE DISCLOSURE

[0003] Substrates for coated (SC) fabrics are used in a wide variety of applications, including, for example, medical substrates, adhesive backings, industrial fabrics, geotextiles, to name only a few. Substrates for coated (SC) fabrics can be made using one of a number of processes. For example, SC fabrics may be made by coating and laminating a fabric with a synthetic material such as, for example, a film of polyester (PET), polyvinyl chloride (PVC), polytetrafluoroethylene (PTFE), or the like. In certain applications, a laminated fabric may consist of a reinforcing polyester scrim that is pressed between two layers of PVC film and heated to join the fabric with the PVC film layers.

[0004] Current manufacturing processes make it difficult and costly to manufacture multiple styles and to fine tune properties for substrates for coated fabrics. That is, existing manufacturing processes lack a flexibility to tailor fabric characteristics to specific customer requirements while keeping costs low. Thus, an unfulfilled need exists for a flexible manufacturing process that tailors fabric characteristics to specific customer requirements with minimal style change cost.

SUMMARY OF THE DISCLOSURE

[0005] According to one non-limiting example of the disclosure, a system and a method are disclosed for weaving substrates for coated (SC) fabrics using multiple weft insertion. The system and method may be used to increase the threadcount of SC fabrics while reducing fabric costs. The system and method may be used to manufacture products such as, for example, backing substrates for various forms of tapes, abrasives or adhesives.

[0006] The disclosed system and method offer numerous advantages that are not available from existing manufacturing processes. For example, the system and method include multiple weft insertion in the production of substrates for coated fabrics, thereby lowering cost by reducing the amount of time required to weave the SC fabric. Multiple weft insertion allows the manufacture of a multitude of fabrics to be produced with customer specific properties while using weaving machines that use a common warp construction. This allows for enormous flexibility in manufacturing and tailoring of fabric characteristics to specific customer requirements with minimal style change cost.

[0007] Some of the properties that are important to coating operations that can easily be altered by multiple weft insertion techniques include, for example, opacity, air permeability, warp direction tear strength, weft direction tear strength, fabric thickness, dimensional stability, fabric tensile strength, bursting strength, rate of wetting out, wicking, weight, shrinkage, and the like.

[0008] According to an aspect of the disclosure, two or more weft threads may be interwoven simultaneously with a warp yarn. The two or more weft threads may follow the same weaving pattern relative to the warp yarn. As a result, multiple weft threads may be woven in a single pass or weaving step, thus saving overall weaving time. The system and method may substantially simultaneously insert multiple weft threads using, for example, double-pick weaving (2 weft threads woven simultaneously) the weft threads, which may be done when making high thread density SC fabrics. The system and method may include existing looms that are available from manufacturers such as, for example, Dornier GmbH, Lindau, Germany in making SC fabrics.

[0009] The number of weft threads woven substantially simultaneously, the density of the weft yarns, and/or the types or blends of yarns chosen a be adjusted and tailored according to particular customer requirements or applications. These may be regarded as important properties for fabrics used as substrates in coating operations.

[0010] The disclosure provides the ability to use common warp styles to produce finely tuned properties such as weight, opacity, air permeability, strength, wet out rate, tear strength and fiber content. The disclosure also provides the ability to produce lower cost substrates with the same properties as currently available SC fabrics, including reducing the time required to manufacture the SC fabrics.

[0011] The system and method according to the present disclosure offer the advantages of reduced downtime at coating range and minimal breakouts or tear outs, while providing each customer with a specialized product that meets the customer's specific SC fabric property requirements. The system and method may use a common warp yarn construction or a minimal number of warp yarn constructions.

[0012] The system and method may produce various styles and types of SC fabrics, according to unique customer requirements. For example, the system and method may make yarns with different blends of fibers and densities for both warp and weft. This may increase turnaround time in product development and increase inventory that must be held. The current approach is to make fabrics for coating substrates with single weft insertion.

[0013] Additional features, advantages, and embodiments of the disclosure may be set forth or apparent from consideration of the detailed description and drawings. Moreover, it is to be understood that both the foregoing summary of the disclosure and the following detailed description are exemplary and intended to provide further explanation without limiting the scope of the disclosure as claimed.

