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Estreicher et al.

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(45) **Date of Patent: Oct. 13, 2020**

(54) **ENERGY HARVESTING, HEAT MANAGING, MULTI-EFFECT THERAPEUTIC GARMENT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 883 days.

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Related U.S. Application Data

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(51) **Int. Cl.**

A61F 7/02	(2006.01)
A61F 7/03	(2006.01)
D02G 3/44	(2006.01)
D04B 1/28	(2006.01)
A61F 7/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A61F 7/02*** (2013.01); ***A61F 7/03*** (2013.01); ***D02G 3/44*** (2013.01); ***D04B 1/28*** (2013.01);

(Continued)

(58) **Field of Classification Search**

CPC D10B 2401/02; D10B 2401/04; D10B 2403/0114; D10B 2403/023;

(Continued)

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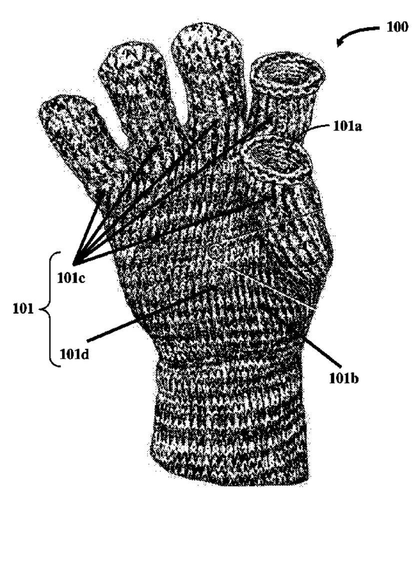
Assistant Examiner — Adam Z Minchella
(74) *Attorney, Agent, or Firm* — Ashok Tankha

(57) **ABSTRACT**

An energy harvesting, heat managing, multi-effect therapeutic garment, defining an inner surface and an outer surface, seamlessly knitted using a predetermined number of yarns is provided. The yarns for constructing the therapeutic garment are selected from a yarn that absorbs, stores, and releases heat energy through a phase change, yarns that convert heat energy and ultra violet radiation energy into far infrared radiation energy and radiate the far infrared radiation energy to other yarns and to a wearer's body part, a yarn that adsorbs moisture from the wearer's body part and/or ambient environment and generates heat energy through an exothermic reaction, a heat insulting and hydrophobic yarn, and a heat conductive yarn that maintains a uniform temperature within the yarns. The yarns of the therapeutic garment are bundled and knitted to create a uniform surface area distribution of the yarns that contact each other and cover the wearer's body part.

11 Claims, 71 Drawing Sheets



(52) **U.S. Cl.**
CPC *A61F 2007/0018* (2013.01); *A61F 2007/0036* (2013.01); *A61F 2007/0045* (2013.01); *A61F 2007/0088* (2013.01); *A61F 2007/0098* (2013.01); *A61F 2007/0233* (2013.01); *A61F 2007/0266* (2013.01); *D10B 2401/02* (2013.01); *D10B 2401/04* (2013.01); *D10B 2403/0114* (2013.01); *D10B 2403/0243* (2013.01)

(58) **Field of Classification Search**
CPC D10B 2403/0234; D04B 1/28; A41D 19/01535; A41D 19/01576; A41D 31/102; A41D 31/065; A41D 31/04; A41D 13/002; D02G 3/44; A61F 7/02; A61F 7/03; A61F 2007/0018; A61F 2007/0036; A61F 2007/0045; A61F 2007/0088; A61F 2007/0098; A61F 2007/0233; A61F 2007/0266
See application file for complete search history.

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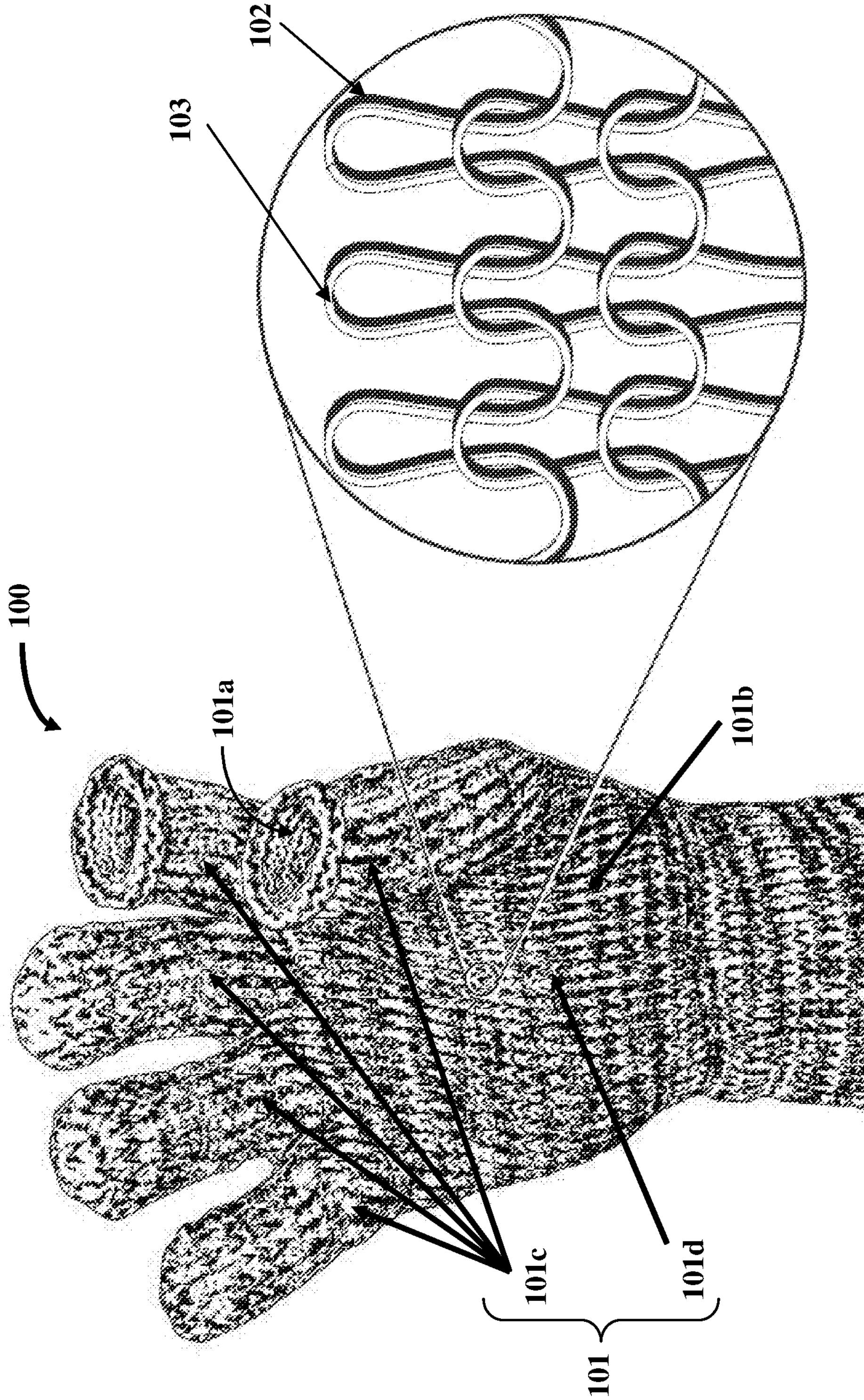


FIG. 1B

FIG. 1A

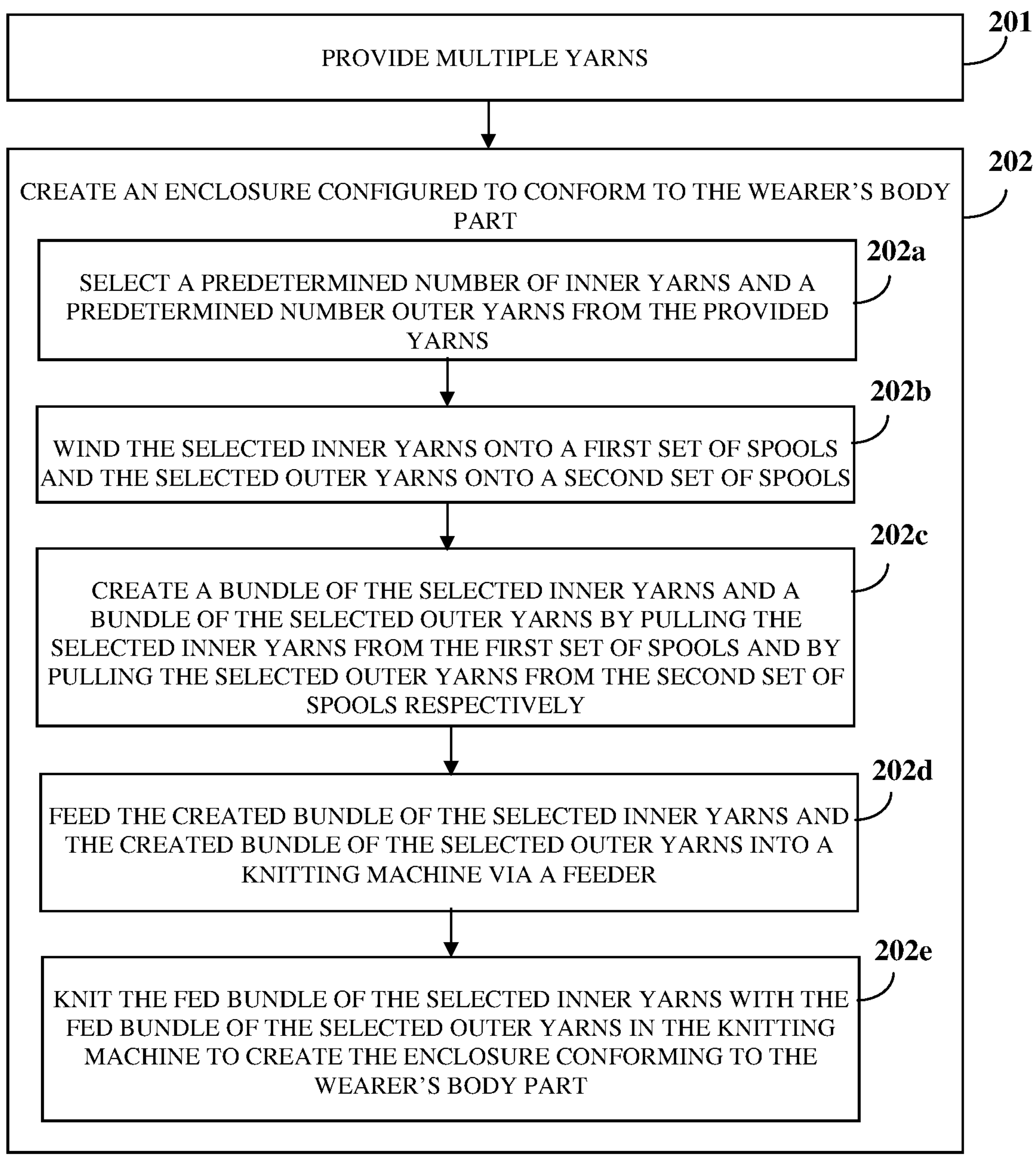

PROVIDE MULTIPLE YARNS
201
CREATE AN ENCLOSURE CONFIGURED TO CONFORM TO THE WEARER'S BODY PART
202
SELECT A PREDETERMINED NUMBER OF INNER YARNS AND A PREDETERMINED NUMBER OUTER YARNS FROM THE PROVIDED YARNS
202a
WIND THE SELECTED INNER YARNS ONTO A FIRST SET OF SPOOLS AND THE SELECTED OUTER YARNS ONTO A SECOND SET OF SPOOLS
202b
CREATE A BUNDLE OF THE SELECTED INNER YARNS AND A BUNDLE OF THE SELECTED OUTER YARNS BY PULLING THE SELECTED INNER YARNS FROM THE FIRST SET OF SPOOLS AND BY PULLING THE SELECTED OUTER YARNS FROM THE SECOND SET OF SPOOLS RESPECTIVELY
202c
FEED THE CREATED BUNDLE OF THE SELECTED INNER YARNS AND THE CREATED BUNDLE OF THE SELECTED OUTER YARNS INTO A KNITTING MACHINE VIA A FEEDER
202d
KNIT THE FED BUNDLE OF THE SELECTED INNER YARNS WITH THE FED BUNDLE OF THE SELECTED OUTER YARNS IN THE KNITTING MACHINE TO CREATE THE ENCLOSURE CONFORMING TO THE WEARER'S BODY PART
202e

FIG. 2

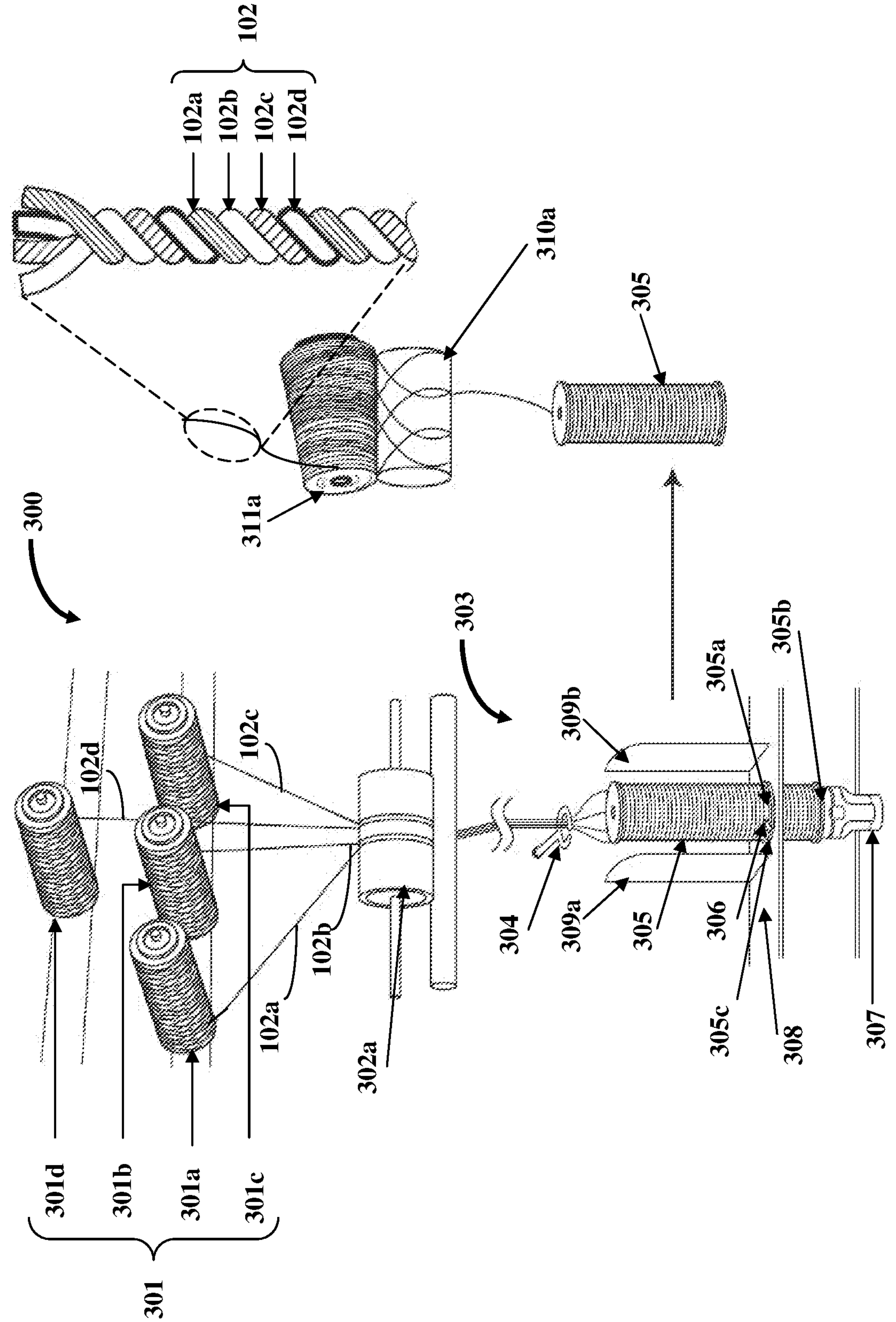

102
102a
102b
102c
102d
310a
305
300
311a
303
309b
305a
305b
102d
102c
304
309a
305
306
302a
102b
102a
305c
308
307
301d
301b
301a
301c
301