BRIEF DESCRIPTION OF THE DRAWING

[0014] The accompanying drawings, which are included to provide a further understanding of the disclosure, are incorporated in and constitute a part of this specification, illustrate an embodiment of the disclosure and together with the detailed description serves to explain the principles of the disclosure. No attempt is made to show structural details of the disclosure in more detail than may be necessary for a fundamental understanding of the disclosure and the various ways in which it may be practiced. In the drawings:

[0015] FIG. **1** shows an example of a system for manufacturing an SC fabric, according to principles of the disclosure;
[0016] FIG. **2** shows a side view of a cross-section of a state of the art woven fabric;
[0017] FIG. **3** shows a side view cross-section example of a woven fabric that is constructed according to the principles of the disclosure; and
[0018] FIG. **4** shows another side view cross-section example of a woven fabric that is constructed according to the principles of the disclosure.
[0019] The present disclosure is further described in the detailed description that follows.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0020] The disclosure and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiment and example that is described and/or illustrated in the accompanying drawing and detailed in the following description. It should be noted that the features illustrated in the drawing are not necessarily drawn to scale, and features of one embodiment may be employed with other embodiments as the skilled artisan would recognize, even if not explicitly stated herein. Descriptions of well-known components and processing techniques may be omitted so as to not unnecessarily obscure the embodiments of the disclosure. The example used herein is intended merely to facilitate an understanding of ways in which the disclosure may be practiced and to further enable those of skill in the art to practice the embodiments of the disclosure. Accordingly, the example and embodiment herein should not be construed as limiting the scope of the disclosure.
[0021] A "computer", as used in this disclosure, means any machine, device, circuit, component, or module, or any system of machines, devices, circuits, components, modules, or the like, which are capable of manipulating data according to one or more instructions, such as, for example, without limitation, a processor, a microprocessor, a central processing unit, a general purpose computer, a super computer, a personal computer, a laptop computer, a palmtop computer, a notebook computer, a desktop computer, a workstation computer, a server, or the like, or an array of processors, microprocessors, central processing units, general purpose computers, super computers, personal computers, laptop computers, palmtop computers, notebook computers, desktop computers, workstation computers, servers, or the like.
[0022] A "database", as used in this disclosure, means any combination of software and/or hardware, including at least one application and/or at least one computer. The database may include a structured collection of records or data organized according to a database model, such as, for example, but not limited to at least one of a relational model, a hierarchical model, a network model or the like. The database may include a database management system application (DBMS) as is known in the art. The at least one application may include, but is not limited to, for example, an application program that can accept connections to service requests from clients by sending back responses to the clients. The database may be configured to run the at least one application, often under heavy workloads, unattended, for extended periods of time with minimal human direction.
[0023] A "communication link", as used in this disclosure, means a wired and/or wireless medium that conveys data or information between at least two points. The wired or wireless medium may include, for example, a metallic conductor link, a radio frequency (RF) communication link, an Infrared (IR) communication link, an optical communication link, or the like, without limitation. The RE communication link may include, for example, WiFi, WiMAX, IEEE 802.11, DECT, 0G, 1G, 2G, 3G or 4G cellular standards, Bluetooth, and the like.
[0024] The terms "including", "comprising" and variations thereof, as used in this disclosure, mean "including, but not limited to", unless expressly specified otherwise.
[0025] The terms "a", "an", and "the", as used in this disclosure, means "one or more", unless expressly specified otherwise.
[0026] Devices that are in communication with each other need not be in continuous communication with each other, unless expressly specified otherwise. In addition, devices that are in communication with each other may communicate directly or indirectly through one or more intermediaries.
[0027] Although process steps, method steps, algorithms, or the like, may be described in a sequential order, such processes, methods and algorithms may be configured to work in alternate orders. In other words, any sequence or order of steps that may be described does not necessarily indicate a requirement that the steps be performed in that order. The steps of the processes, methods or algorithms described herein may be performed in any order practical. Further, some steps may be performed simultaneously.
[0028] When a single device or article is described herein, it will be readily apparent that more than one device or article may be used in place of a single device or article. Similarly, where more than one device or article is described herein, it will be readily apparent that a single device or article may be used in place of the more than one device or article. The functionality or the features of a device may be alternatively embodied by one or more other devices which are not explicitly described as having such functionality or features.
[0029] A "computer-readable medium", as used in this disclosure, means any medium that participates in providing data (for example, instructions) which may be read by a computer. Such a medium may take many forms, including non-volatile media, volatile media, and transmission media, Non-volatile media may include, for example, optical or magnetic disks and other persistent memory. Volatile media may include dynamic random access memory (DRAM). Transmission media may include coaxial cables, copper wire and fiber optics, including the wires that comprise a system bus coupled to the processor. Transmission media may include or convey acoustic waves, light waves and electromagnetic emissions, such as those generated during radio frequency (RF) and infrared (IR) data communications. Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a CD-ROM, DVD, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, a RAM, a PROM, an EPROM, a FLASH-EEPROM, any other memory chip or cartridge, a carrier wave as described hereinafter, or any other medium from which a computer can read.
[0030] Various forms of computer readable media may be involved in carrying sequences of instructions to a computer. For example, sequences of instruction (i) may be delivered from a RAM to a processor, (ii) may be carried over a wireless transmission medium, and/or (iii) may be formatted accord-