FIG. 3A

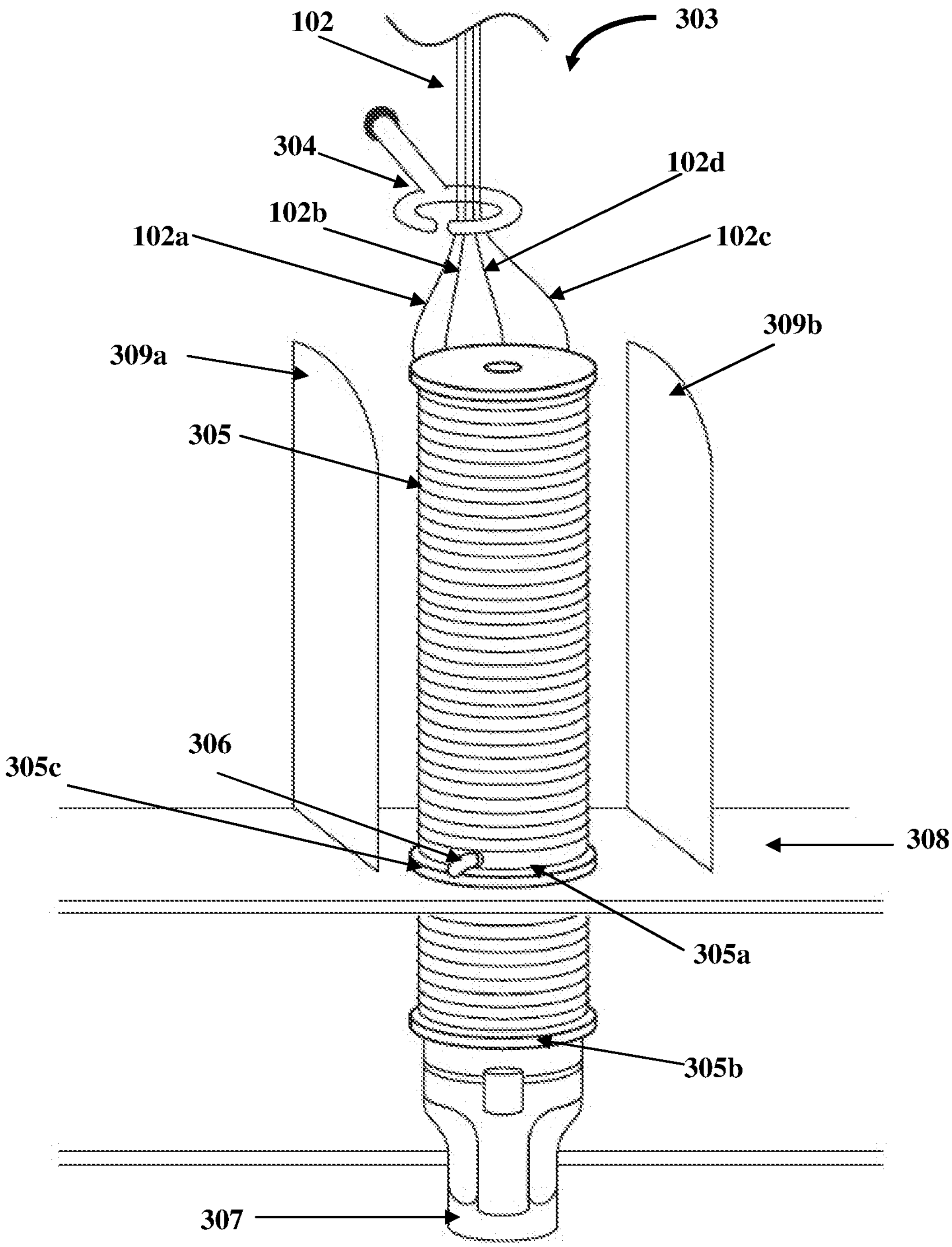

102
303
304
102d
102b
102a
102c
309b
309a
305
306
305c
308
305a
305b
307

FIG. 3B

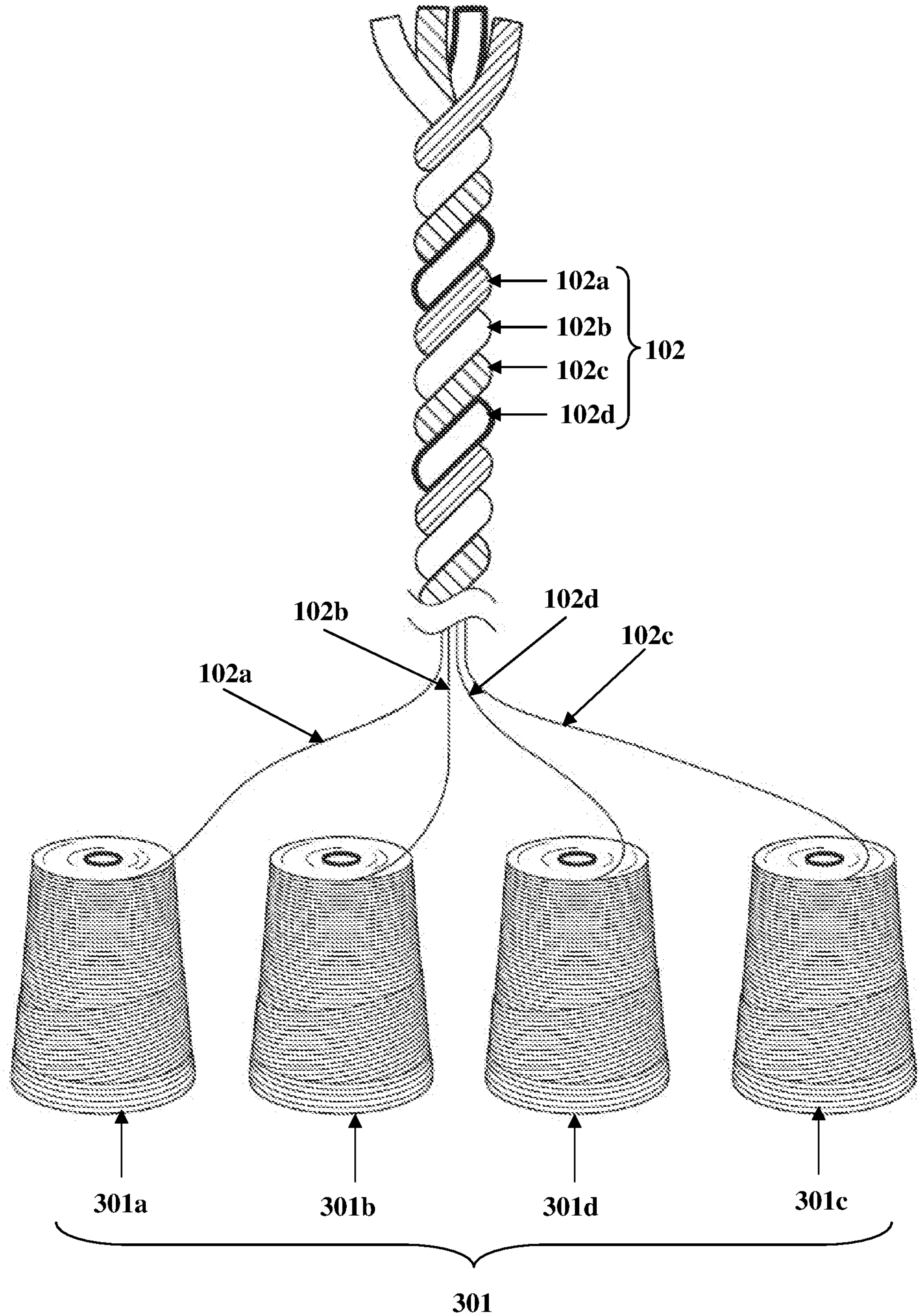

102a
102b
102c
102d
102
102b
102d
102c
102a
301a
301b
301d
301c
301

FIG. 3C

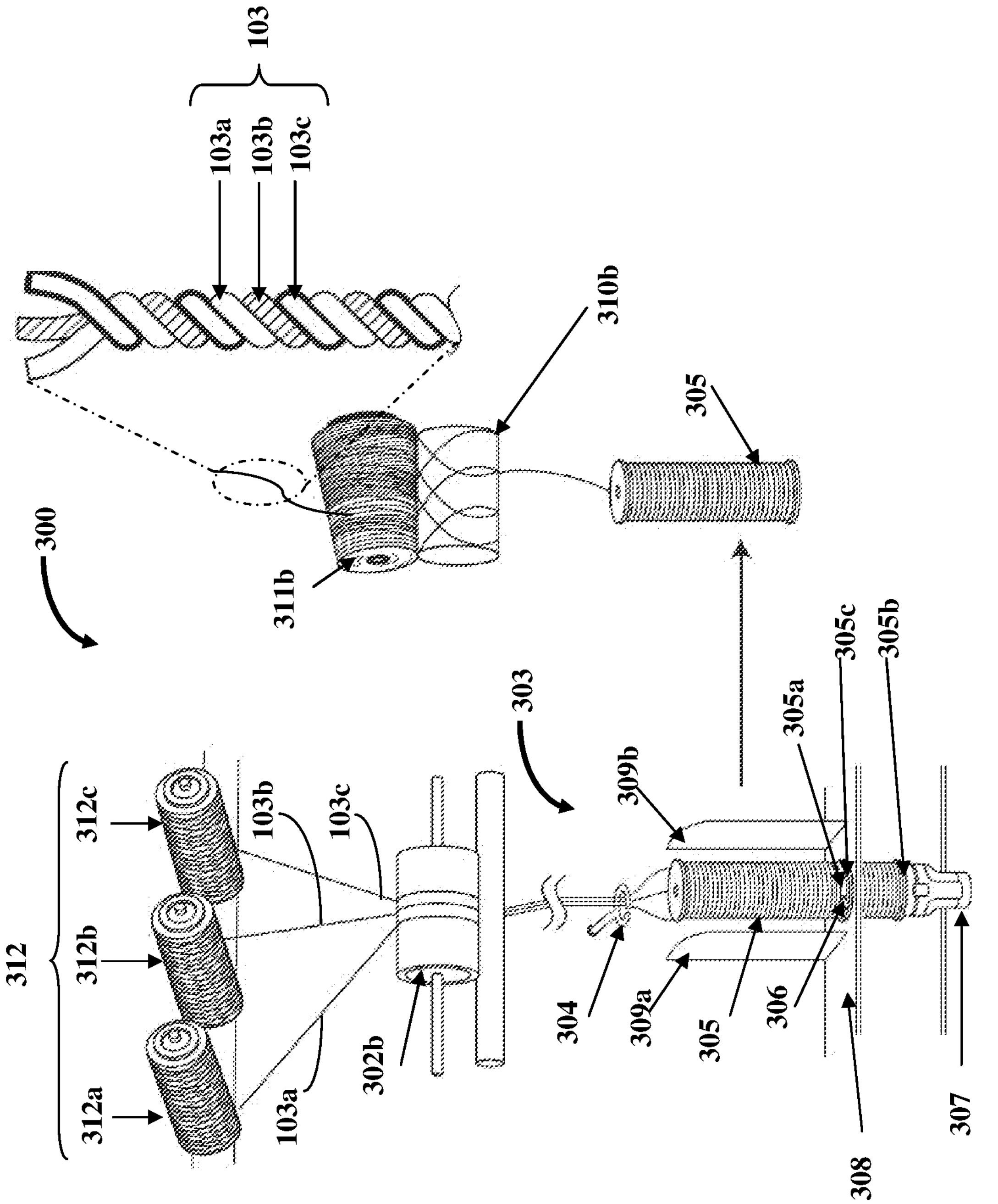

300
103
103a
103b
103c
310b
305
311b
303
312
312a
312b
312c
103a
103b
103c
302b
304
309a
309b
305
306
305a
305b
305c
308
307

FIG. 3D

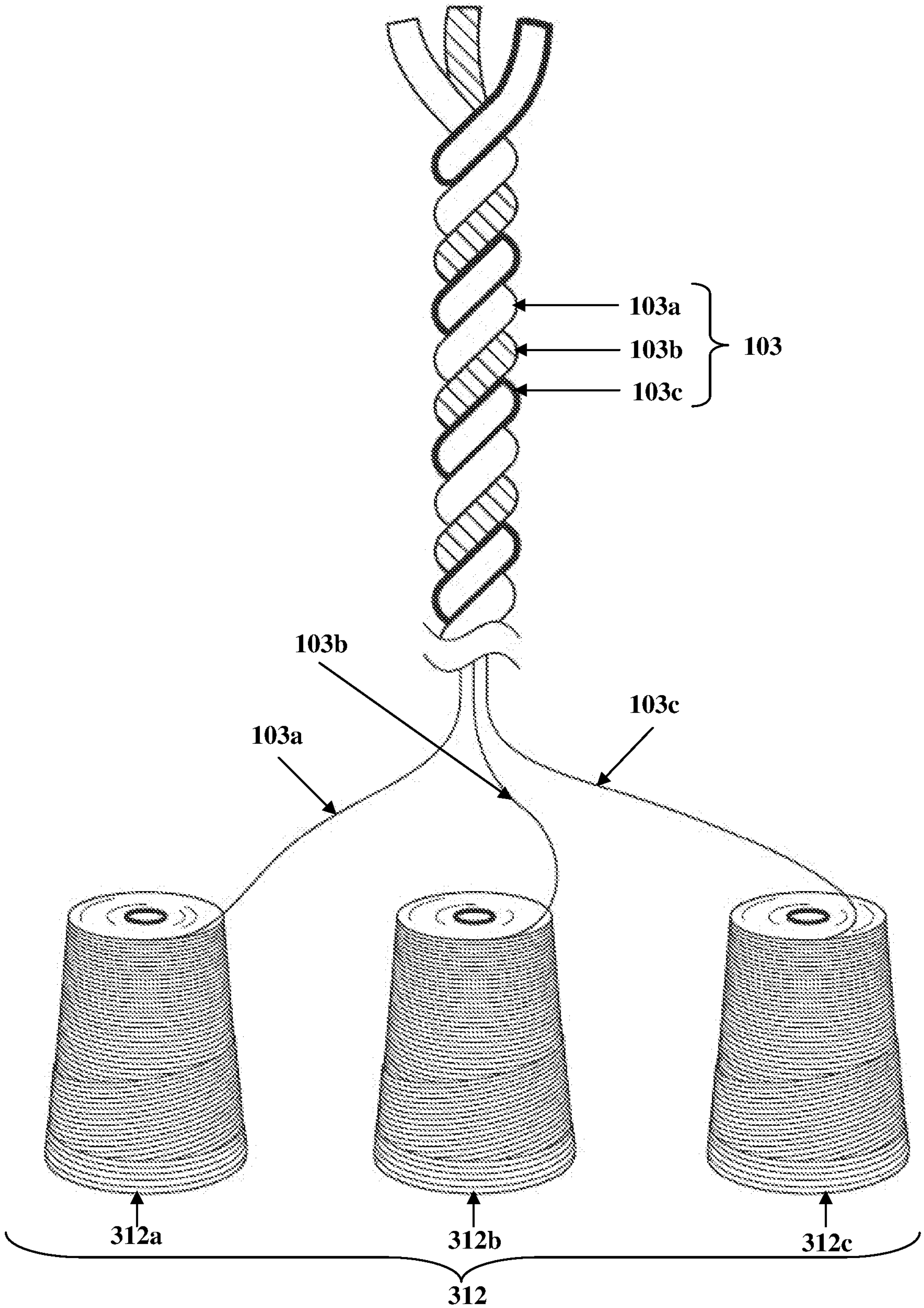
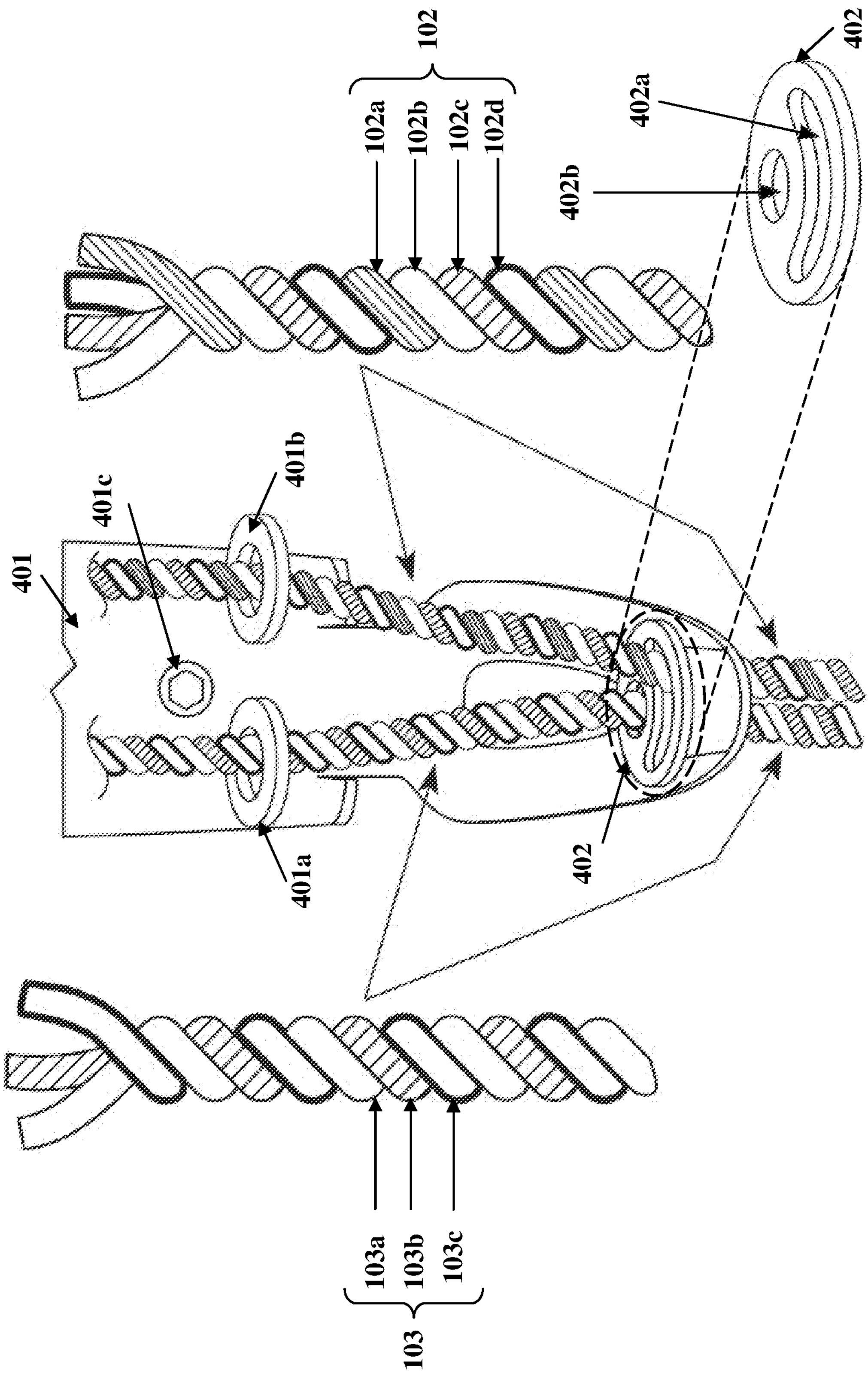


FIG. 3E



102
102a
102b
102c
102d
402
402a
402b
401
401c
401b
401a
402
103a
103b
103c
103

FIG. 4A

FIG. 4B

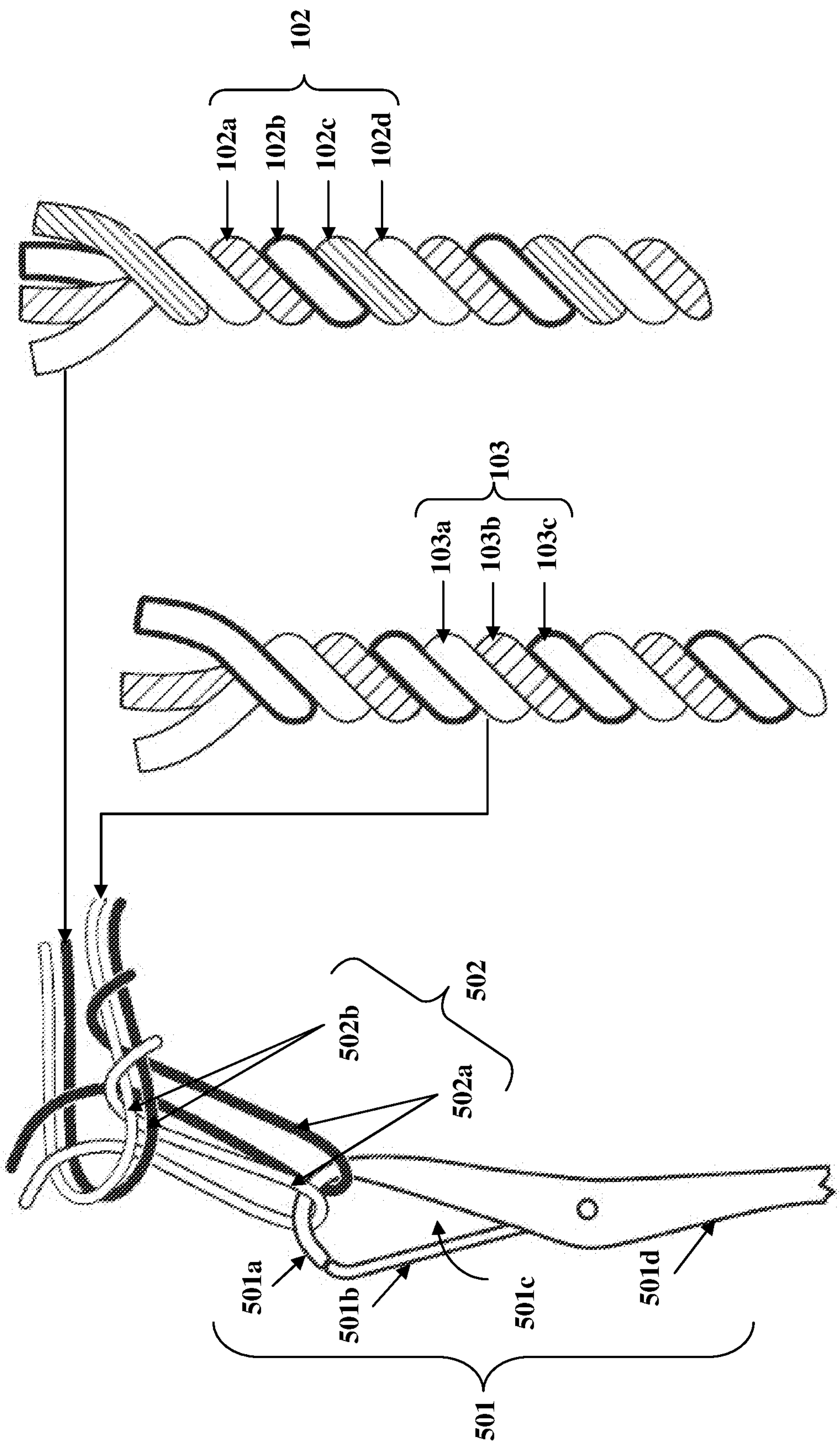
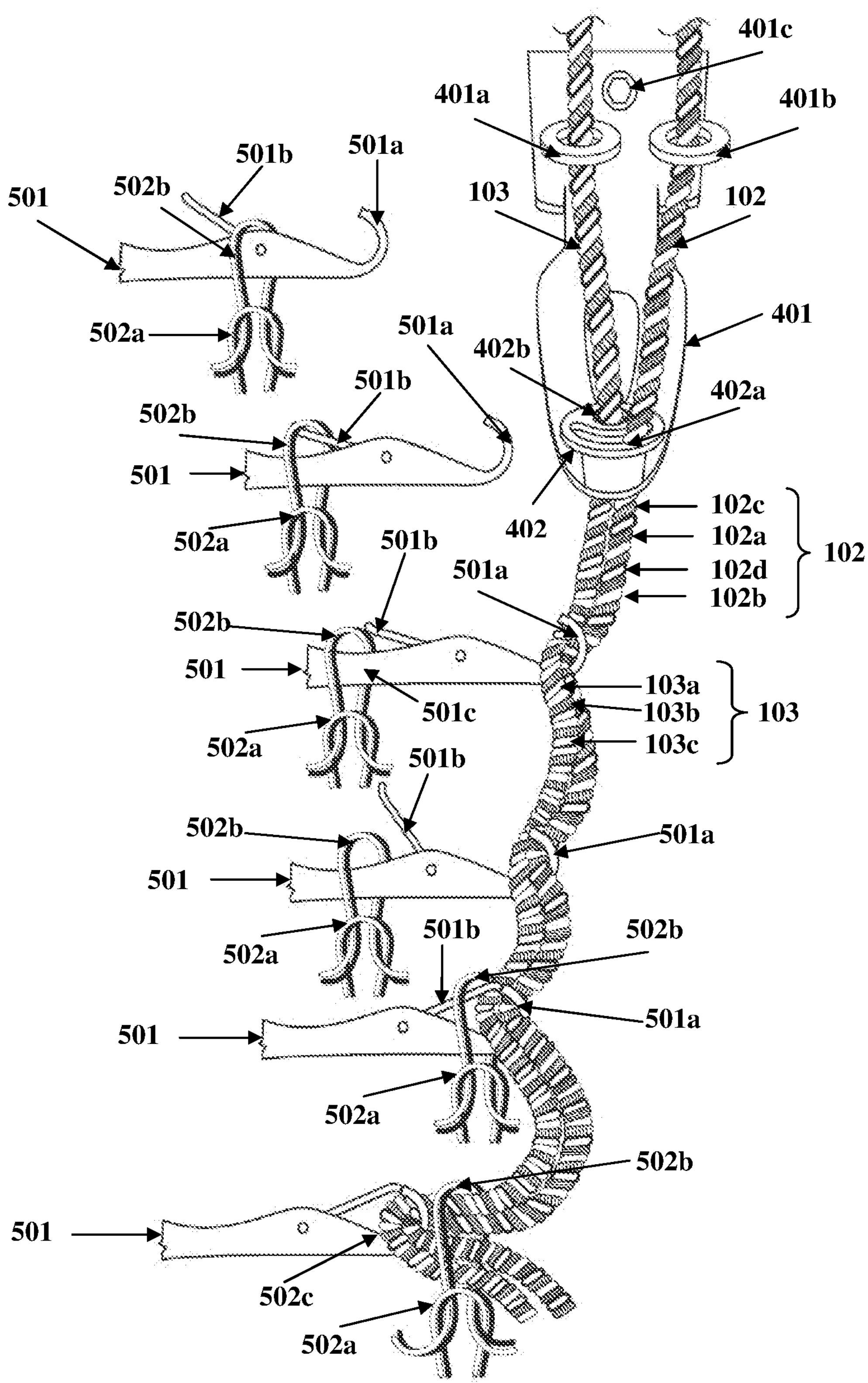

102
102a
102b
102c
102d
103
103a
103b
103c
502
502b
502a
501a
501b
501c
501d
501

FIG. 5A


401c
401a
401b
501b
501a
501
502b
103
102
502a
401
501a
402b
402a
501b
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501
402
502a
102c
102a
102d
102b
102
501b
501a
502b
501
501c
103a
103b
103c
103
502a
501b
502b
501a
501
502a
501b
502b
501a
501
502a
502b
501
502c
502a

FIG. 5B

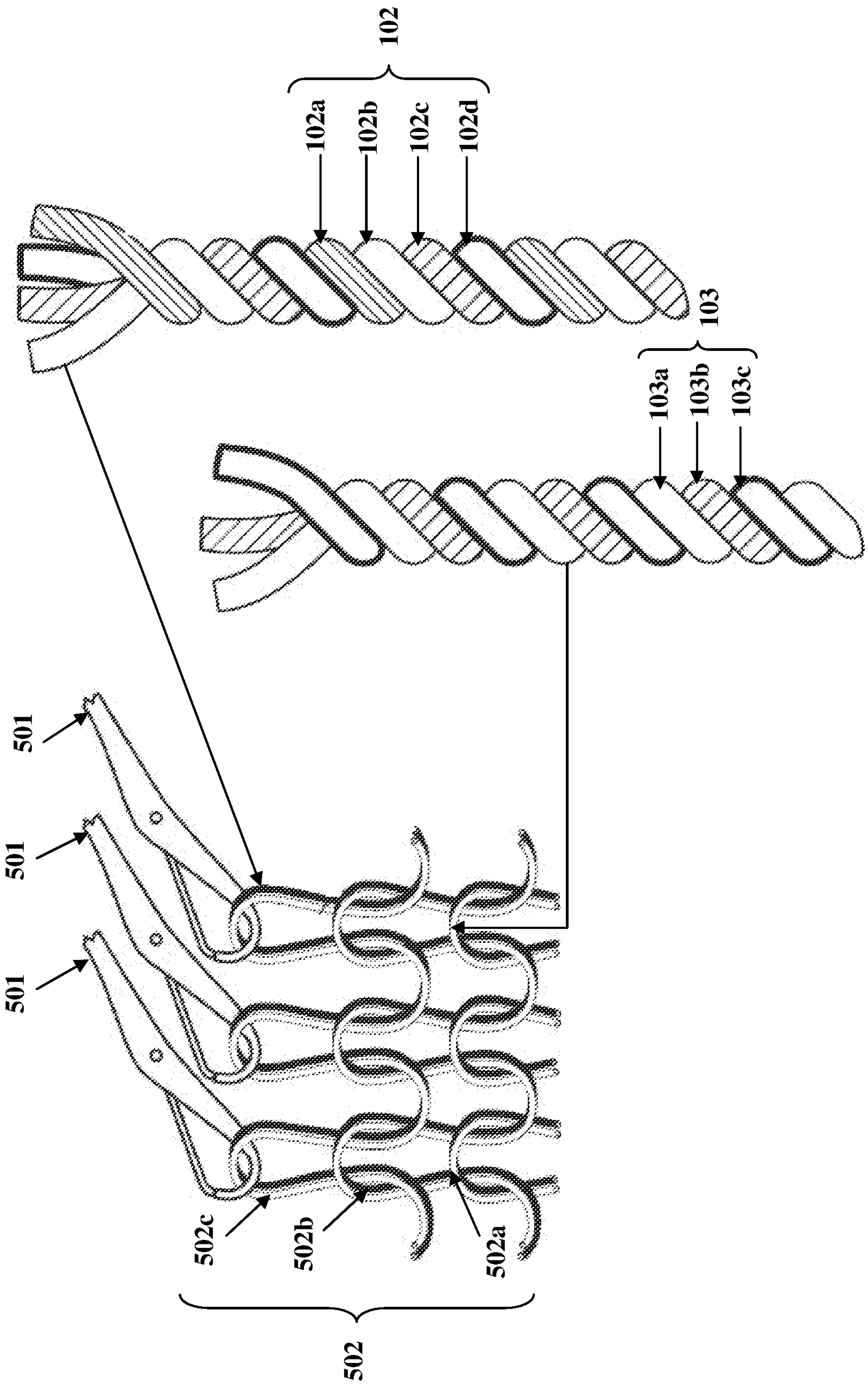
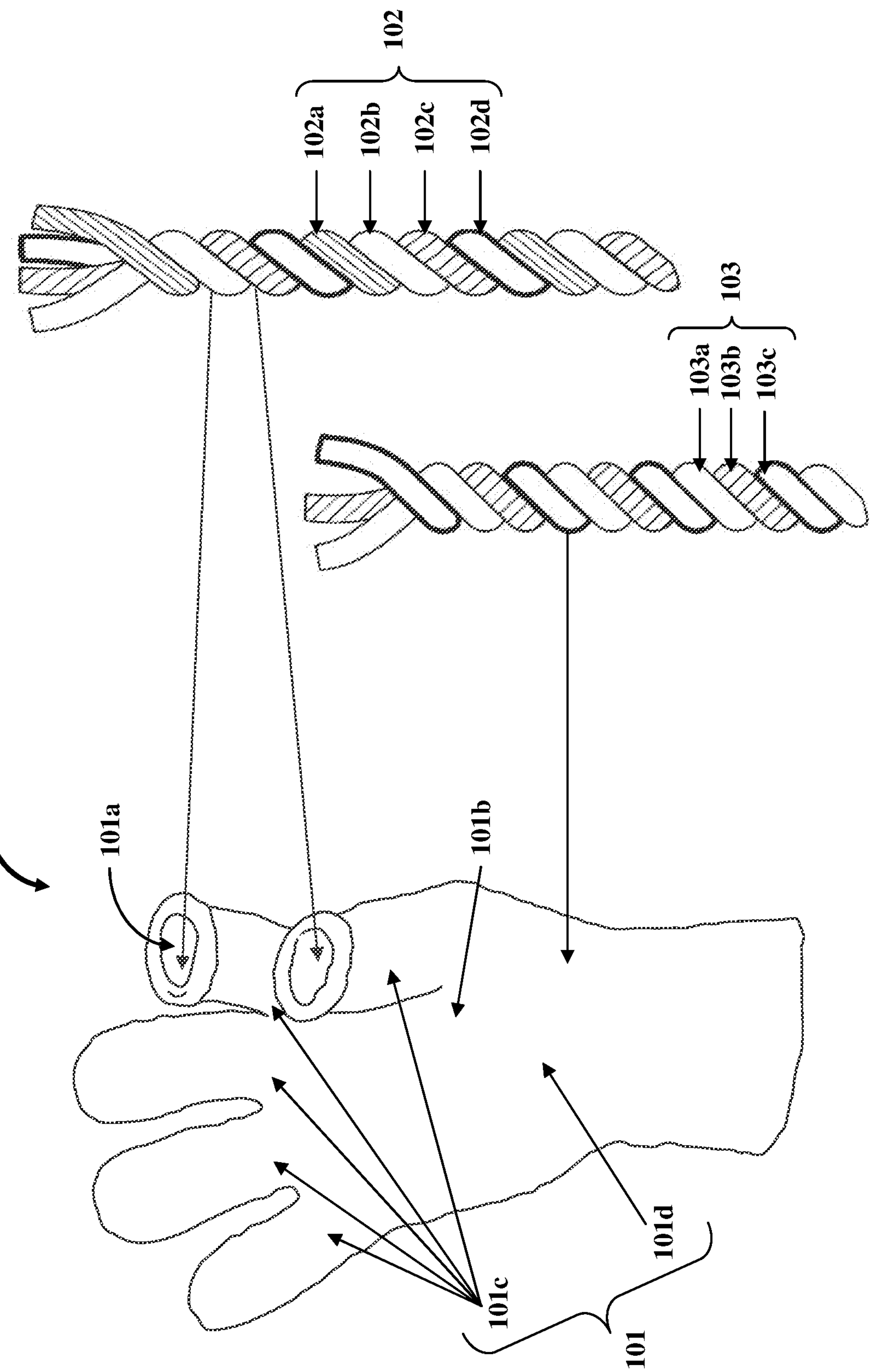
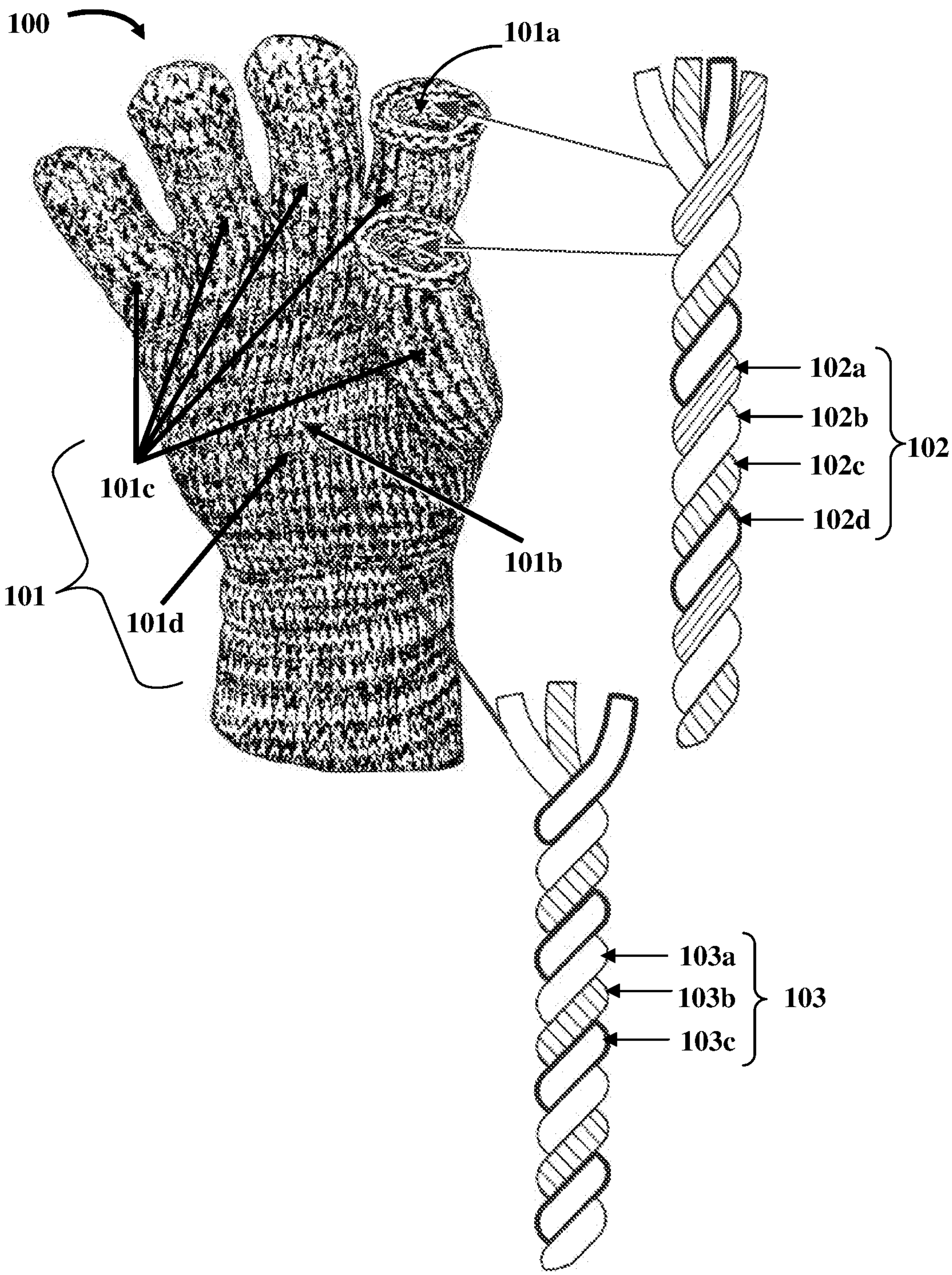

102
102a
102b
102c
102d
103
103a
103b
103c
501
501
501
502c
502b
502a
502

FIG. 5C



102
102a
102b
102c
102d
103
103a
103b
103c
100
101a
101b
101c
101d
101

FIG. 6A



100
101a
101c
101
101d
101b
102a
102b
102c
102d
102
103a
103b
103c
103

FIG. 6B

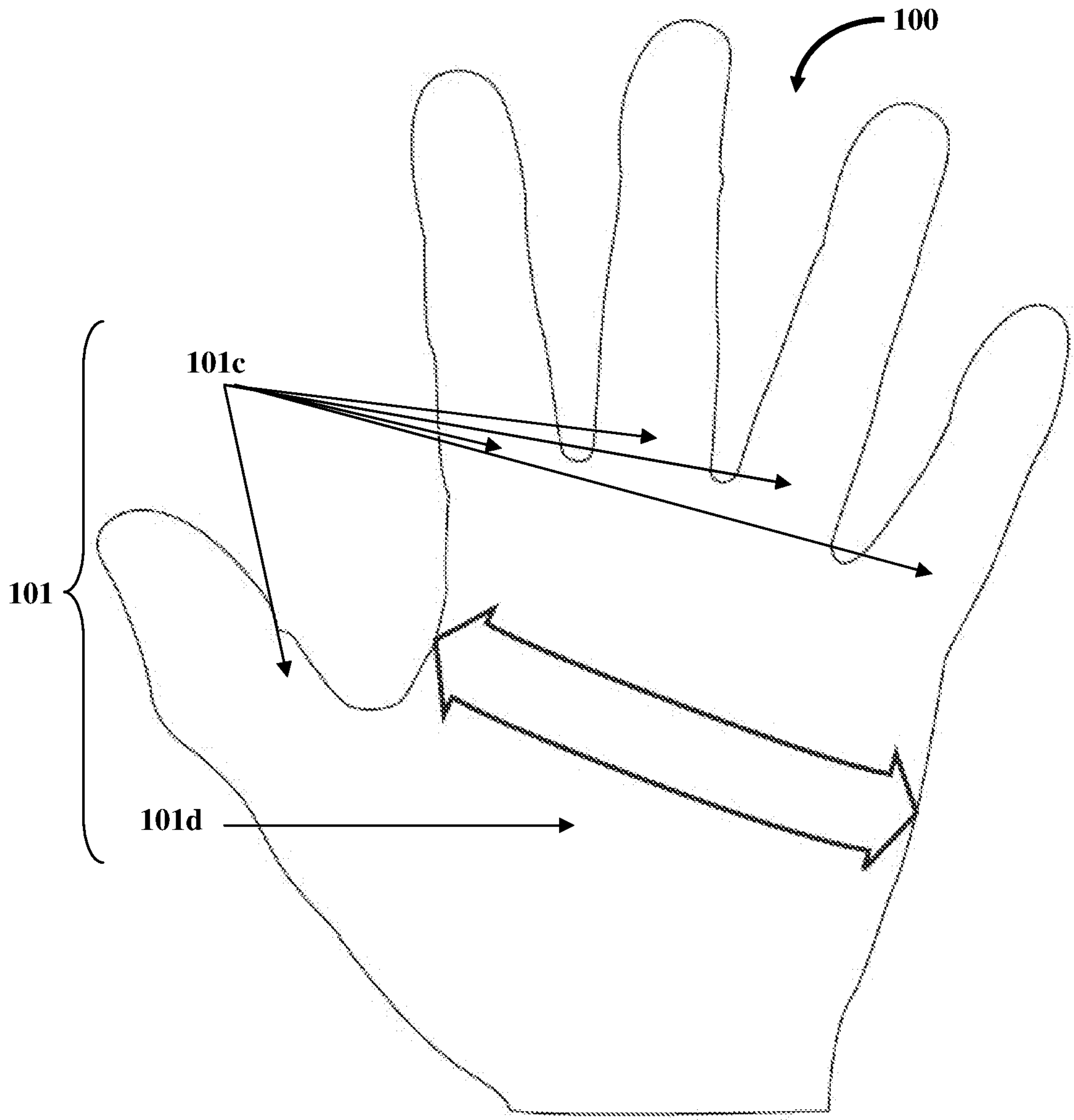


FIG. 7

TEST SAMPLE	ELEMENT 1 YARN	ELEMENT 2 YARN	ELEMENT 3 YARN	ELEMENT 6 YARN	SLOPE
A	4 (320 den.)	2 (312 den.)	4 (760 den.)	-	-40
B	5 (400 den.)	3 (468 den.)	3 (570 den.)	-	-26
C	8 (640 den.)	4 (624 den.)	-	-	-39
D	8 (640 den.)	-	4 (760 den.)	-	-35
E	-	4 (624 den.)	4 (760 den.)	-	-35
F	-	-	7 (1330 den.)	-	-76
G	-	8 (1248den.)	-	-	-58
H	17 (1360 den.)	-	-	-	-54
I	2 (160 den.)	1 (156 den.)	2 (380 den.)	5 (630 den.)	-41

FIG. 8A

TEST SAMPLE	ELEMENT 5 YARN	ELEMENT 3 YARN	SPANDEX	SLOPE
A	1 (550 den.)	3 (570 den.)	1 (40 den.)	-40
B	1 (550 den.)	3 (570 den.)	1 (40 den.)	-26
C	1 (550 den.)	3 (570 den.)	1 (40 den.)	-39
D	1 (550 den.)	3 (570 den.)	1 (40 den.)	-35
E	1 (550 den.)	3 (570 den.)	1 (40 den.)	-35
F	1 (550 den.)	3 (570 den.)	1 (40 den.)	-76
G	1 (550 den.)	3 (570 den.)	1 (40 den.)	-58
H	1 (550 den.)	3 (570 den.)	1 (40 den.)	-54
I	1 (550 den.)	3 (570 den.)	1 (40 den.)	-41

FIG. 8B

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:08:06 PM	91.3	91.3
2:08:21 PM	91.4	91.9
2:08:36 PM	91.5	92.1
2:08:51 PM	91.4	91.6
2:09:06 PM	90.8	90.8
2:09:21 PM	90.9	89.9
2:09:36 PM	91.1	90.3
2:09:51 PM	91.4	91.1
2:10:06 PM	91.6	90.5
2:10:21 PM	91.8	90.8
2:10:36 PM	92	91.2
2:10:51 PM	92.1	91.5
2:11:06 PM	92.1	91.8
2:11:21 PM	92.2	92
2:11:36 PM	92.2	92.1
2:11:51 PM	92.3	92.3
2:12:06 PM	92.3	92.4
2:12:21 PM	92.3	92.5
2:12:36 PM	92.2	92.6
2:12:51 PM	92.1	92.6
2:13:06 PM	92.1	92.7
2:13:21 PM	92	92.8
2:13:36 PM	91.9	92.8
2:13:51 PM	91.9	92.9
2:14:06 PM	91.9	92.9
2:14:21 PM	91.9	93
2:14:36 PM	91.9	93
2:14:51 PM	91.8	93.1
2:15:06 PM	91.8	93.1
2:15:21 PM	91.7	93.2
2:15:36 PM	91.7	93.2
2:15:51 PM	91.7	93.2
2:16:06 PM	91.7	93.3