ing to numerous formats, standards or protocols, including, for example, WiFi, WiMAX, IEEE 802.11, DECT, 0G, 10, 20, 30 or 40 cellular standards, Bluetooth, or the like.

[0031] FIG. **1** shows an example of a system **100** for manufacturing an SC fabric, according to principles of the disclosure. The system **100** comprises a controller **110**, a driver **120**, a user interface **130**, a storage **140**, and a random access memory (RAM) **150**, all of which may be connected to a bus **160** via one or more communication links **170**. The controller **110** includes a computer that is configured to control the manufacture of an SC fabric. For example, the controller **110** may effectuate the weaving of substrate-coated fabrics using multiple welt insertion via an interweaver (not shown) and the driver **120**. The driver **120** may be configured to drive the interweaver (not shown) to receive two or more weft threads simultaneously with one or more warp yarns and to interweave the two or more weft threads substantially simultaneously with the one or more warp yarns, outputting a manufactured product. The controller **110** may be configured to control and monitor the driver **120**. For example, the controller **110** may generate a control signal that it may forward to the driver **120** via the communication link **170** to control the interweaver according to one or more customer defined requirements, which it may receive from the storage **140**. The system **100** may be configured to make manufactured products such as, for example, backing substrates for various forms of tapes, abrasives or adhesives.

[0032] The storage **140** includes a database, which may include one or more SC fabric property parameters, including, for example, but not limited to, an SC fabric style(s), a number of weft thread insertions, a number of weft threads to be woven simultaneously, a weft thread insertion configuration(s), a weft thread dimension(s), a weft thread weight(s), a density of the weft yarn(s), the types of blends of yarns, a substrate type, a desired opacity, a desired air permeability, a desired warp direction tear strength, a desired weft direction tear strength, a desired fabric thickness, a desired dimensional stability, a desired bursting strength, a desired rate of wetting out, a desired wicking, a desired fiber blend level, a desired shrinkage rate, and the like. The storage **140** may include a record for each customer, each SC fabric product, each application, and the like. The storage **140** may be accessed by the controller **110** to retrieve customer or product specific SC fabric property parameters. Accordingly, the system **100** may provide for enormous flexibility in manufacturing and tailoring of fabric characteristics to specific customers and/or products with minimal style change cost.

[0033] The system **100** may effectuate two or more weft threads to be interwoven substantially simultaneously with a warp yarn. The two or more weft threads may follow substantially the same weaving pattern relative to the warp yarn. As a result, the system **100** may weave multiple well threads in a single pass or weaving step, thus saving overall weaving time. The system **100** may effectuate the insertion of multiple well threads by, for example, double-pick weaving (for example, 2 weft threads woven simultaneously) the multiple weft threads, which may be done when making, for example, high thread density SC fabrics. The system **100** may use available looms (not shown) from manufacturers such as, for example, Dornier GmbH, Lindau, Germany, in making the SC fabrics.