FIG. 9A

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:16:21 PM	91.6	93.3
2:16:36 PM	91.6	93.3
2:16:51 PM	91.6	93.3
2:17:06 PM	91.6	93.3
2:17:21 PM	91.6	93.3
2:17:36 PM	91.6	93.3
2:17:51 PM	91.6	93.4
2:18:06 PM	91.5	93.4
2:18:21 PM	91.4	93.4
2:18:36 PM	91.4	93.4
2:18:51 PM	91.4	93.4
2:19:06 PM	91.3	93.4
2:19:21 PM	91.3	93.4
2:19:36 PM	91.2	93.4
2:19:51 PM	91	93.3
2:20:06 PM	91.1	93.1
2:20:21 PM	91.1	93
2:20:36 PM	91.2	93
2:20:51 PM	91.2	93
2:21:06 PM	91.2	93
2:21:21 PM	91.1	93
2:21:36 PM	91.1	92.8
2:21:51 PM	91.1	92.8
2:22:06 PM	91	92.9
2:22:21 PM	90.9	92.9
2:22:36 PM	90.9	93.1
2:22:51 PM	91	93.2
2:23:06 PM	91	93.2
2:23:21 PM	90.9	93.2
2:23:36 PM	90.8	93.1
2:23:51 PM	90.8	93.1
2:24:06 PM	90.7	93.1
2:24:21 PM	90.7	93.1

FIG. 9B

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:24:36 PM	90.5	93
2:24:51 PM	90.3	92.9
2:25:06 PM	90.2	92.8
2:25:21 PM	90.1	92.6
2:25:36 PM	90.1	92.5
2:25:51 PM	90.1	92.5
2:26:06 PM	90.1	92.5
2:26:21 PM	90	92.4
2:26:36 PM	89.9	91.3
2:26:51 PM	90.1	91.8
2:27:06 PM	90.2	92.1
2:27:21 PM	90.3	92.3
2:27:36 PM	90.3	92.4
2:27:51 PM	90.2	92.5
2:28:06 PM	90.3	92.6
2:28:21 PM	90.3	92.6
2:28:36 PM	90.3	92.6
2:28:51 PM	90.3	92.6
2:29:06 PM	90.3	92.7
2:29:21 PM	90.2	92.7
2:29:36 PM	90.2	92.7
2:29:51 PM	90.1	92.7
2:30:06 PM	90.1	92.7
2:30:21 PM	89.9	92.5
2:30:36 PM	89.7	92.5
2:30:51 PM	89.6	92.5
2:31:06 PM	89.6	92.4
2:31:21 PM	89.6	92.4
2:31:36 PM	89.6	92.3
2:31:51 PM	89.5	92.1
2:32:06 PM	89.6	92.2
2:32:21 PM	89.3	90.9
2:32:36 PM	89.3	91.1
2:32:51 PM	89.4	91.5

FIG. 9C

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:33:06 PM	89.4	91.6
2:33:21 PM	89.4	91.7
2:33:36 PM	89.2	91.8
2:33:51 PM	89.2	91.8
2:34:06 PM	89.1	91.9
2:34:21 PM	88.8	91.7
2:34:36 PM	88.7	91.7
2:34:51 PM	88.6	91.6
2:35:06 PM	88.5	91.5
2:35:21 PM	88.3	91.5
2:35:36 PM	88.3	91.5
2:35:51 PM	88.1	91.5
2:36:06 PM	87.7	91.4
2:36:21 PM	87.3	91.4
2:36:36 PM	87.1	91.5
2:36:51 PM	87.3	91.5
2:37:06 PM	87.5	91.6
2:37:21 PM	87.7	91.6
2:37:36 PM	87.7	91.6
2:37:51 PM	87.6	91.4
2:38:06 PM	87.6	91.3
2:38:21 PM	87.6	91.1
2:38:36 PM	87.6	91
2:38:51 PM	87.5	90.5
2:39:06 PM	87.4	90.4
2:39:21 PM	87.4	90.3
2:39:36 PM	87.5	90.6
2:39:51 PM	87.4	90.4
2:40:06 PM	87.4	89.7
2:40:21 PM	87.4	89.9
2:40:36 PM	87.4	90.2
2:40:51 PM	87.2	90.3
2:41:06 PM	87.2	90.4

FIG. 9D

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:41:21 PM	87.2	90.4
2:41:36 PM	87.2	90.4
2:41:51 PM	87.2	90.5
2:42:06 PM	87.2	90.5
2:42:21 PM	87.1	90.5
2:42:36 PM	87.1	90.5
2:42:51 PM	87	90.4
2:43:06 PM	87.1	90.5
2:43:21 PM	87.1	90.5
2:43:36 PM	87	90.6
2:43:51 PM	86.4	90.2
2:44:06 PM	86.7	90.2
2:44:21 PM	86.7	90.2
2:44:36 PM	86.8	90
2:44:51 PM	86.9	90
2:45:06 PM	86.9	90
2:45:21 PM	86.8	90
2:45:36 PM	86.8	90.1
2:45:51 PM	86.8	90.1
2:46:06 PM	86.7	90.1
2:46:21 PM	86.6	90.1
2:46:36 PM	86.6	90.1
2:46:51 PM	86.4	90.1
2:47:06 PM	86.3	90.1
2:47:21 PM	86.4	90.1
2:47:36 PM	86.4	90
2:47:51 PM	86.3	90
2:48:06 PM	86.3	90
2:48:21 PM	86.3	90
2:48:36 PM	86.2	89.9
2:48:51 PM	86.2	89.9
2:49:06 PM	86.1	89.8
2:49:21 PM	86	89.7

FIG. 9E

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:49:36 PM	86.1	89.7
2:49:51 PM	86.1	89.8
2:50:06 PM	86	89.8
2:50:21 PM	85.9	89.8
2:50:36 PM	85.8	89.8
2:50:51 PM	85.8	89.6
2:51:06 PM	85.9	89.6
2:51:21 PM	86	89.5
2:51:36 PM	85.9	89.4
2:51:51 PM	85.9	89.4
2:52:06 PM	85.9	89.4
2:52:21 PM	85.8	89.3
2:52:36 PM	85.5	88.8
2:52:51 PM	85.5	88.6
2:53:06 PM	85.4	88.6
2:53:21 PM	85.4	88.6
2:53:36 PM	85.3	88.6
2:53:51 PM	85.2	88.6
2:54:06 PM	85.3	88.6
2:54:21 PM	85.4	88.7
2:54:36 PM	85.3	88.7
2:54:51 PM	85.3	88.6
2:55:06 PM	85.3	88.6
2:55:21 PM	85.2	88.6
2:55:36 PM	85.2	88.6
2:55:51 PM	85.1	88.6
2:56:06 PM	85.1	88.7
2:56:21 PM	85.1	88.8
2:56:36 PM	85	88.8
2:56:51 PM	85	88.8
2:57:06 PM	84.9	88.8
2:57:21 PM	84.8	88.8
2:57:36 PM	84.9	88.6

FIG. 9F

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
2:57:51 PM	84.8	88.5
2:58:06 PM	84.8	88.5
2:58:21 PM	84.7	88.5
2:58:36 PM	84.7	88.5
2:58:51 PM	84.6	88.5
2:59:06 PM	84.6	88.5
2:59:21 PM	84.5	88.5
2:59:36 PM	84.5	88.5
2:59:51 PM	84.4	88.5
3:00:06 PM	84.4	88.5
3:00:21 PM	84.4	88.5
3:00:36 PM	84.3	88.5
3:00:51 PM	84.3	88.3
3:01:06 PM	84.3	88.2
3:01:21 PM	84.4	88.1
3:01:36 PM	84.3	88.1
3:01:51 PM	84.3	88.1
3:02:06 PM	84.2	87.9
3:02:21 PM	84.2	87.8
3:02:36 PM	84.1	87.8
3:02:51 PM	84.1	87.8
3:03:06 PM	84.1	87.7
3:03:21 PM	84	87.7
3:03:36 PM	84	87.6
3:03:51 PM	83.9	87.5
3:04:06 PM	84	87.4
3:04:21 PM	84	87.4
3:04:36 PM	84	87.3
3:04:51 PM	83.9	87.3
3:05:06 PM	83.8	87.3
3:05:21 PM	83.8	87.2
3:05:36 PM	83.8	87.2
3:05:51 PM	83.7	87.1

FIG. 9G

TIME	TECH SAMPLE A (°F)	TECH SAMPLE B (°F)
3:06:06 PM	83.8	87.1
3:06:21 PM	83.8	87.1
3:06:36 PM	83.8	87
3:06:51 PM	81.2	84
3:07:06 PM	82.2	84
3:07:21 PM	81.7	82.8

FIG. 9H

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
2:18:44 PM	79.9	78.6
2:18:59 PM	79.7	79
2:19:14 PM	80.2	79.9
2:19:29 PM	80.4	79.9
2:19:44 PM	78.9	78.8
2:19:59 PM	79.5	78.6
2:20:14 PM	78.4	76.9
2:20:29 PM	78.6	79.3
2:20:44 PM	78.8	80
2:20:59 PM	79.2	80.4
2:21:14 PM	79.4	81
2:21:29 PM	79.5	81.3
2:21:44 PM	79.6	81.5
2:21:59 PM	79.7	81.4
2:22:14 PM	79.8	81.2
2:22:29 PM	80.1	81.4
2:22:44 PM	80.2	81.8
2:22:59 PM	80	81.9
2:23:14 PM	80.1	81.9
2:23:29 PM	80.2	82
2:23:44 PM	80.2	82.2
2:23:59 PM	80.3	82.3
2:24:14 PM	80.6	82.6
2:24:29 PM	80.7	82.8
2:24:44 PM	80.7	82.9
2:24:59 PM	80.8	83.1
2:25:14 PM	81.1	83.1
2:25:29 PM	81.2	83.2
2:25:44 PM	81.3	83
2:25:59 PM	81.3	83.2
2:26:14 PM	81.2	83.3
2:26:29 PM	81.1	82.7

FIG. 10A

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
2:26:44 PM	81.1	83
2:26:59 PM	81.1	82.1
2:27:14 PM	81.2	83
2:27:29 PM	81.4	83.3
2:27:44 PM	81.4	83.4
2:27:59 PM	81.4	83.5
2:28:14 PM	81.4	83.6
2:28:29 PM	81.3	83.8
2:28:44 PM	81.5	83.9
2:28:59 PM	81.6	84
2:29:14 PM	81.5	84
2:29:29 PM	81.6	84
2:29:44 PM	81.6	83.6
2:29:59 PM	82	84.3
2:30:14 PM	82.2	84.5
2:30:29 PM	82.3	84.6
2:30:44 PM	82.1	84.6
2:30:59 PM	82	84.6
2:31:14 PM	82	84.4
2:31:29 PM	81.7	84
2:31:44 PM	81.7	84.4
2:31:59 PM	81.6	82.3
2:32:14 PM	81.4	82.2
2:32:29 PM	81.6	81.7
2:32:44 PM	81.8	81.7
2:32:59 PM	81.7	81.7
2:33:14 PM	81.5	81.6
2:33:29 PM	81.3	81.4
2:33:44 PM	81.3	82.2
2:33:59 PM	81.1	82.4
2:34:14 PM	80.8	81.1
2:34:29 PM	80.6	81.2

FIG. 10B

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
2:34:44 PM	80.3	81.2
2:34:59 PM	80.4	81.4
2:35:14 PM	80.4	80.8
2:35:29 PM	80.2	80.1
2:35:44 PM	80	79.8
2:35:59 PM	80.1	81.3
2:36:14 PM	80.4	82.6
2:36:29 PM	80.8	83.3
2:36:44 PM	80.9	83.2
2:36:59 PM	80.9	82.6
2:37:14 PM	80.8	82.3
2:37:29 PM	80.9	82
2:37:44 PM	80.9	81.8
2:37:59 PM	81	82.1
2:38:14 PM	81	82.2
2:38:29 PM	80.9	82.3
2:38:44 PM	80.9	82.7
2:38:59 PM	80.9	82.5
2:39:14 PM	80.9	82.2
2:39:29 PM	80.8	81.5
2:39:44 PM	80.8	79.1
2:39:59 PM	80.7	78.9
2:40:14 PM	80.7	77.3
2:40:29 PM	80.7	77
2:40:44 PM	80.6	76.4
2:40:59 PM	80.7	76.6
2:41:14 PM	80.9	78
2:41:29 PM	81	79.1
2:41:44 PM	81.1	78.1
2:41:59 PM	81	77.6
2:42:14 PM	80.8	77.1
2:42:29 PM	80.7	76.9
2:42:44 PM	80.7	79.8

FIG. 10C

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
2:42:59 PM	80.6	79.1
2:43:14 PM	80.2	78.8
2:43:29 PM	79.7	77.4
2:43:44 PM	80.3	80.4
2:43:59 PM	80.1	79.9
2:44:14 PM	80	81.6
2:44:29 PM	80.2	81.7
2:44:44 PM	80.3	81.3
2:44:59 PM	80.3	80.3
2:45:14 PM	80.3	80.3
2:45:29 PM	80.2	78.7
2:45:44 PM	80	77.5
2:45:59 PM	79.7	77
2:46:14 PM	79.6	77.1
2:46:29 PM	79.4	75.9
2:46:44 PM	79.5	77.4
2:46:59 PM	79.6	80
2:47:14 PM	79.8	80.6
2:47:29 PM	79.9	80.8
2:47:44 PM	79.9	79.2
2:47:59 PM	79.7	80.6
2:48:14 PM	79.8	80.8
2:48:29 PM	79.8	81
2:48:44 PM	79.7	81.1
2:48:59 PM	79.6	80.7
2:49:14 PM	79.5	81.5
2:49:29 PM	79.7	81.7
2:49:44 PM	79.8	81.6
2:49:59 PM	79.7	81.7
2:50:14 PM	79.8	81.7
2:50:29 PM	79.8	81.8
2:50:44 PM	79.7	81.5
2:50:59 PM	79.6	80.4

FIG. 10D

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
2:51:14 PM	79.5	79.7
2:51:29 PM	79.6	79.9
2:51:44 PM	79.5	80.2
2:51:59 PM	79.6	80.7
2:52:14 PM	79.6	80.6
2:52:29 PM	79.6	81.9
2:52:44 PM	79.6	82
2:52:59 PM	79.4	82.1
2:53:14 PM	79.3	81.8
2:53:29 PM	79.2	81.5
2:53:44 PM	78.9	81.2
2:53:59 PM	78.8	80.9
2:54:14 PM	78.7	80.7
2:54:29 PM	78.4	80.8
2:54:44 PM	78.7	80.4
2:54:59 PM	78.6	80
2:55:14 PM	78.4	77.6
2:55:29 PM	78.1	76.9
2:55:44 PM	77.8	77.1
2:55:59 PM	77.9	78.1
2:56:14 PM	77.7	77.3
2:56:29 PM	77.6	77.2
2:56:44 PM	77.5	77.4
2:56:59 PM	77.4	77.6
2:57:14 PM	77.3	77.5
2:57:29 PM	77.2	77.3
2:57:44 PM	77.1	78.3
2:57:59 PM	77	78.4
2:58:14 PM	76.8	77.9
2:58:29 PM	76.8	77.8
2:58:44 PM	76.7	76.8
2:58:59 PM	76.4	78.4
2:59:14 PM	76.2	78.7

FIG. 10E

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
2:59:29 PM	76.2	78.9
2:59:44 PM	76.1	78.7
2:59:59 PM	76	78.9
3:00:14 PM	76	80
3:00:29 PM	76.3	80.3
3:00:44 PM	76.6	80.6
3:00:59 PM	76.6	80
3:01:14 PM	76.5	79.1
3:01:29 PM	76.5	78.7
3:01:44 PM	76.5	78.4
3:01:59 PM	76.5	78.4
3:02:14 PM	76.4	78.1
3:02:29 PM	76.4	78.1
3:02:44 PM	76.4	78.8
3:02:59 PM	76.3	78.3
3:03:14 PM	76.4	77.6
3:03:29 PM	76.5	77.7
3:03:44 PM	76.6	79.5
3:03:59 PM	76.7	79.1
3:04:14 PM	76.7	79.1
3:04:29 PM	76.8	79.1
3:04:44 PM	76.7	79
3:04:59 PM	76.6	78.6
3:05:14 PM	76.6	78.4
3:05:29 PM	76.5	78.1
3:05:44 PM	76.5	78.2
3:05:59 PM	76.5	78.1
3:06:14 PM	76.5	78
3:06:29 PM	76.4	77.7
3:06:44 PM	76.4	76
3:06:59 PM	76.6	73.9
3:07:14 PM	75.7	66.1
3:07:29 PM	75.5	74.5

FIG. 10F

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
3:07:44 PM	75.6	75.8
3:07:59 PM	75	75.7
3:08:14 PM	74.9	76.6
3:08:29 PM	74.6	75.6
3:08:44 PM	74.5	76.5
3:08:59 PM	74.4	76.3
3:09:14 PM	74.4	76.3
3:09:29 PM	74.3	76.4
3:09:44 PM	74.1	75.8
3:09:59 PM	74	76.3
3:10:14 PM	73.7	76.2
3:10:29 PM	73.6	76.3
3:10:44 PM	73.7	76.6
3:10:59 PM	73.7	76.9
3:11:14 PM	74	76.6
3:11:29 PM	74.3	76.6
3:11:44 PM	74.4	76.1
3:11:59 PM	74.6	75.5
3:12:14 PM	74.6	72.7
3:12:29 PM	74.6	74.1
3:12:44 PM	74.5	73.8
3:12:59 PM	74.5	74.7
3:13:14 PM	74.5	74.1
3:13:29 PM	74.5	73.8
3:13:44 PM	74.5	74.2
3:13:59 PM	74.4	73.7
3:14:14 PM	74.4	75.1
3:14:29 PM	74.4	74.3
3:14:44 PM	74.3	74.2
3:14:59 PM	74.2	74.3
3:15:14 PM	73.3	64.3
3:15:29 PM	72.6	70.4
3:15:44 PM	72.6	73.1
3:15:59 PM	72.9	73.3

FIG. 10G

TIME	TECH SAMPLE D (°F)	TECH SAMPLE C (°F)
3:16:14 PM	73.1	70.5
3:16:29 PM	73.1	73
3:16:44 PM	73.2	73.9
3:16:59 PM	73.3	73.5
3:17:14 PM	73.1	65.8
3:17:29 PM	73.1	67.7
3:17:44 PM	71.9	67
3:17:59 PM	72.2	70.1
3:18:14 PM	72.5	71.5

FIG. 10H

TIME	TEST SAMPLE E (°F)
11:14:15 AM	86.6
11:14:30 AM	86.7
11:14:45 AM	87
11:15:00 AM	86.6
11:15:15 AM	85.9
11:15:30 AM	85.3
11:15:45 AM	84.3
11:16:00 AM	84.4
11:16:15 AM	85.1
11:16:30 AM	85.9
11:16:45 AM	86.3
11:17:00 AM	86.7
11:17:15 AM	86.8
11:17:30 AM	86.8
11:17:45 AM	86.9
11:18:00 AM	86.9
11:18:15 AM	86.8
11:18:30 AM	86.8
11:18:45 AM	86.8
11:19:00 AM	86.8
11:19:15 AM	86.8
11:19:30 AM	86.8
11:19:45 AM	87
11:20:00 AM	86.6
11:20:15 AM	86.6
11:20:30 AM	86.6
11:20:45 AM	86.7
11:21:00 AM	86.7
11:21:15 AM	86.8
11:21:30 AM	86.8
11:21:45 AM	86.8
11:22:00 AM	86.8

FIG. 11A

TIME	TEST SAMPLE E (°F)
11:22:15 AM	86.7
11:22:30 AM	86.7
11:22:45 AM	86.7
11:23:00 AM	86.7
11:23:15 AM	86.8
11:23:30 AM	86.7
11:23:45 AM	86.8
11:24:00 AM	86.8
11:24:15 AM	86.9
11:24:30 AM	87
11:24:45 AM	86.9
11:25:00 AM	87
11:25:15 AM	87
11:25:30 AM	87
11:25:45 AM	87
11:26:00 AM	87
11:26:15 AM	87
11:26:30 AM	87.1
11:26:45 AM	87.3
11:27:00 AM	87.5
11:27:15 AM	87.6
11:27:30 AM	87.7
11:27:45 AM	87.7
11:28:00 AM	87.7
11:28:15 AM	87.8
11:28:30 AM	87.8
11:28:45 AM	87.9
11:29:00 AM	88
11:29:15 AM	87.9
11:29:30 AM	87.7
11:29:45 AM	88
11:30:00 AM	88.2

FIG. 11B

TIME	TEST SAMPLE E (°F)
11:30:15 AM	88.2
11:30:30 AM	88.1
11:30:45 AM	88.1
11:31:00 AM	88
11:31:15 AM	88
11:31:30 AM	88
11:31:45 AM	87.8
11:32:00 AM	87.7
11:32:15 AM	87.6
11:32:30 AM	87.5
11:32:45 AM	87.4
11:33:00 AM	87.4
11:33:15 AM	87.4
11:33:30 AM	87.5
11:33:45 AM	87.6
11:34:00 AM	87.7
11:34:15 AM	87.6
11:34:30 AM	87.5
11:34:45 AM	87.5
11:35:00 AM	87.5
11:35:15 AM	87.5
11:35:30 AM	87.4
11:35:45 AM	87.5
11:36:00 AM	87.6
11:36:15 AM	87.6
11:36:30 AM	87.6
11:36:45 AM	87.5
11:37:00 AM	87.5
11:37:15 AM	87.4
11:37:30 AM	87.2
11:37:45 AM	87.1
11:38:00 AM	87

FIG. 11C

TIME	TEST SAMPLE E (°F)
11:38:15 AM	86.8
11:38:30 AM	86.7
11:38:45 AM	86.6
11:39:00 AM	86.4
11:39:15 AM	86.3
11:39:30 AM	86.1
11:39:45 AM	86.3
11:40:00 AM	86.4
11:40:15 AM	86.4
11:40:30 AM	86.1
11:40:45 AM	86.3
11:41:00 AM	86.4
11:41:15 AM	86.4
11:41:30 AM	86.6
11:41:45 AM	86.7
11:42:00 AM	86.7
11:42:15 AM	86.8
11:42:30 AM	86.6
11:42:45 AM	86.4
11:43:00 AM	86.1
11:43:15 AM	85.8
11:43:30 AM	86
11:43:45 AM	86.1
11:44:00 AM	86
11:44:15 AM	85.1
11:44:30 AM	85.3
11:44:45 AM	85.5
11:45:00 AM	85.2
11:45:15 AM	85.3
11:45:30 AM	85.3
11:45:45 AM	85.2
11:46:00 AM	85.1

FIG. 11D

TIME	TEST SAMPLE E (°F)
11:46:15 AM	85
11:46:30 AM	84.9
11:46:45 AM	84.8
11:47:00 AM	84.7
11:47:15 AM	84.8
11:47:30 AM	84.7
11:47:45 AM	84.7
11:48:00 AM	84.8
11:48:15 AM	84.7
11:48:30 AM	84.6
11:48:45 AM	84.4
11:49:00 AM	84.3
11:49:15 AM	84.3
11:49:30 AM	84.2
11:49:45 AM	84.2
11:50:00 AM	84.1
11:50:15 AM	84.1
11:50:30 AM	84.1
11:50:45 AM	83.9
11:51:00 AM	83.8
11:51:15 AM	83.7
11:51:30 AM	83.8
11:51:45 AM	83.9
11:52:00 AM	83.9
11:52:15 AM	83.7
11:52:30 AM	83.7
11:52:45 AM	83.7
11:53:00 AM	83.6
11:53:15 AM	83.5
11:53:30 AM	83.5
11:53:45 AM	83.5
11:54:00 AM	83.6

FIG. 11E

TIME	TEST SAMPLE E (°F)
11:54:15 AM	83.5
11:54:30 AM	83.5
11:54:45 AM	83.4
11:55:00 AM	83.3
11:55:15 AM	83.3
11:55:30 AM	83.3
11:55:45 AM	83.1
11:56:00 AM	83.1
11:56:15 AM	83.3
11:56:30 AM	83.3
11:56:45 AM	83.3
11:57:00 AM	83.3
11:57:15 AM	83.2
11:57:30 AM	83.2
11:57:45 AM	83.1
11:58:00 AM	83
11:58:15 AM	82.9
11:58:30 AM	82.8
11:58:45 AM	82.7
11:59:00 AM	82.6
11:59:15 AM	82.6
11:59:30 AM	82.5
11:59:45 AM	82
12:00:00 PM	81.9
12:00:15 PM	82.1
12:00:30 PM	82.2
12:00:45 PM	82
12:01:00 PM	82
12:01:15 PM	82
12:01:30 PM	82
12:01:45 PM	82
12:02:00 PM	82.1

FIG. 11F

TIME	TEST SAMPLE E (°F)
12:02:15 PM	82
12:02:30 PM	82
12:02:45 PM	80.9
12:03:00 PM	79.1
12:03:15 PM	79.8
12:03:30 PM	80.2
12:03:45 PM	80.6
12:04:00 PM	80.7
12:04:15 PM	80.7
12:04:30 PM	80.7
12:04:45 PM	80.8
12:05:00 PM	80.9
12:05:15 PM	80.9
12:05:30 PM	80.8
12:05:45 PM	80.7
12:06:00 PM	80.3
12:06:15 PM	80.4
12:06:30 PM	80.6
12:06:45 PM	80.6
12:07:00 PM	80.6
12:07:15 PM	79.6
12:07:30 PM	79.7
12:07:45 PM	80
12:08:00 PM	80
12:08:15 PM	80
12:08:30 PM	80.1
12:08:45 PM	80.1
12:09:00 PM	80
12:09:15 PM	80.1
12:09:30 PM	80.1
12:09:45 PM	80.1
12:10:00 PM	80.2

FIG. 11G

TIME	TEST SAMPLE E (°F)
12:10:15 PM	80.1
12:10:30 PM	80
12:10:45 PM	80
12:11:00 PM	79.9
12:11:15 PM	79.9
12:11:30 PM	79.8
12:11:45 PM	79.8
12:12:00 PM	79.7
12:12:15 PM	79.8
12:12:30 PM	79.8
12:12:45 PM	79.8
12:13:00 PM	79.8
12:13:15 PM	79.8
12:13:30 PM	79.7
12:13:45 PM	78.5
12:14:00 PM	78.4

FIG. 11H

TIME	TECH SAMPLE F (°F)
10:38:55 AM	87.4
10:39:10 AM	87.4
10:39:25 AM	87.6
10:39:40 AM	87.6
10:39:55 AM	86
10:40:10 AM	87.2
10:40:25 AM	87.6
10:40:40 AM	87.8
10:40:55 AM	87.2
10:41:10 AM	87.6
10:41:25 AM	87.8
10:41:40 AM	87.8
10:41:55 AM	87.9
10:42:10 AM	87.5
10:42:25 AM	87.8
10:42:40 AM	87.7
10:42:55 AM	87.8
10:43:10 AM	87.9
10:43:25 AM	87.9
10:43:40 AM	88
10:43:55 AM	88
10:44:10 AM	88.1
10:44:25 AM	88.1
10:44:40 AM	87.7
10:44:55 AM	87.9
10:45:10 AM	87.9
10:45:25 AM	87.9
10:45:40 AM	88
10:45:55 AM	88
10:46:10 AM	88
10:46:25 AM	88.1
10:46:40 AM	88.2
10:46:55 AM	88

FIG. 12A

TIME	TECH SAMPLE F (°F)
10:47:10 AM	88.2
10:47:25 AM	88.3
10:47:40 AM	88.4
10:47:55 AM	88.4
10:48:10 AM	88.4
10:48:25 AM	88.6
10:48:40 AM	88.6
10:48:55 AM	88.5
10:49:10 AM	88.6
10:49:25 AM	88.3
10:49:40 AM	88.2
10:49:55 AM	88.2
10:50:10 AM	88.2
10:50:25 AM	88.1
10:50:40 AM	88
10:50:55 AM	87.3
10:51:10 AM	87.4
10:51:25 AM	87.4
10:51:40 AM	87.5
10:51:55 AM	87.6
10:52:10 AM	87.6
10:52:25 AM	87.8
10:52:40 AM	87.5
10:52:55 AM	87.6
10:53:10 AM	87.4
10:53:25 AM	87.6
10:53:40 AM	87.6
10:53:55 AM	87.6
10:54:10 AM	87.6
10:54:25 AM	87.5
10:54:40 AM	87.4
10:54:55 AM	87.3
10:55:10 AM	87.2

FIG. 12B

TIME	TECH SAMPLE F (°F)
10:55:25 AM	87.1
10:55:40 AM	87.1
10:55:55 AM	87
10:56:10 AM	86.8
10:56:25 AM	87
10:56:40 AM	87.3
10:56:55 AM	87.3
10:57:10 AM	86.4
10:57:25 AM	86.9
10:57:40 AM	87.3
10:57:55 AM	87.2
10:58:10 AM	86.7
10:58:25 AM	86.3
10:58:40 AM	85.9
10:58:55 AM	85.4
10:59:10 AM	85.3
10:59:25 AM	85.3
10:59:40 AM	85.1
10:59:55 AM	85
11:00:10 AM	84.9
11:00:25 AM	84.8
11:00:40 AM	84.8
11:00:55 AM	85.4
11:01:10 AM	85.5
11:01:25 AM	85.5
11:01:40 AM	85.4
11:01:55 AM	85.2
11:02:10 AM	85.2
11:02:25 AM	85.1
11:02:40 AM	84.9
11:02:55 AM	83.8
11:03:10 AM	82.8
11:03:25 AM	82.6

FIG. 12C

TIME	TECH SAMPLE F (°F)
11:03:40 AM	82.1
11:03:55 AM	81.7
11:04:10 AM	81.4
11:04:25 AM	81.2
11:04:40 AM	80.9
11:04:55 AM	81.1
11:05:10 AM	82.2
11:05:25 AM	82.7
11:05:40 AM	82.9
11:05:55 AM	82.9
11:06:10 AM	82.6
11:06:25 AM	82.5
11:06:40 AM	82.7
11:06:55 AM	82.8
11:07:10 AM	82.9
11:07:25 AM	83
11:07:40 AM	83.1
11:07:55 AM	83.1
11:08:10 AM	83.1
11:08:25 AM	83.2
11:08:40 AM	83.1
11:08:55 AM	83.1
11:09:10 AM	83.3
11:09:25 AM	83.1
11:09:40 AM	82.5
11:09:55 AM	82
11:10:10 AM	81.8
11:10:25 AM	81.6
11:10:40 AM	81.6
11:10:55 AM	81.4
11:11:10 AM	81.1
11:11:25 AM	81.3
11:11:40 AM	81.5

FIG. 12D

TIME	TECH SAMPLE F (°F)
11:11:55 AM	81.5
11:12:10 AM	81.3
11:12:25 AM	81.1
11:12:40 AM	80.6
11:12:55 AM	80.3
11:13:10 AM	80.1
11:13:25 AM	80
11:13:40 AM	79.9
11:13:55 AM	79.6
11:14:10 AM	79.4
11:14:25 AM	79.2
11:14:40 AM	79
11:14:55 AM	78.8
11:15:10 AM	78.7
11:15:25 AM	79.1
11:15:40 AM	79.5
11:15:55 AM	79.5
11:16:10 AM	79.2
11:16:25 AM	79.2
11:16:40 AM	79
11:16:55 AM	79.8
11:17:10 AM	79.8
11:17:25 AM	79.7
11:17:40 AM	79.4
11:17:55 AM	79.2
11:18:10 AM	78
11:18:25 AM	77.2
11:18:40 AM	76.8
11:18:55 AM	76.5
11:19:10 AM	76.3
11:19:25 AM	75.9
11:19:40 AM	75.7
11:19:55 AM	75.7
11:20:10 AM	75.6

FIG. 12E

TIME	TECH SAMPLE F (°F)
11:20:25 AM	75.6
11:20:40 AM	75.3
11:20:55 AM	75
11:21:10 AM	74.8
11:21:25 AM	74.7
11:21:40 AM	74.8
11:21:55 AM	75.1
11:22:10 AM	75.5
11:22:25 AM	76.1
11:22:40 AM	76.9
11:22:55 AM	77.4
11:23:10 AM	77.7
11:23:25 AM	77.7
11:23:40 AM	77.9
11:23:55 AM	77.2
11:24:10 AM	76.1
11:24:25 AM	75.8
11:24:40 AM	76.2
11:24:55 AM	76.4
11:25:10 AM	76.7
11:25:25 AM	77
11:25:40 AM	77.2
11:25:55 AM	77.4
11:26:10 AM	77.6
11:26:25 AM	77.8
11:26:40 AM	77.9
11:26:55 AM	78
11:27:10 AM	78.1
11:27:25 AM	78.3
11:27:40 AM	78.4
11:27:55 AM	78.5
11:28:10 AM	78.5
11:28:25 AM	78.6

FIG. 12F

TIME	TECH SAMPLE F (°F)
11:28:40 AM	78.6
11:28:55 AM	77.1
11:29:10 AM	76
11:29:25 AM	75.3
11:29:40 AM	75
11:29:55 AM	74.6
11:30:10 AM	74.6
11:30:25 AM	74.4
11:30:40 AM	74.6
11:30:55 AM	74.4
11:31:10 AM	74.1
11:31:25 AM	73.9
11:31:40 AM	73.7
11:31:55 AM	73.7
11:32:10 AM	73.7
11:32:25 AM	73.7
11:32:40 AM	73.6
11:32:55 AM	73.5
11:33:10 AM	73.4
11:33:25 AM	73.2
11:33:40 AM	73.1
11:33:55 AM	73
11:34:10 AM	73
11:34:25 AM	73.1
11:34:40 AM	73.1
11:34:55 AM	73.1
11:35:10 AM	73
11:35:25 AM	72.8
11:35:40 AM	72.8
11:35:55 AM	72.7
11:36:10 AM	73.3
11:36:25 AM	73.2
11:36:40 AM	72.5

FIG. 12G

TIME	TECH SAMPLE F (°F)
11:36:55 AM	72.1
11:37:10 AM	71.8
11:37:25 AM	71.5
11:37:40 AM	71.3
11:37:55 AM	71.9
11:38:10 AM	72.7

FIG. 12H

TIME	TECH SAMPLE G (°F)
2:13:02 PM	78.2
2:13:17 PM	78.6
2:13:32 PM	78.3
2:13:47 PM	78.1
2:14:02 PM	77
2:14:17 PM	76.6
2:14:32 PM	77.7
2:14:47 PM	77.9
2:15:02 PM	78.3
2:15:17 PM	78.5
2:15:32 PM	78.6
2:15:47 PM	78.6
2:16:02 PM	78.7
2:16:17 PM	78.9
2:16:32 PM	79
2:16:47 PM	79.1
2:17:02 PM	79.1
2:17:17 PM	78.9
2:17:32 PM	78.7
2:17:47 PM	78
2:18:02 PM	78.7
2:18:17 PM	79
2:18:32 PM	79.1
2:18:47 PM	79.1
2:19:02 PM	79.4
2:19:17 PM	79.6
2:19:32 PM	79.9
2:19:47 PM	80.1
2:20:02 PM	80.2
2:20:17 PM	80.3
2:20:32 PM	80.4
2:20:47 PM	80.6

FIG. 13A

TIME	TECH SAMPLE G (°F)
2:21:02 PM	80.4
2:21:17 PM	80.6
2:21:32 PM	80.7
2:21:47 PM	80.6
2:22:02 PM	80.7
2:22:17 PM	80.8
2:22:32 PM	80.7
2:22:47 PM	80.7
2:23:02 PM	80.8
2:23:17 PM	80.8
2:23:32 PM	80.9
2:23:47 PM	80.8
2:24:02 PM	80.8
2:24:17 PM	80.7
2:24:32 PM	80.6
2:24:47 PM	79.8
2:25:02 PM	80.3
2:25:17 PM	80.8
2:25:32 PM	81.1
2:25:47 PM	81.3
2:26:02 PM	81.3
2:26:17 PM	81.3
2:26:32 PM	81.5
2:26:47 PM	81.7
2:27:02 PM	81.7
2:27:17 PM	81.7
2:27:32 PM	81.8
2:27:47 PM	81.8
2:28:02 PM	81.6
2:28:17 PM	81.4
2:28:32 PM	81.3
2:28:47 PM	81.2
2:29:02 PM	81
2:29:17 PM	81.2

FIG. 13B

TIME	TECH SAMPLE G (°F)
2:29:32 PM	81.3
2:29:47 PM	81.5
2:30:02 PM	81.6
2:30:17 PM	81.7
2:30:32 PM	81
2:30:47 PM	81
2:31:02 PM	81.1
2:31:17 PM	81.3
2:31:32 PM	81.2
2:31:47 PM	81.2
2:32:02 PM	81.1
2:32:17 PM	81.1
2:32:32 PM	81
2:32:47 PM	80.9
2:33:02 PM	80.7
2:33:17 PM	80.6
2:33:32 PM	80.3
2:33:47 PM	80.2
2:34:02 PM	80
2:34:17 PM	79.9
2:34:32 PM	79.8
2:34:47 PM	79.8
2:35:02 PM	79.8
2:35:17 PM	79.8
2:35:32 PM	79.6
2:35:47 PM	79.6
2:36:02 PM	79.6
2:36:17 PM	79.5
2:36:32 PM	79.4
2:36:47 PM	79.1
2:37:02 PM	78.7
2:37:17 PM	79.3
2:37:32 PM	79.6

FIG. 13C

TIME	TECH SAMPLE G (°F)
2:37:47 PM	79.7
2:38:02 PM	79.8
2:38:17 PM	80
2:38:32 PM	80.1
2:38:47 PM	80.1
2:39:02 PM	80.2
2:39:17 PM	80
2:39:32 PM	79.6
2:39:47 PM	79.5
2:40:02 PM	79.4
2:40:17 PM	79.5
2:40:32 PM	79.5
2:40:47 PM	79.4
2:41:02 PM	78.1
2:41:17 PM	77.1
2:41:32 PM	77.4
2:41:47 PM	77.5
2:42:02 PM	76.7
2:42:17 PM	76.3
2:42:32 PM	76.3
2:42:47 PM	77
2:43:02 PM	77.3
2:43:17 PM	77.5
2:43:32 PM	77.6
2:43:47 PM	77.8
2:44:02 PM	77.9
2:44:17 PM	77.7
2:44:32 PM	77.5
2:44:47 PM	77.3
2:45:02 PM	77.4
2:45:17 PM	77.4
2:45:32 PM	77.2
2:45:47 PM	77.2

FIG. 13D

TIME	TECH SAMPLE G (°F)
2:46:02 PM	77.4
2:46:17 PM	77.5
2:46:32 PM	77.6
2:46:47 PM	77.7
2:47:02 PM	77.7
2:47:17 PM	77.7
2:47:32 PM	77.8
2:47:47 PM	77.7
2:48:02 PM	77.6
2:48:17 PM	77.4
2:48:32 PM	77.3
2:48:47 PM	77.2
2:49:02 PM	76.9
2:49:17 PM	76.6
2:49:32 PM	76.5
2:49:47 PM	76.4
2:50:02 PM	76.4
2:50:17 PM	76.3
2:50:32 PM	76.2
2:50:47 PM	76.3
2:51:02 PM	76.3
2:51:17 PM	76.2
2:51:32 PM	76.1
2:51:47 PM	76
2:52:02 PM	75.9
2:52:17 PM	76
2:52:32 PM	76
2:52:47 PM	76
2:53:02 PM	75.9
2:53:17 PM	75.7
2:53:32 PM	75.2
2:53:47 PM	75.3
2:54:02 PM	75.1

FIG. 13E

TIME	TECH SAMPLE G (°F)
2:54:17 PM	74.6
2:54:32 PM	73.6
2:54:47 PM	73.8
2:55:02 PM	73.9
2:55:17 PM	73.4
2:55:32 PM	72.9
2:55:47 PM	72.5
2:56:02 PM	72.7
2:56:17 PM	72.7
2:56:32 PM	72.7
2:56:47 PM	71
2:57:02 PM	71.6
2:57:17 PM	71.1
2:57:32 PM	71.1
2:57:47 PM	71.1
2:58:02 PM	71.1
2:58:17 PM	70.7
2:58:32 PM	71.1
2:58:47 PM	71.7
2:59:02 PM	72.1
2:59:17 PM	72.5
2:59:32 PM	72.7
2:59:47 PM	71.9
3:00:02 PM	71.9
3:00:17 PM	72
3:00:32 PM	71.3
3:00:47 PM	71.2
3:01:02 PM	70.6
3:01:17 PM	70.3
3:01:32 PM	70.2
3:01:47 PM	69.9
3:02:02 PM	69.5
3:02:17 PM	69.4

FIG. 13F

TIME	TECH SAMPLE G (°F)
3:02:32 PM	69.3
3:02:47 PM	69.1
3:03:02 PM	68.9
3:03:17 PM	68.9
3:03:32 PM	68.7
3:03:47 PM	68.8
3:04:02 PM	68.9
3:04:17 PM	68.9
3:04:32 PM	68.8
3:04:47 PM	68.9
3:05:02 PM	68.9
3:05:17 PM	68.8
3:05:32 PM	68.6
3:05:47 PM	68.3
3:06:02 PM	68.5
3:06:17 PM	68.4
3:06:32 PM	68.5
3:06:47 PM	68.6
3:07:02 PM	68.6
3:07:17 PM	68.6
3:07:32 PM	68.7
3:07:47 PM	68.3
3:08:02 PM	68.1
3:08:17 PM	68
3:08:32 PM	67.8
3:08:47 PM	67.8
3:09:02 PM	68
3:09:17 PM	67.9
3:09:32 PM	68
3:09:47 PM	68.1
3:10:02 PM	68.5
3:10:17 PM	68.7
3:10:32 PM	68.8