[0034] The system **100** may be used with common warp styles to produce finely tuned properties such as weight, opacity, air permeability, strength, wet out rate, tear strength and fiber content. The system **100** may effectuate the production of lower cost substrates with the same properties as currently available SC fabrics, while reducing the time required to manufacture the SC fabrics.

[0035] U.S. Pat. No. 7,111,648, which issued on Sep. 26, 2006, titled "Terry Fabric and Method for Weaving Same," describes a terry fabric and a method for weaving a terry fabric. The entire disclosure of U.S. Pat. No. 7,111,648 is incorporated herein by reference, as if fully set forth herein. The patent describes a number of weave patterns for terry fabrics. The technology described in the patent enables the production of fabrics with different performance characteristics. For example, the technology of the patent has been used to manufacture bed sheeting, since the technology allows for an increased thread count of the fabric while reducing fabric costs. The system **100** may be used with the technology described in the patent to manufacture tailored SC fabrics.

[0036] According to an aspect of the disclosure, a computer readable medium is provided containing a computer program, which when executed in, for example, the controller **110**, causes an SC fabric to be manufactured according to specific customer requirements. The computer program may be tangibly embodied in the computer readable medium, comprising a code segment or code section for each of the step of manufacturing of the SC fabric.

[0037] The system **100** may effectuate the production of woven fabrics with different properties by simultaneously inserting two or more weft threads in a single type of warp thread. For example, the system **100** may effectuate the production of woven fabrics such as woven fabric **200** (shown in FIG. **2**), woven fabric **300** (shown in FIG. **3**), woven fabric **400** (shown in FIG. **4**), or the like, varying the construction of the woven fabric from a single insertion to a multiple insertion fabric on the basis of the SC fabric property parameters, which may include, for example, the number of wefts, the type of weave, the size/density of weft, the type of weft, and the like. By using multiple weft insertion technology, as well as selection of particular yarns, the system **100** can manipulate one or more SC fabric properties to desired levels. As noted earlier, the SC fabric property parameters may be stored in, for example, the storage **140** (shown in FIG. **1**).

[0038] FIG. **2** shows a side view of a cross-section of a state of the art woven fabric **200**. As seen, the fabric **200** is constructed of a single weft **210** of a consistent density and/or size. The weft **210** is embedded (or inserted) in an interlacing warp yarn **220**. The fabric **200** may be constructed using the system **100**.

[0039] FIG. **3** shows an example of a woven fabric **300** that is constructed according to the principles of the disclosure. The fabric **300** includes multiple wefts **310** that are embedded (or inserted) in a single type of interlacing warp yarn **320**. As seen in FIG. **3**, the woven fabric **300** may be constructed by substantially simultaneously inserting two wefts **310** during a weaving cycle, wherein the two wefts **310** may be of substantially the same type and have substantially the same density. The weft threads **310** and/or warp thread **320** may be selected based on the SC fabric parameters, which may, for example, be retrieved from the storage **140** (shown in FIG. **1**).

[0040] FIG. **4** shows another example of a woven fabric **400** that is constructed according to the principles of the disclosure. The fabric **400** includes multiple wefts **410** that are embedded (or inserted) in a single type of interlacing warp yarn **420**. As seen in FIG. **4**, the woven fabric **400** may be constructed by substantially simultaneously inserting two or more wefts **410** during a weaving cycle, wherein the two or

more wefts **410** may be of substantially the same type and have substantially the same density and size. Additionally (or alternatively), the two or more weft threads **410** may be of different types, different densities and/or different sizes. Each interlacing in the figures (shown in FIGS. **2-4**) represents one weaving cycle. The weft threads **410** and/or warp thread **420** may be selected based on the SC fabric parameters, which may, for example, be retrieved from the storage **140** (shown in FIG. **1**).

[0041] While the disclosure has been described in terms of exemplary embodiments, those skilled in the art will recognize that the disclosure can be practiced with modifications in the spirit and scope of the appended claims. These examples are merely illustrative and are not meant to be an exhaustive list of all possible designs, embodiments, applications or modifications of the disclosure.