FIG. 13G

TIME	TECH SAMPLE G (°F)
3:10:47 PM	68.9
3:11:02 PM	69
3:11:17 PM	68.3
3:11:32 PM	68.5
3:11:47 PM	67.7
3:12:02 PM	67.7
3:12:17 PM	67.4
3:12:32 PM	68.2
3:12:47 PM	68.3

FIG. 13H

TIME	TECH SAMPLE H (°F)
11:09:04 AM	81.1
11:09:19 AM	81.1
11:09:34 AM	80.9
11:09:49 AM	80.9
11:10:04 AM	80.2
11:10:19 AM	79.8
11:10:34 AM	79.4
11:10:49 AM	79.3
11:11:04 AM	79.2
11:11:19 AM	79.1
11:11:34 AM	79.4
11:11:49 AM	78.9
11:12:04 AM	78.9
11:12:19 AM	78.8
11:12:34 AM	78.7
11:12:49 AM	78.6
11:13:04 AM	78.6
11:13:19 AM	78.6
11:13:34 AM	79.2
11:13:49 AM	79.8
11:14:04 AM	80
11:14:19 AM	80.2
11:14:34 AM	79.5
11:14:49 AM	79.3
11:15:04 AM	79
11:15:19 AM	78.6
11:15:34 AM	79.4
11:15:49 AM	80.4
11:16:04 AM	80.7
11:16:19 AM	80.4
11:16:34 AM	80.4
11:16:49 AM	80

FIG. 14A

TIME	TECH SAMPLE H (°F)
11:17:04 AM	79.4
11:17:19 AM	79.1
11:17:34 AM	78.8
11:17:49 AM	78.8
11:18:04 AM	78.9
11:18:19 AM	79.6
11:18:34 AM	79.9
11:18:49 AM	79.8
11:19:04 AM	79.1
11:19:19 AM	79.3
11:19:34 AM	78.6
11:19:49 AM	77.8
11:20:04 AM	78.4
11:20:19 AM	79.1
11:20:34 AM	80
11:20:49 AM	80.6
11:21:04 AM	80.9
11:21:19 AM	80.7
11:21:34 AM	79.6
11:21:49 AM	80.6
11:22:04 AM	80.7
11:22:19 AM	79.5
11:22:34 AM	80.3
11:22:49 AM	80
11:23:04 AM	80
11:23:19 AM	79.7
11:23:34 AM	79.6
11:23:49 AM	79.5
11:24:04 AM	79.4
11:24:19 AM	79.2
11:24:34 AM	79.1
11:24:49 AM	78.6
11:25:04 AM	78.3

FIG. 14B

TIME	TECH SAMPLE H (°F)
11:25:19 AM	78.7
11:25:34 AM	78.7
11:25:49 AM	78.5
11:26:04 AM	77.4
11:26:19 AM	76.7
11:26:34 AM	76.5
11:26:49 AM	77.2
11:27:04 AM	77.8
11:27:19 AM	78
11:27:34 AM	77.8
11:27:49 AM	77.6
11:28:04 AM	77.7
11:28:19 AM	78.2
11:28:34 AM	78.3
11:28:49 AM	78.4
11:29:04 AM	78.6
11:29:19 AM	78.8
11:29:34 AM	78.5
11:29:49 AM	78.1
11:30:04 AM	77.9
11:30:19 AM	77.6
11:30:34 AM	77.8
11:30:49 AM	77.6
11:31:04 AM	77.5
11:31:19 AM	77.2
11:31:34 AM	77.1
11:31:49 AM	77.2
11:32:04 AM	77.2
11:32:19 AM	77
11:32:34 AM	76.4
11:32:49 AM	76.6
11:33:04 AM	76.6
11:33:19 AM	76.6

FIG. 14C

TIME	TECH SAMPLE H (°F)
11:33:34 AM	76.3
11:33:49 AM	75.6
11:34:04 AM	75.2
11:34:19 AM	74.9
11:34:34 AM	74.8
11:34:49 AM	74.8
11:35:04 AM	74.7
11:35:19 AM	74.3
11:35:34 AM	74
11:35:49 AM	74
11:36:04 AM	73.8
11:36:19 AM	74.2
11:36:34 AM	74.8
11:36:49 AM	74.9
11:37:04 AM	74.5
11:37:19 AM	74
11:37:34 AM	73.9
11:37:49 AM	73.9
11:38:04 AM	73.6
11:38:19 AM	73.3
11:38:34 AM	73.6
11:38:49 AM	73
11:39:04 AM	72.3
11:39:19 AM	72.4
11:39:34 AM	72.8
11:39:49 AM	72.4
11:40:04 AM	71.9
11:40:19 AM	71.9
11:40:34 AM	72
11:40:49 AM	71.8
11:41:04 AM	71.6
11:41:19 AM	71.6
11:41:34 AM	71.1

FIG. 14D

TIME	TECH SAMPLE H (°F)
11:41:49 AM	70.2
11:42:04 AM	70.2
11:42:19 AM	70.1
11:42:34 AM	70.1
11:42:49 AM	71.4
11:43:04 AM	71.5
11:43:19 AM	71.3
11:43:34 AM	71.3
11:43:49 AM	71.3
11:44:04 AM	71.3
11:44:19 AM	71.3
11:44:34 AM	70.7
11:44:49 AM	69.6
11:45:04 AM	70.1
11:45:19 AM	71
11:45:34 AM	71.3
11:45:49 AM	71.9
11:46:04 AM	71.1
11:46:19 AM	70.4
11:46:34 AM	70.1
11:46:49 AM	69.9
11:47:04 AM	70.1
11:47:19 AM	70.4
11:47:34 AM	70.6
11:47:49 AM	72
11:48:04 AM	72.4
11:48:19 AM	72.5
11:48:34 AM	72.5
11:48:49 AM	72.5
11:49:04 AM	72.5
11:49:19 AM	72.5
11:49:34 AM	72.4
11:49:49 AM	72.5

FIG. 14E

TIME	TECH SAMPLE H (°F)
11:50:04 AM	72.5
11:50:19 AM	72.4
11:50:34 AM	72.3
11:50:49 AM	72.1
11:51:04 AM	72.2
11:51:19 AM	72.2
11:51:34 AM	72.4
11:51:49 AM	72.5
11:52:04 AM	71.9
11:52:19 AM	71.9
11:52:34 AM	72.5
11:52:49 AM	72.4
11:53:04 AM	72.3
11:53:19 AM	72.3
11:53:34 AM	72.6
11:53:49 AM	72.9
11:54:04 AM	72.6
11:54:19 AM	71.5
11:54:34 AM	71.6
11:54:49 AM	70.3
11:55:04 AM	70.9
11:55:19 AM	70.1
11:55:34 AM	70.5
11:55:49 AM	70.1
11:56:04 AM	69.9
11:56:19 AM	70.1
11:56:34 AM	69.8
11:56:49 AM	69.8
11:57:04 AM	69.8
11:57:19 AM	70.4
11:57:34 AM	70.9
11:57:49 AM	71.3
11:58:04 AM	71.4
11:58:19 AM	71.2

FIG. 14F

TIME	TECH SAMPLE H (°F)
11:58:34 AM	71.3
11:58:49 AM	71.6
11:59:04 AM	72.1
11:59:19 AM	72.4
11:59:34 AM	72.5
11:59:49 AM	72.5
12:00:04 PM	71.9
12:00:19 PM	71.4
12:00:34 PM	71.2
12:00:49 PM	71.6
12:01:04 PM	71.5
12:01:19 PM	70.5
12:01:34 PM	70.1
12:01:49 PM	69.9
12:02:04 PM	69.7
12:02:19 PM	69.7
12:02:34 PM	69.6
12:02:49 PM	69.7
12:03:04 PM	70
12:03:19 PM	70.4
12:03:34 PM	70.3
12:03:49 PM	70.3
12:04:04 PM	70
12:04:19 PM	69.8
12:04:34 PM	69.8
12:04:49 PM	69.8
12:05:04 PM	69.7
12:05:19 PM	69.5
12:05:34 PM	69.1
12:05:49 PM	68.8
12:06:04 PM	69.3
12:06:19 PM	69.4
12:06:34 PM	69.4
12:06:49 PM	69.7

FIG. 14G

TIME	TECH SAMPLE H (°F)
12:07:04 PM	68.6
12:07:19 PM	68.8
12:07:34 PM	68.3
12:07:49 PM	67.8
12:08:04 PM	68.4
12:08:19 PM	69

FIG. 14H

TIME	TEST SAMPLE I (°F)
11:05:19 AM	82.8
11:05:34 AM	82.9
11:05:49 AM	83
11:06:04 AM	83.1
11:06:19 AM	83
11:06:34 AM	83.4
11:06:49 AM	82.1
11:07:04 AM	81.3
11:07:19 AM	81.5
11:07:34 AM	81.2
11:07:49 AM	81
11:08:04 AM	81.1
11:08:19 AM	81.2
11:08:34 AM	81.1
11:08:49 AM	80.7
11:09:04 AM	80.7
11:09:19 AM	80.8
11:09:34 AM	80.7
11:09:49 AM	80.8
11:10:04 AM	81
11:10:19 AM	81.9
11:10:34 AM	81.8
11:10:49 AM	82.2
11:11:04 AM	82.5
11:11:19 AM	82.6
11:11:34 AM	82.7
11:11:49 AM	82.8
11:12:04 AM	83
11:12:19 AM	82.9
11:12:34 AM	82.9
11:12:49 AM	82.9
11:13:04 AM	83.5

FIG. 15A

TIME	TEST SAMPLE I (°F)
11:13:19 AM	83.8
11:13:34 AM	83.9
11:13:49 AM	84
11:14:04 AM	84.1
11:14:19 AM	84.3
11:14:34 AM	84.4
11:14:49 AM	84.4
11:15:04 AM	84.5
11:15:19 AM	84.6
11:15:34 AM	84.7
11:15:49 AM	84.1
11:16:04 AM	83.2
11:16:19 AM	83
11:16:34 AM	82.7
11:16:49 AM	83.1
11:17:04 AM	83.3
11:17:19 AM	83.6
11:17:34 AM	83.6
11:17:49 AM	83.7
11:18:04 AM	83.6
11:18:19 AM	83.6
11:18:34 AM	83.6
11:18:49 AM	83.4
11:19:04 AM	83.4
11:19:19 AM	82.5
11:19:34 AM	82.1
11:19:49 AM	82.1
11:20:04 AM	82.6
11:20:19 AM	82.9
11:20:34 AM	83
11:20:49 AM	82.7
11:21:04 AM	82.8

FIG. 15B

TIME	TEST SAMPLE I (°F)
11:21:19 AM	83.2
11:21:34 AM	83.2
11:21:49 AM	83.2
11:22:04 AM	83.4
11:22:19 AM	83.5
11:22:34 AM	83.6
11:22:49 AM	83.6
11:23:04 AM	83.6
11:23:19 AM	83.6
11:23:34 AM	83.7
11:23:49 AM	83.6
11:24:04 AM	83.7
11:24:19 AM	83.7
11:24:34 AM	83.8
11:24:49 AM	83.9
11:25:04 AM	84
11:25:19 AM	84
11:25:34 AM	84.1
11:25:49 AM	84
11:26:04 AM	84.1
11:26:19 AM	83.9
11:26:34 AM	83.7
11:26:49 AM	83.7
11:27:04 AM	83.6
11:27:19 AM	83.6
11:27:34 AM	83.7
11:27:49 AM	83.7
11:28:04 AM	83.6
11:28:19 AM	83.6
11:28:34 AM	83.6
11:28:49 AM	83.7
11:29:04 AM	83.7

FIG. 15C

TIME	TEST SAMPLE I (°F)
11:29:19 AM	83.7
11:29:34 AM	83.7
11:29:49 AM	83.5
11:30:04 AM	83.6
11:30:19 AM	83.5
11:30:34 AM	83.5
11:30:49 AM	83.6
11:31:04 AM	83.5
11:31:19 AM	83.4
11:31:34 AM	83.4
11:31:49 AM	83.2
11:32:04 AM	83.5
11:32:19 AM	83.5
11:32:34 AM	83.6
11:32:49 AM	83.7
11:33:04 AM	83.7
11:33:19 AM	83.7
11:33:34 AM	83.7
11:33:49 AM	83.5
11:34:04 AM	83.3
11:34:19 AM	83.4
11:34:34 AM	82.9
11:34:49 AM	81.8
11:35:04 AM	82.1
11:35:19 AM	81.8
11:35:34 AM	81.5
11:35:49 AM	80
11:36:04 AM	79.9
11:36:19 AM	80.8
11:36:34 AM	81.2
11:36:49 AM	81.4
11:37:04 AM	81.3

FIG. 15D

TIME	TEST SAMPLE I (°F)
11:37:19 AM	81.4
11:37:34 AM	81.5
11:37:49 AM	81.6
11:38:04 AM	81.7
11:38:19 AM	81.7
11:38:34 AM	81.7
11:38:49 AM	81.7
11:39:04 AM	81.5
11:39:19 AM	81.1
11:39:34 AM	80.8
11:39:49 AM	80.4
11:40:04 AM	80
11:40:19 AM	80.3
11:40:34 AM	80.7
11:40:49 AM	80.7
11:41:04 AM	80.9
11:41:19 AM	81
11:41:34 AM	81.1
11:41:49 AM	80.9
11:42:04 AM	80.6
11:42:19 AM	80.7
11:42:34 AM	80.8
11:42:49 AM	80.7
11:43:04 AM	80.6
11:43:19 AM	80.7
11:43:34 AM	80.8
11:43:49 AM	80.8
11:44:04 AM	80.8
11:44:19 AM	80.8
11:44:34 AM	80.6
11:44:49 AM	80.3
11:45:04 AM	80.2

FIG. 15E

TIME	TEST SAMPLE I (°F)
11:45:19 AM	80
11:45:34 AM	79.6
11:45:49 AM	79.1
11:46:04 AM	78.9
11:46:19 AM	79.3
11:46:34 AM	79.3
11:46:49 AM	79.2
11:47:04 AM	79.3
11:47:19 AM	79.2
11:47:34 AM	79
11:47:49 AM	79
11:48:04 AM	78.6
11:48:19 AM	78.5
11:48:34 AM	78.4
11:48:49 AM	78.1
11:49:04 AM	77.5
11:49:19 AM	77.5
11:49:34 AM	76.7
11:49:49 AM	77.5
11:50:04 AM	77.9
11:50:19 AM	77.9
11:50:34 AM	78
11:50:49 AM	78.2
11:51:04 AM	78.1
11:51:19 AM	78
11:51:34 AM	78
11:51:49 AM	77.9
11:52:04 AM	77.7
11:52:19 AM	77.6
11:52:34 AM	77.5
11:52:49 AM	77.5
11:53:04 AM	77.3

FIG. 15F

TIME	TEST SAMPLE I (°F)
11:53:19 AM	77.1
11:53:34 AM	76
11:53:49 AM	76.9
11:54:04 AM	76.8
11:54:19 AM	77
11:54:34 AM	77.1
11:54:49 AM	77
11:55:04 AM	76.8
11:55:19 AM	76.6
11:55:34 AM	76.9
11:55:49 AM	77
11:56:04 AM	76.9
11:56:19 AM	76.6
11:56:34 AM	76.5
11:56:49 AM	76.4
11:57:04 AM	76.3
11:57:19 AM	76.2
11:57:34 AM	76.2
11:57:49 AM	76.2
11:58:04 AM	76.2
11:58:19 AM	76.3
11:58:34 AM	76.1
11:58:49 AM	76.1
11:59:04 AM	75.7
11:59:19 AM	75.2
11:59:34 AM	75.5
11:59:49 AM	75.3
12:00:04 PM	74.1
12:00:19 PM	74.4
12:00:34 PM	73.9
12:00:49 PM	73.9
12:01:04 PM	74.4

FIG. 15G

TIME	TEST SAMPLE I (°F)
12:01:19 PM	74.4
12:01:34 PM	74.3
12:01:49 PM	74.1
12:02:04 PM	73.6
12:02:19 PM	73.2
12:02:34 PM	72.7
12:02:49 PM	72.5
12:03:04 PM	72.6
12:03:19 PM	72.5
12:03:34 PM	72.1
12:03:49 PM	71.9
12:04:04 PM	71.9
12:04:19 PM	71.8
12:04:34 PM	71.9
12:04:49 PM	72.2

FIG. 15H

ENERGY HARVESTING, HEAT MANAGING, MULTI-EFFECT THERAPEUTIC GARMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to and the benefit of provisional patent application No. 62/200,124 titled "Energy Harvesting, Heat Managing, Multi-effect Therapeutic Garment", filed in the United States Patent and Trademark Office on Aug. 3, 2015. The specification of the above referenced patent application is incorporated herein by reference in its entirety.

BACKGROUND

Raynaud's syndrome, aggravation of arthritis in hands and feet, cold hands and feet, and discoloration of fingers and toes in cold weather are caused by reduced blood flow to hands, fingers, and toes in cold weather. This condition where blood supply to the fingers or the toes is significantly reduced due to narrowing of blood vessels, due to which, for example, skin turns pale or white and becomes cold and numb due to cold weather is called vasospasm. Persons suffering from vasospasm may also experience thickening of blood vessels in their fingers and toes over time, thereby further limiting the blood flow. Vasospasm over a prolonged period of time can lead to tissue death. Raynaud's syndrome is managed primarily by treating the underlying cause and avoiding triggers, for example, cold conditions, keeping a warm core body temperature by dressing for cold weather in layers and wearing gloves or heavy socks, etc. Most garments with active heat management features use electric heating, single use or re-useable heating cartridges or inserts, microwaveable gels, or other organic materials in a lining of the garment, etc., to provide heat to persons suffering from Raynaud's syndrome and/or arthritis. In these conventional heat management methods, additional heat is introduced into the garment by using additional, relatively cumbersome devices, which restrict movement and provide discomfort to a wearer.

Hence, there is a long felt need for an energy harvesting, heat managing, multi-effect therapeutic garment that harvests energy from both a wearer's interaction with the therapeutic garment and ambient environment, and converts the harvested energy into heat energy that can be stored and distributed within the therapeutic garment without any additional device for introducing and maintaining heat within the therapeutic garment.

SUMMARY OF THE INVENTION

This summary is provided to introduce a selection of concepts in a simplified form that are further disclosed in the detailed description of the invention. This summary is not intended to determine the scope of the claimed subject matter.

The energy harvesting, heat managing, multi-effect therapeutic garment, herein referred to as a "therapeutic garment", and method of construction thereof, address the above mentioned need for harvesting energy from both a wearer's interaction with the therapeutic garment and ambient environment, and converting the harvested energy into heat energy that can be stored and distributed within the therapeutic garment without any additional device, for example, a heat cartridge, a heatable insert, microwaveable gels, battery, charger, etc., for introducing and maintaining

heat within the therapeutic garment. The therapeutic garment disclosed herein is made from a combination of a predetermined number of yarns, for example, at least three yarns defining an inner surface and at least one yarn defining an outer surface of the therapeutic garment. The yarns are knitted in a single piece free of seams as a complete garment or as a whole garment, thereby providing an improved fit with improved construction integrity.

The therapeutic garment disclosed herein comprises an enclosure configured to conform to a wearer's body part, for example, the wearer's hand, feet, torso, or any other part of the wearer's body. The enclosure comprises an inner surface and an outer surface, the inner surface being proximal to the wearer's body part and the outer surface being distal to the wearer's body part when the wearer is wearing the enclosure. The therapeutic garment comprises a combination of a predetermined number of yarns knitted to create the enclosure. The yarns comprise a first yarn for absorbing, storing, and releasing heat energy through a phase change, a second yarn for converting the heat energy into far infrared radiation energy and radiating the far infrared radiation energy to other of the yarns and to the wearer's body part, a third yarn for adsorbing moisture from the wearer's body part and/or ambient environment and generating heat energy through an exothermic reaction between the moisture and desiccant type crystals contained in the third yarn, a fourth yarn for converting ultraviolet radiation energy from sunlight into far infrared radiation energy and radiating the far infrared radiation energy to other of the yarns and to the wearer's body part, a fifth yarn for providing heat insulation and for repelling water, and a sixth yarn for conducting heat and maintaining a uniform temperature within the yarns. A bundle of inner yarns selected from the predetermined number of yarns disclosed above is knitted with a bundle of outer yarns selected from the predetermined number of yarns disclosed above to define the inner surface and the outer surface of the enclosure respectively. The bundle of inner yarns is knitted with the bundle of outer yarns to create a uniform surface area distribution of the inner yarns and the outer yarns on the inner surface and the outer surface of the enclosure respectively. Knitting of the bundle of inner yarns and the bundle of outer yarns produces interwoven inner yarns and interwoven outer yarns, respectively. The interwoven inner yarns are exposed on the inner surface of the enclosure and the interwoven outer yarns are exposed on the outer surface of the enclosure. The interwoven inner yarns and the interwoven outer yarns contact each other and cover the wearer's body part when the therapeutic garment is worn by the wearer.

Disclosed herein is also a method for constructing the therapeutic garment with self-contained heat management capabilities. In the method disclosed herein, multiple yarns as disclosed above are provided and an enclosure configured to conform to the wearer's body part is created as follows. A predetermined number of inner yarns and a predetermined number of outer yarns are selected from the yarns disclosed above. The selected inner yarns are wound onto a first set of spools and the selected outer yarns are wound onto a second set of spools. A bundle of the selected inner yarns and a bundle of the selected outer yarns are created by pulling the selected inner yarns from the first set of spools and by pulling the selected outer yarns from the second set of spools, respectively. The created bundle of the selected inner yarns and the created bundle of the selected outer yarns are fed into a knitting machine via a feeder. The fed bundle of the selected inner yarns is knit with the fed bundle of the selected outer yarns in the knitting machine to create the enclosure conforming to the wearer's body part. The knitted bundle of the selected inner yarns defines the inner surface of the enclosure and the knitted bundle of the selected outer yarns defines the outer surface of the enclosure. The knitted bundle of the selected inner yarns is exposed on the inner surface of the enclosure and the knitted bundle of the selected outer yarns is exposed on the outer surface of the enclosure. The positions of the inner yarns and the outer yarns are consistently maintained relative to each other to create a uniform surface area distribution of the inner yarns and the outer yarns on the inner surface and the outer surface of the enclosure, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of the invention, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, exemplary constructions of the invention are shown in the drawings. However, the invention is not limited to the specific structures and methods disclosed herein. The description of a structure or a method step referenced by a numeral in a drawing is applicable to the description of that structure or method step shown by that same numeral in any subsequent drawing herein.

FIG. **1**A exemplarily illustrates an energy harvesting, heat managing, multi-effect therapeutic garment configured as a therapeutic glove.

FIG. **1**B exemplarily illustrates an enlarged view of a portion of the energy harvesting, heat managing, multi-effect therapeutic garment shown in FIG. **1**A, showing inner yarns knitted with outer yarns.

FIG. **2** illustrates a method for constructing an energy harvesting, heat managing, multi-effect therapeutic garment with self-contained heat management capabilities.

FIG. **3**A exemplarily illustrates a yarn bundle creation machine for creating a bundle of inner yarns from a first set of spools.

FIG. **3**B exemplarily illustrates an enlarged view of a twisting machine incorporated within the yarn bundle creation machine for creating a twisted bundle of inner yarns.

FIG. **3**C exemplarily illustrates creation of the twisted bundle of inner yarns from the first set of spools.

FIG. **3**D exemplarily illustrates a yarn bundle creation machine for creating a bundle of outer yarns from a second set of spools.

FIG. **3**E exemplarily illustrates creation of a twisted bundle of outer yarns from the second set of spools.

FIG. **4**A exemplarily illustrates feeding of the twisted bundle of inner yarns and the twisted bundle of outer yarns into a plaiting feeder.

FIG. **4**B exemplarily illustrates an enlarged view of a guide element of the plaiting feeder shown in FIG. **4**A.

FIG. **5**A exemplarily illustrates feeding of the twisted bundle of inner yarns and the twisted bundle of outer yarns into a single knitting needle.

FIG. **5**B exemplarily illustrates knitting of the twisted bundle of inner yarns with the twisted bundle of outer yarns using a single knitting needle.

FIG. **5**C exemplarily illustrates positions of the twisted bundle of inner yarns and the twisted bundle of outer yarns in a knit pattern created using multiple knitting needles.

FIGS. **6**A-**6**B exemplarily illustrate energy harvesting, heat managing, multi-effect therapeutic garments configured as therapeutic gloves and constructed in accordance with the method exemplarily illustrated in FIG. **2**.

FIG. **7** exemplarily illustrates an energy harvesting, heat managing, multi-effect therapeutic garment configured as a therapeutic glove and seamlessly constructed to provide a snug fit across a palm of a wearer.

FIGS. **8**A-**8**B exemplarily illustrate tables containing construction data of yarns in multiple test samples of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **9**A-**9**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample A and test sample B of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **10**A-**10**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample D and test sample C of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **11**A-**11**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample E of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **12**A-**12**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample F of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **13**A-**13**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample G of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **14**A-**14**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample H of the energy harvesting, heat managing, multi-effect therapeutic garment.

FIGS. **15**A-**15**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample I of the energy harvesting, heat managing, multi-effect therapeutic garment.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1**A exemplarily illustrates an energy harvesting, heat managing, multi-effect therapeutic garment **100**, herein referred to as a "therapeutic garment", configured as a therapeutic glove. For purposes of illustration, the detailed description refers to the therapeutic garment **100** configured as a therapeutic glove; however the scope of the therapeutic garment **100** disclosed herein is not limited to be configured as a therapeutic glove, but may be extended to be configured as a therapeutic sock to be worn on a wearer's foot, a therapeutic undergarment, a therapeutic T-shirt, or any other type of garment that can be worn on a wearer's body part, for example, hands, feet, torso, or any other part of the wearer's body to provide heat to the wearer. The therapeutic garment **100** comprises an enclosure **101** configured to conform to a wearer's body part, for example, the wearer's hand. The enclosure **101** is configured, for example, as a glove. The enclosure **101** comprises an inner surface **101**_a_ and an outer surface **101**_b_ defining a finger section **101**_c_ and a palm section **101**_d_ of the therapeutic garment **100**. The inner surface **101**_a_ is proximal to the wearer's body part and the outer surface **101**_b_ is distal to the wearer's body part when the wearer is wearing the enclosure **101**. The therapeutic garment **100** disclosed herein addresses needs of persons who suffer, for example, from Raynaud's syndrome and/or rheumatoid arthritis in their hands and feet, or those who suffer from cold hands and feet in cold weather. The therapeutic garment **100** disclosed herein further comprises a combination of a predetermined number of yarns knitted to create the enclosure **101**. The therapeutic garment **100** disclosed herein is made from a combination of a predetermined number of yarns for defining the inner surface **101***a* and the outer surface **101***b* of the therapeutic garment **100**. The predetermined number of yarns of the therapeutic garment **100** is knitted by a knitted construction that maintains the positions of the predetermined number of yarns relative to each other.

FIG. **1**B exemplarily illustrates an enlarged view of a portion of the energy harvesting, heat managing, multi-effect therapeutic garment **100** shown in FIG. **1**A, showing inner yarns **102** knitted with outer yarns **103**. A bundle of inner yarns **102** selected from the predetermined number of yarns is knitted with a bundle of outer yarns **103** selected from the predetermined number of yarns to define the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** exemplarily illustrated in FIG. **1**A, respectively, and to create a uniform surface area distribution of the inner yarns **102** and the outer yarns **103** on the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** respectively. The knitted bundle of inner yarns **102** is exposed on the inner surface **101***a* of the enclosure **101** and the knitted bundle of outer yarns **103** is exposed on the outer surface **101***b* of the enclosure **101**. The knitted bundle of inner yarns **102** and the knitted bundle of outer yarns **103** contact each other and cover the wearer's body part, for example, the skin on the wearer's hand when the therapeutic garment **100** is worn by the wearer.

The bundle of inner yarns **102** and the bundle of outer yarns **103** are selected from the following yarns **101***a*, **101***b*, **101***c*, **101***d*, **102***a*, **102***b*, and **102***c* as exemplarily illustrated in FIG. **3**A and FIGS. **3**C-**3**E: a first yarn **102***a* for absorbing, storing, and releasing heat energy through a phase change; a second yarn **102***b* for converting the heat energy into far infrared radiation energy and for radiating the far infrared radiation energy to other yarns and to a wearer's body part; a third yarn **102***c* for adsorbing moisture from the wearer's body part and/or the ambient environment and for generating heat energy through an exothermic reaction between the moisture and desiccant type crystals contained in the third yarn **102***c;* a fourth yarn **103***a* for converting ultraviolet radiation energy from sunlight into far infrared radiation energy and for radiating the far infrared radiation energy to other yarns and to the wearer's body part; a fifth yarn **103***b* that is heat resistant and provides heat insulation and is hydrophobic, that is, water repellant; and a sixth yarn **102***d* for conducting heat and maintaining a uniform temperature, that is, an even distribution of temperature within the yarns.

At least three of the yarns in the bundle of inner yarns **102** are selected from the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d* exemplarily illustrated in FIG. **3**A, to define the inner surface **101***a* of the enclosure **101**. In an embodiment, the bundle of inner yarns **102** that defines the inner surface **101***a* of the enclosure **101** comprise the first yarn **102***a*, the second yarn **102***b*, and the third yarn **102***c*. In another embodiment, the bundle of inner yarns **102** that defines the inner surface **101***a* of the enclosure **101** comprises the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d*. The functionality, structure, and/or material of the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d* that define the inner surface **101***a* of the therapeutic garment **100** are disclosed below.

The first yarn **102***a* is made of a phase change material for absorbing, storing, and releasing heat energy similar to a heat battery through a physical chemical process called phase change. As used herein, "phase change material (PCM)" refers to a substance that undergoes a process of phase change, for example, from a solid phase to a liquid phase and vice versa. The phase change material absorbs, stores, and releases heat energy as the phase change material oscillates between a solid phase and a liquid phase. The phase change functionality in the first yarn **102***a* comes from micron size droplets of paraffin or similar phase change materials that change between a liquid phase and a solid phase, which are encapsulated in the first yarn **102***a.* When heated, the phase change material droplets contained in the first yarn **102***a* change to a liquid phase, and when cooled, the phase change material droplets contained in the first yarn **102***a* change to a solid phase. Heat energy is released as the phase change material changes to a solid phase and heat energy is absorbed as the phase change material returns to a liquid phase. Phase change in the phase change material is dependent on the temperature range that is just above and just below human skin temperature. The first yarn **102***a* with its phase change material stores heat generated by the wearer. In an embodiment, the phase change material applied to the first yarn **102***a* is in the 100 micron to 100,000 micron range. In an embodiment, the phase change material is sprayed onto the first yarn **102***a.* Furthermore, the phase change material in the first yarn **102***a* provides a heat buffering functionality to the first yarn **102***a.* The first yarn **102***a* therefore functions as a heat buffer and minimizes temperature swings in the therapeutic garment **100**, thereby providing a uniform temperature within the therapeutic garment **100**. An example of the first yarn **102***a* is the Outlast® phase change yarn of Outlast Technologies, LLC, Golden, Colo.

The second yarn **102***b* conductively harvests the wearer's body heat and the heat energy from the first yarn **102***a* and converts the harvested heat energy into far infrared radiation energy that radiates far infrared heat. The wavelength of the far infrared radiation is in a range of, for example, about 1 micrometer (μm) to about 10 μm. The second yarn **102***b* comprises multiple bioceramic particles. The bioceramic particles are, for example, boron-silicate minerals or tourmaline in a nanoparticle form embedded in the second yarn **102***b.* The bioceramic particles are minerals with photo thermal properties. The bioceramic particles emit and/or reflect far infrared thermal radiation when heated. The far infrared thermal radiation promotes molecular vibration leading to increased cellular metabolism and cell membrane permeability, thereby triggering biochemical changes that stimulate the exchange of metabolites and adenosine triphosphate (ATP) synthesis, up-regulation of chemical mediators that play a role in edema formation, pH regulation, free radicals metabolism, and microcirculation. Therefore, the molecular vibration due to the far infrared radiation results in physiological effects essential to the healing process, for example, pain relief, decrease of inflammatory processes, re-absorption of edema, and nerve or lymphatic vessel regeneration. Far infrared rays can penetrate the wearer's skin and underlying tissues, and generate heat by causing subcutaneous proteins, collagens, fats, and water molecules to vibrate, elevating tissue temperatures and causing blood vessels to dilate. The improvement in blood circulation delivers more oxygen to the tissues, thereby providing a range of therapeutic effects. An example of the second yarn **102***b* is the NILIT® Innergy yarn of NILIT Limited Corporation, Maurizio Levi Road, P.O. Box 276, Ramat Gabriel, Migdal Haemek, 2310201, Israel.

The third yarn **102***c* generates heat energy by adsorbing moisture from perspiration of the wearer and/or from humidity in the ambient environment. The third yarn **102***c* comprises desiccant type crystals, for example, silica crystals for adsorbing moisture and releasing heat. The adsorbed moisture and the desiccant type crystals contained in the third yarn **102***c* undergo an exothermic reaction to generate heat energy. An example of the third yarn **102***c* is the eks® yarn of Toyobo Co., Ltd., Osaka, Japan.

The sixth yarn **102***d* functions to maintain a uniform temperature within the combination of the predetermined number of yarns, for example, using carbon nanotube technology. The sixth yarn **102***d* is a carbon nanofiber. Carbon nanofibers are seamless, cylindrical, hollow, and lightweight fibers, comprising a single sheet of pure graphite. The type of bond holding graphite atoms together has substantial strength, and a hexagonal pattern of the graphite atoms gives rise to a phenomenon known as electron delocalization. The graphite atoms vibrate to move heat through the nanotube structure of the carbon nanofiber, thereby providing high thermal and electrical conductivity within the therapeutic garment **100**. The thermal conductivity of the sixth yarn **102***d* functions to equalize temperature distribution within the therapeutic garment **100**. The sixth yarn **102***d* equalizes temperature between the palm section **101***d* and the finger section **101***c* of the enclosure **101** exemplarily illustrated in FIG. **1**A, by transferring heat from the palm section **101***d* to the finger section **101***c* of the enclosure **101**. As the inner palm is the warmest part of the wearer's hand, the sixth yarn **102***d* exposed on the inner surface **101***a* of the enclosure **101** configured, for example, as a glove, equalizes the temperature between the inner palm and colder fingers by conducting heat from the palm section **101***d* of the enclosure **101** to the finger section **101***c* of the enclosure **101**. An example of the sixth yarn **102***d* is the Miralon™ yarn by Nanocomp Technologies, Inc., Merrimack, N.H.

At least one of the yarns in the bundle of outer yarns **103** is selected from the third yarn **102***c,* the fourth yarn **103***a,* and the fifth yarn **103***b* exemplarily illustrated in FIG. **3**D, to define the outer surface **101***b* of the enclosure **101**. In an embodiment, the bundle of outer yarns **103** that defines the outer surface **101***b* of the enclosure **101** comprises the third yarn **102***c* and the fifth yarn **103***b*. In another embodiment, the bundle of outer yarns **103** that defines the outer surface **101***b* of the enclosure **101** comprises the fourth yarn **103***a* and the fifth yarn **103***b*. In another embodiment, the bundle of outer yarns **103** that defines the outer surface **101***b* of the enclosure **101** comprises the third yarn **102***c,* the fourth yarn **103***a,* and the fifth yarn **103***b*. In another embodiment, the bundle of outer yarns **103** that defines the outer surface **101***b* of the enclosure **101** comprises multiple threads of the fifth yarn **103***b*. In an embodiment, the bundle of outer yarns **103** comprises a supplementary yarn **103***c,* for example, a **40** denier spandex yarn bundled with at least one of the third yarn **102***c,* the fourth yarn **103***a,* and the fifth yarn **103***b* to define the outer surface **101***b* of the enclosure **101**. The third yarn **102***c,* the fourth yarn **103***a,* the fifth yarn **103***b,* and the supplementary yarn **103***c* that define the outer surface **101***b* of the enclosure **101** are disclosed below:

The third yarn **102***c* in the bundle of outer yarns **103** is disclosed above in the description of the bundle of inner yarns **102**. The fourth yarn **103***a* in the bundle of outer yarns **103** is exposed on the outer surface **101***b* of the enclosure **101** for exposure to ultraviolet radiation. The wavelength of the ultraviolet radiation is in a range of, for example, about 10 nanometers (nm) to about 380 nm. An example of the fourth yarn **103***a* is CERAM® A of Japan Exlan Co., Ltd., Osaka, Japan.

The fifth yarn **103***b* is an olefin or polypropylene fiber, with low specific gravity, low thermal conductivity, and high insulting properties. The fifth yarn **103***b* is heat insulating and hydrophobic and therefore repels water to reduce an intrusion of unwanted outside cold weather into the therapeutic garment **100**. The fifth yarn **103***b* is bacteria and micro-organism resistant, water resistant, fade resistant, and resistant to most acids. The heat insulating function of the fifth yarn **103***b* keeps the cold out and locks the warmth of the inner surface **101***a* within the therapeutic garment **100**. An example of the fifth yarn **103***b* is Prolen® by Chemosvit Fibrochem, Štúrova, Slovakia.

The supplementary yarn **103***c* enhances heat conductivity between the wearer's body part and the inner surface **101***a* of the enclosure **101**. An example of the supplementary yarn **103***c* is, for example, a 40 denier spandex. The supplementary yarn **103***c* also allows the therapeutic garment **100** to have a snug fit on the wearer's body part. The supplementary yarn **103***c* has significant elasticity made of a polyester-polyurethane copolymer, for example, Lycra® of the INVISTA company, Wichita, Kans.

The therapeutic garment **100** maintains the wearer's skin temperature at a comfortable level by combining conductive heat transfer and heat radiation within the therapeutic garment **100** and between the therapeutic garment **100** and the wearer's body part. This multi-effect heat transfer and the therapeutic performance of the therapeutic garment **100** are achieved by interactions between the yarns disclosed above and between the yarns and the wearer of the therapeutic garment **100**, as a result of the combination of at least three of several different yarn configurations in the entire therapeutic garment **100** or in specific areas of the therapeutic garment **100**.

The interactions between the yarns further improve when the therapeutic garment **100** has an inner surface **101***a* and an outer surface **101***b* as exemplarily illustrated in FIG. **1**A. The first yarn **102***a* absorbs far infrared radiation energy in the range of, for example, about 1 μm to about 10 μm from the second yarn **102***b* and the fourth yarn **103***a* and conductively receives heat energy from the third yarn **102***c* by physical contact with the third yarn **102***c*. The first yarn **102***a* with the heat buffering effect of the phase change material, in conjunction with the sixth yarn **102***d* having high heat conductivity, affects a uniform temperature within the combination of the predetermined number of yarns. The second yarn **102***b,* the third yarn **102***c,* and the fourth yarn **103***a* interact with each other and with the wearer's body part and/or the ambient environment to harvest heat energy. The second yarn **102***b* and the fourth yarn **103***a* provide a deep, gentle heating to the wearer's body part by radiating the far infrared radiation energy into the other yarns, and also back to skin tissues of the wearer's body part. The hydrophobic property of the fifth yarn **103***b* removes moisture when the fifth yarn **103***b* is in contact with the third yarn **102***c,* thereby allowing the exothermic process between the moisture and desiccant type crystals contained in the third yarn **102***c* to progress without reaching equilibrium or saturation.

The inner surface **101***a* and the outer surface **101***b* of the enclosure **101** of the therapeutic garment **100** are knitted using a predetermined number of inner yarns **102** and a predetermined number of outer yarns **103** selected from the yarns disclosed above. The combination of the predetermined number of specific yarns in the therapeutic garment **100** disclosed herein results in energy harvesting, active heat management, and other, not heat related therapeutic features, all self-contained within the therapeutic garment **100**. The combination of the predetermined number of specific yarns in the therapeutic garment **100** disclosed herein interact with each other and with the wearer and the ambient environment. The effect of all the processes performed by the yarns together, for example, generation of heat energy by an exothermic reaction, the conductive use of the heat energy by transferring the heat energy to the wearer and to the other yarns, conversion of the heat energy and ultraviolet radiation energy into far infrared radiation energy, storage of the heat energy, adsorption, heat insulation, moisture removal, etc., result in heat generation and energy harvesting and in development of a heat management system in the therapeutic garment **100** that works effectively without introducing any other external energy source or heating device into the therapeutic garment **100**.

The therapeutic garment **100** disclosed herein is a self-heat generating system as the therapeutic garment **100** harvests or scavenges energy both from the therapeutic garment's **100** interaction with its wearer and from the outside environment, and converts this harvested energy into heat, which is stored and distributed within the therapeutic garment **100**. The active heat management of the therapeutic garment **100** is self-generated with no additional device, for example, a heat cartridge, microwaveable gels, a battery, a charger, etc., needed for introducing and maintaining heat within the therapeutic garment **100**. This is accomplished by combining at least three different types of specific yarns, selected from the yarns disclosed above, each performing the function of generating, storing, and distributing heat, respectively. The energy harvesting, heat managing, and therapeutic effects of the therapeutic garment **100** are achieved by the interaction of each yarn with the wearer and/or the ambient environment, and with another physically adjacent yarn due to the method of construction of the therapeutic garment **100**. The combination of the predetermined number of yarns and the specific construction of the therapeutic garment **100** disclosed herein achieve positive results for those suffering, for example, from Raynaud's syndrome or rheumatoid arthritis, or those seeking relief from cold hands and feet in cold weather.