What is claimed:

1. A system for manufacturing a substrate for coated fabric tailored to customer defined requirements, the system comprising:
- an interweaver that interweaves two or more weft threads substantially simultaneously with a warp yarn and outputs the substrate; and
- a controller that controls the interweaver according to the customer defined requirements.

2. The system according to claim **1**, wherein the customer defined requirements comprise at least one of:
- an opacity;
- an air permeability;
- a warp direction tear strength;
- a weft direction tear strength;
- a fabric thickness;
- a dimensional stability;
- a fabric tensile strength;
- a bursting strength;
- a rate of wetting out;
- a wicking;
- a weight; and
- a shrinkage.

3. The system according to claim **1**, wherein the two or more weft threads are interwoven to follow a weaving pattern of the warp yarn.

4. The system according to claim **1**, wherein the two or more weft threads are interwoven in a single pass or weaving step in the interweaver.

5. The system according to claim **1**, wherein the two or more weft threads are interwoven using a double-pick weaving of the two or more weft threads.

6. The system according to claim **1**, wherein the customer defined requirements comprise at least one of:
- a number of weft threads to be woven substantially simultaneously;
- a density for each of the two or more weft threads; and
- a type or blend of warp yarn to be included.

7. The system according to claim **1**, further comprising:
- a database that stores the customer defined requirements.

8. The system according to claim **1**, further comprising:
- a driver that controls the interweaver according to a signal received from the controller.

9. A method for manufacturing a substrate for coated fabric tailored to customer defined requirements, the method comprising:
- substantially simultaneously interweaving two or more weft threads with a warp yarn;
- controlling the interweaving according to the customer defined requirements; and
- outputting a substrate that comprises the two or more weft threads and warp yarn.

10. The method according to claim **9**, wherein the customer defined requirements comprise at least one of:
- an opacity;
- an air permeability;
- a warp direction tear strength;
- a weft direction tear strength;
- a fabric thickness;
- a dimensional stability;
- a fabric tensile strength;
- a bursting strength;
- a rate of wetting out;
- a wicking;
- a weight; and
- a shrinkage.

11. The method according to claim **9**, wherein the two or more weft threads are interwoven to follow a weaving pattern of the warp yarn.

12. The method according to claim **9**, wherein the two or more weft threads are interwoven in a single pass or weaving step in an interweaver.

13. The method according to claim **9**, wherein the two or more weft threads are interwoven using a double-pick weaving of the two or more weft threads.

14. The method according to claim **9**, wherein the customer defined requirements comprise at least one of:
- a number of weft threads to be woven substantially simultaneously;
- a density for each of the two or more weft threads; and
- a type or blend of warp yarn to be included.

15. The method according to claim **9**, further comprising:
- receiving the customer defined requirements from a database that stores the customer defined requirements.

16. The method according to claim **9**, further comprising:
- driving an interweaver according to a signal received from a controller.

17. A computer readable medium comprising a computer program for a manufacturing process for manufacturing a substrate for coated fabric according to a customer defined requirement, the computer medium comprising program code sections, which when executed on a computer, cause the computer to:
- substantially simultaneously interweave two or more well threads with a warp yarn;
- control the interweaving according to the customer defined requirement; and
- output a substrate that comprises the two or more weft threads and warp yarn.

18. The computer readable medium according to claim **17**, wherein the customer defined requirement comprises at least one of:
- an opacity;
- an air permeability;
- a warp direction tear strength;
- a weft direction tear strength;
- a fabric thickness;
- a dimensional stability;
- a fabric tensile strength;
- a bursting strength;
- a rate of wetting out;
- a wicking;
- a weight; and
- a shrinkage.

19. The computer readable medium according to claim **17**, wherein the two or more weft threads are interwoven to follow a weaving pattern of the warp yarn.

20. The computer readable medium according to claim **17**, wherein the customer defined requirement comprises at least one of:

a number of weft threads to be woven substantially simultaneously;

a density for each of the two or more weft threads; and

a type or blend of warp yarn to be included.

* * * * *