FIG. **2** illustrates a method for constructing an energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIG. **1**A, with self-contained heat management capabilities. The method disclosed herein is applicable for constructing therapeutic garments of different types, for example, gloves, socks, underwear, long underwear, stockings, leggings, shirts, headgear, scarves, sweaters, slacks, etc., for any part of a wearer's body. The method disclosed herein comprises providing **201** multiple yarns as disclosed in the detailed description of FIG. **1**B, and creating **202** an enclosure **101** exemplarily illustrated in FIG. **1**A, configured, for example, as a glove to conform to a wearer's body part, for example, the wearer's hand. The method for creating **202** the enclosure **101** comprises selecting **202***a* a predetermined number of inner yarns **102** and a predetermined number of outer yarns **103** exemplarily illustrated in FIG. **1**B, from the provided yarns; winding **202***b* the selected inner yarns **102** onto a first set of spools **301** exemplarily illustrated in FIG. **3**A, and the selected outer yarns **103** onto a second set of spools **312** exemplarily illustrated in FIG. **3**D; creating **202***c* a bundle of the selected inner yarns **102** and a bundle of the selected outer yarns **103** by pulling the selected inner yarns **102** from the first set of spools **301** and by pulling the selected outer yarns **103** from the second set of spools **312** respectively; feeding **202***d* the created bundle of the selected inner yarns **102** and the created bundle of the selected outer yarns **103** into a knitting machine (not shown) via a plaiting feeder **401** exemplarily illustrated in FIG. **4**A; and knitting **202***e* the fed bundle of the selected inner yarns **102** with the fed bundle of the selected outer yarns **103** in the knitting machine to create the enclosure **101** conforming to the wearer's body part. An example of the knitting machine used in the method disclosed herein is the WHOLEGARMENT® Computerized Flat Knitting Machine, model number SWG061N2, of Shima Seiki Manufacturing, Ltd., Sakata Wakayama, Japan, developed specifically for knitting seamless clothing accessories. The knitted bundle of the selected inner yarns **102** defines the inner surface **101***a* of the enclosure **101** and the knitted bundle of the selected outer yarns **103** defines the outer surface **101***b* of the enclosure **101** as exemplarily illustrated in FIGS. **1**A-**1**B. In an embodiment, the bundle of inner yarns **102** and the bundle of outer yarns **103** are separately made prior to the knitting of the bundle of inner yarns **102** with the bundle of outer yarns **103** to create the enclosure **101**.

The bundle of inner yarns **102** plaited on the inner surface **101***a* of the enclosure **101** and the bundle of outer yarns **103** plaited on the outer surface **101***b* of the enclosure **101** comprise several different technical yarns as exemplarily illustrated in FIG. **3**A and FIGS. **3**C-**3**E. To create these bundles of yarns **102** and **103**, in an embodiment, the individual yarns **102** and **103** are twisted together on yarn tubes **305** of a twisting machine **303** exemplarily illustrated in FIGS. **3**A-**3**B and FIG. **3**D. An example of the twisting machine **303** is the yarn twister of Whiting Co., Boston, Mass. This twisting machine **303** receives and twists the yarns **102** and **103** into bundles that are wound onto cones **311***a* and **311***b* exemplarily illustrated in FIG. **3**A and FIG. **3**D respectively, applying a predetermined amount of twist during this process. This ensures that each of the individual yarns **102** and **103** remains tight and in close proximity within their final respective bundles, while ensuring that each of the inner yarns **102** has the same amount of contact with the wearer's body part, which is necessary for maximum functionality. The winding and twisting of the outer yarns **103** ensure that each of the outer yarns **103** has an equal amount of exposure to the environment.

The knitted bundle of the selected inner yarns **102** is exposed on the inner surface **101***a* of the enclosure **101** and the knitted bundle of the selected outer yarns **103** is exposed on the outer surface **101***b* of the enclosure **101**. The positions of the inner yarns **102** and the outer yarns **103** are consistently maintained relative to each other to create a uniform surface area distribution of the inner yarns **102** and the outer yarns **103** on the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** respectively. The knitted bundle of the selected inner yarns **102** and the knitted bundle of the selected outer yarns **103** contact each other and cover the wearer's body part, for example, the skin on the wearer's hand when the therapeutic garment **100** is worn by the wearer. The consistent positions of the inner yarns **102** and the outer yarns **103** are maintained by a plaiting technique where the knitting machine knits one yarn of a material or more than one yarn of different materials to construct the inner surface **101***a* of the therapeutic garment **100**, and one yarn of a material or more than one yarn of different materials to construct the outer surface **101***b* of the therapeutic garment **100**. The plaiting technique comprises knitting with two strands of yarn where one yarn is positioned in front of the other yarn.

FIG. **3**A exemplarily illustrates a yarn bundle creation machine **300** for creating a bundle of inner yarns **102** from a first set of spools **301**. The inner yarns **102** comprise at least three of the yarns selected, for example, from the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d* as disclosed in the detailed description of

FIG. 1B. For purposes of illustration, the detailed description herein refers to a selection of the first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* for creating a bundle of inner yarns **102**; however the scope of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIG. **1**A, and the method of construction thereof, is not limited to the selection of the first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* for creating the bundle of inner yarns **102**, but may include a different selection of inner yarns **102**, for example, the first yarn **102***a,* the second yarn **102***b,* and the third yarn **102***c* for creating the bundle of inner yarns **102**.

The selected inner yarns **102***a,* **102***b,* **102***c,* and **102***d* are fed to the yarn bundle creation machine **300** for creating the bundle of inner yarns **102**. The yarn bundle creation machine **300** comprises a first set of spools **301**, a roller **302***a,* a winding machine **310***a,* and an inner yarn cone **311***a.* The selected inner yarns **102***a,* **102***b,* **102***c,* and **102***d* are wound around the first set of spools **301**. FIG. **3**A and FIG. **3**C exemplarily illustrate an embodiment comprising the first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* wound around a first inner yarn spool **301***a,* a second inner yarn spool **301***b,* a third inner yarn spool **301***c,* and a fourth inner yarn spool **301***d* respectively. The roller **302***a* pulls the inner yarns **102***a,* **102***b,* **102***c,* and **102***d* from their respective spools **301***a,* **301***b,* **301***c,* and **301***d.* In an embodiment, a motor (not shown) operably coupled to the roller **302***a* rotates the roller **302***a* to pull the inner yarns **102***a,* **102***b,* **102***c,* and **102***d* from their respective spools **301***a,* **301***b,* **301***c,* and **301***d.*

In an embodiment, the yarn bundle creation machine **300** further comprises a twisting machine **303** comprising a yarn guide **304**, a yarn tube **305**, a traveler **306**, and a spindle **307** as exemplarily illustrated in FIGS. **3**A-**3**B, for twisting the inner yarns **102***a,* **102***b,* **102***c,* and **102***d* prior to knitting of the bundle of inner yarns **102** with the bundle of outer yarns **103** exemplarily illustrated in FIGS. **3**D-**3**E, to create the enclosure **101** exemplarily illustrated in FIG. **1**A. In this embodiment, the roller **302***a* transfers the pulled inner yarns **102***a,* **102***b,* **102***c,* and **102***d* to the yarn tube **305** of the twisting machine **303** via the yarn guide **304**. The transferred inner yarns **102***a,* **102***b,* **102***c,* and **102***d* are twisted using the traveler **306** that protrudes from a lower end **305***a* of the yarn tube **305** to create a twisted bundle of the selected inner yarns **102**, and wound on the yarn tube **305** as disclosed in the detailed description of FIG. **3**B. The traveler **306** operably coupled to the spindle **307** that extends below the yarn tube **305**, that is, from a bottom end **305***b* of the yarn tube **305**, applies a predetermined amount of twist to the transferred inner yarns **102***a,* **102***b,* **102***c,* and **102***d* by spinning at a high speed, for example, about 3000 revolutions per minute (rpm) to create the twisted bundle of the selected inner yarns **102**.

Twisting ensures that the individual inner yarns **102***a,* **102***b,* **102***c,* and **102***d* remain tight within the final twisted bundle of the selected inner yarns **102**, and ensures that each of the inner yarns **102***a,* **102***b,* **102***c,* and **102***d* has the same amount of contact with the wearer's body part, for example, the wearer's skin, which is necessary for maximum functionality. The created twisted bundle of the selected inner yarns **102** on the yarn tube **305** is wound around the inner yarn cone **311***a* by the winding machine **310***a* for feeding the created twisted bundle of the selected inner yarns **102** into the plaiting feeder **401** exemplarily illustrated in FIG. **4**A. In an embodiment, the winding machine **310***a* is configured as a grooved roller. An example of the winding machine **310***a* is the cone winder of the Foster Machine Company, Elkhart, Ind. FIG. **3**A exemplarily illustrates a schematic view of the twisted bundle of the selected inner yarns **102** wound on the inner yarn cone **311***a.* The inner yarn cone **311***a* is tapered for ease of knitting on the knitting machine. The twisted bundle of the selected inner yarns **102** created from the first set of spools **301** is exemplarily illustrated in FIG. **3**C.

FIG. **3**B exemplarily illustrates an enlarged view of the twisting machine **303** incorporated within the yarn bundle creation machine **300** for creating the twisted bundle of inner yarns **102** exemplarily illustrated in FIG. **3**A. The twisting machine **303** comprises the yarn tube **305** positioned on a movable platform **308**, the traveler **306** positioned proximal to the lower end **305***a* of the yarn tube **305**, and the spindle **307** extending from the bottom end **305***b* of the yarn tube **305**. There is a rotating drum (not shown) near the bottom and rear of the yarn tube **305**. There are belts (not shown) that are wound around the rotating drum and that connect at the bottom of the spindle **307** to rotate the spindle **307**. The spindle **307**, in turn, rotates the traveler **306** that is twisting the inner yarns **102**, which are then wound onto the yarn tube **305** positioned above the spindle **307**. The inner yarns **102** travel underneath the traveler **306**, which is rotating along a ring **305***c* positioned around the lower end **305***a* of the yarn tube **305**. The moving platform **308** with vertical walls **309***a* and **309***b* on opposing sides of the yarn tube **305** moves in an upward direction and a downward direction to evenly distribute the twisted inner yarns **102** onto the yarn tube **305**. The twisting machine **303** exemplarily illustrated in FIG. **3**B, is also used for twisting the outer yarns **103** as exemplarily illustrated in FIG. **3**D.

FIG. **3**C exemplarily illustrates creation of the twisted bundle of inner yarns **102** from the first set of spools **301**. The first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* in the twisted bundle of inner yarns **102** created as disclosed in the detailed description of FIGS. **3**A-**3**B, interact with each other and with the wearer's body part, for example, the skin of the wearer's hand as follows. The second yarn **102***b* receives heat energy conductively from the wearer's skin and from the first yarn **102***a* and converts this heat energy into far infrared radiation energy. This conversion shows a transformation in how heat is transferred from conductivity to radiation. This far infrared radiation energy penetrates below the wearer's skin, and by exciting water molecules in the wearer's body generates gentle heat. In an embodiment, the phase change material of the first yarn **102***a* absorbs the far infrared radiation energy, thus delaying the phase change by staying warmer longer. The first yarn **102***a* stores the heat energy in the embedded phase change material. The heat energy maintains the adsorption process in the third yarn **102***c* by delaying reaching equilibrium. The third yarn **102***c* adsorbs moisture based on ambient pressure and ambient temperature. When the third yarn **102***c* receives heat, moisture adsorbed is desorbed and escapes from the surface of the third yarn **102***c*. The fifth yarn **103***b,* being hydrophobic, carries the moisture escaped from the third yarn **102***c* away. The third yarn **102***c* cools after the desorption of the moisture. The process of adsorption and desorption is a thermodynamically reversible process. The third yarn **102***c* can start the adsorption anew. This heat energy and the heat energy generated by the third yarn **102***c* are used conductively in different methods. In a first method, the heat energy generated by the third yarn **102***c* is used conductively by touching the wearer's skin. In a second method, by touching the first yarn **102***a,* the third yarn **102***c* transfers the generated heat energy to the phase change material of the first yarn **102***a,* which stores the heat energy. In a third method, the third yarn **102**c transfers the generated heat energy to the second yarn **102**b, which converts this heat energy into far infrared radiation energy. The sixth yarn **102**d is a carbon nanofiber that functions to maintain a uniform temperature within the combination of the first yarn **102**a, the second yarn **102**b, the third yarn **102**c, and the outer yarns **103**.

FIG. **3**D exemplarily illustrates a yarn bundle creation machine **300** for creating a bundle of outer yarns **103** from a second set of spools **312**. The outer yarns **103** comprise at least one of the yarns selected, for example, from the third yarn **102**c, the fourth yarn **103**a, the fifth yarn **103**b, and the supplementary yarn **103**c as disclosed in the detailed description of FIG. **1**B. FIG. **3**D exemplarily illustrates an embodiment comprising the fourth yarn **103**a, the fifth yarn **103**b, and the supplementary yarn **103**c wound around a first outer yarn spool **312**a, a second outer yarn spool **312**b, and a third outer yarn spool **312**c respectively. In an embodiment, multiple threads of the fifth yarn **103**b are selected as the outer yarns **103** for creating the outer surface **101**b of the enclosure **101** of the therapeutic garment **100** exemplarily illustrated in FIG. **1**A. In an embodiment, the fifth yarn **103**b selected as the outer yarn **103** is resistant to environmental elements of the ambient environment. For purposes of illustration, the detailed description refers to a selection of the fourth yarn **103**a, the fifth yarn **103**b, and the supplementary yarn **103**c for creating a bundle of outer yarns **103**; however the scope of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIG. **1**A, and the method of construction thereof, is not limited to the selection of the fourth yarn **103**a, the fifth yarn **103**b, and the supplementary yarn **103**c for creating the bundle of outer yarns **103**, but may include a different selection of outer yarns **103**, for example, the third yarn **102**c and the fifth yarn **103**b, or the fourth yarn **103**a and the fifth yarn **103**b, or the third yarn **102**c, the fourth yarn **103**a, and the fifth yarn **103**b, or multiple threads of the fifth yarn **103**b for creating the bundle of outer yarns **103**.

The selected outer yarns **103**a, **103**b, and **103**c are fed to the yarn bundle creation machine **300** for creating the bundle of outer yarns **103**. The yarn bundle creation machine **300** comprises a second set of spools **312**, a roller **302**b, a winding machine **310**b, and an outer yarn cone **311**b. The selected outer yarns **103**a, **103**b, and **103**c are wound around the second set of spools **312**. FIGS. **3**D-**3**E exemplarily illustrate an embodiment comprising the fourth yarn **103**a, the fifth yarn **103**b, and the supplementary yarn **103**c wound around a first outer yarn spool **312**a, a second outer yarn spool **312**b, and a third outer yarn spool **312**c respectively. The roller **302**b pulls the outer yarns **103**a, **103**b, and **103**c from their respective spools **312**a, **312**b, and **312**c. In an embodiment, a motor (not shown) operably coupled to the roller **302**b rotates the roller **302**b to pull the outer yarns **103**a, **103**b, and **103**c from their respective spools **312**a, **312**b, and **312**c. In an embodiment, the yarn bundle creation machine **300** further comprises the twisting machine **303** comprising the yarn guide **304**, the yarn tube **305**, the traveler **306**, and the spindle **307** as disclosed in the detailed description of FIG. **3**B, for twisting the outer yarns **103**a, **103**b, and **103**c prior to knitting of the bundle of inner yarns **102** exemplarily illustrated in FIG. **3**A and FIG. **3**C, with the bundle of outer yarns **103** to create the enclosure **101**.

In this embodiment, the roller **302**b transfers the pulled outer yarns **103**a, **103**b, and **103**c to the yarn tube **305** of the twisting machine **303** via the yarn guide **304**. The transferred outer yarns **103**a, **103**b, and **103**c are twisted using the traveler **306** that protrudes from the lower end **305**a of the yarn tube **305** to create a twisted bundle of the selected outer yarns **103**, and wound on the yarn tube **305** as disclosed in the detailed description of FIG. **3**B. The traveler **306** operably coupled to the spindle **307** that extends below the yarn tube **305**, that is, from the bottom end **305**b of the yarn tube **305**, applies a predetermined amount of twist to the transferred outer yarns **103**a, **103**b, and **103**c by spinning at a high speed, for example, about 3000 revolutions per minute (rpm) to create the twisted bundle of the selected outer yarns **103**. Twisting ensures that the individual outer yarns **103**a, **103**b, and **103**c remain tight within the final twisted bundle of the selected outer yarns **103**, and ensures that each of the outer yarns **103**a, **103**b, and **103**c has an equal amount of exposure to the environment. The created twisted bundle of the selected outer yarns **103** on the yarn tube **305** is wound around the outer yarn cone **311**b by the winding machine **310**b configured, for example, as a grooved roller, for feeding the created twisted bundle of the selected outer yarns **103** into the plaiting feeder **401** exemplarily illustrated in FIG. **4**A. An example of the winding machine **310**b is the cone winder of the Foster Machine Company, Elkhart, Ind. FIG. **3**D exemplarily illustrates a schematic view of the twisted bundle of the selected outer yarns **103** wound on the outer yarn cone **311**b. The outer yarn cone **311**b is tapered for ease of knitting on the knitting machine. The twisted bundle of the selected outer yarns **103** created from the second set of spools **312** is exemplarily illustrated FIG. **3**E.

FIG. **4**A exemplarily illustrates feeding of the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** into a plaiting feeder **401**. The plaiting feeder **401** comprises a first yarn guide **401**a, a second yarn guide **401**b, and a guide element **402** for inserting the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103**. The plating feeder **401** receives the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** from the inner yarn cone **311**a and the outer yarn cone **311**b respectively, exemplarily illustrated in FIG. **3**A and FIG. **3**D respectively. The plaiting feeder **401** holds the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** by the first yarn guide **401**a and the second yarn guide **401**b respectively. A fastener, for example, a bolt **401**c attaches the plaiting feeder **401** to a sub carrier (not shown) that is mounted on a bar (not shown), on which the sub carrier slides back and forth. The guide element **402** comprises guides **402**a and **402**b for receiving the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** respectively, from the first yarn guide **401**a and the second yarn guide **401**b respectively, as exemplarily illustrated in the enlarged view of the guide element **402** shown in FIG. **4**B.

FIG. **4**A exemplarily illustrates an embodiment where the twisted bundle of inner yarns **102** comprises the first yarn **102**a, the second yarn **102**b, the third yarn **102**c, and the sixth yarn **102**d, and the twisted bundle of outer yarns **103** comprises the fourth yarn **103**a, the fifth yarn **103**b, and the supplementary yarn **103**c. The twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** are fed into the guides **402**a and **402**b of the guide element **402** respectively. The plaiting feeder **401** is used to feed the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** into a knitting machine with knitting needles **501** as exemplarily illustrated in FIGS. **5**A-**5**C. In an embodiment, a regular feeder feeds the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** into the knitting machine with the knitting needles **501**. The guide **402**a that receives the twisted bundle of inner yarns **102** and the guide **402**b that receives the twisted bundle of outer yarns **103** in the plaiting feeder **401** maintain consistent positions of the inner yarns **102** and the outer yarns **103** on the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** of the therapeutic garment **100** exemplarily illustrated in FIG. **1**A, respectively.

FIG. **5**A exemplarily illustrates feeding of the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** into a single knitting needle **501**. The knitting needle **501** is, for example, a latch needle. The knitting needle **501** comprises a hook **501***a*, a latch blade **501***b*, and a stem **501***d*. The stem **501***d* of the knitting needle **501** extends from the hook **501***a* of the knitting needle **501**. The latch blade **501***b* is pivotally connected to the stem **501***d* of the knitting needle **501**. The inner yarns **102** and the outer yarns **103** are selected and twisted as disclosed in the detailed description of FIGS. **3**A-**3**E, for creating the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** of the therapeutic garment **100** exemplarily illustrated in FIG. **1**A, respectively. FIG. **5**A exemplarily illustrates the inner yarns **102** comprising the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d*, and the outer yarns **103** comprising the fourth yarn **103***a*, the fifth yarn **103***b*, and the supplementary yarn **103***c*. The functionality, structure, and/or material of the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, the sixth yarn **102***d*, the fourth yarn **103***a*, the fifth yarn **103***b*, and the supplementary yarn **103***c* are disclosed in the detailed description of FIG. **1**B. For purposes of illustration, the detailed description of the FIG. **3**A and FIG. **3**B refers to the inner surface **101***a* of the enclosure **101** being made from a combination of the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d*; however the scope of the therapeutic garment **100** disclosed herein is not limited to the inner surface **101***a* of the enclosure **101** being made from the combination of the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d*, but may be made from any combination of the yarns disclosed in the detailed description of FIG. **3**A and FIG. **3**C. Furthermore, for purposes of illustration, the detailed description refers to the outer surface **101***b* of the enclosure **101** being made from a combination of the fourth yarn **103***a*, the fifth yarn **103***b*, and the supplementary yarn **103***c*; however the scope of the therapeutic garment **100** disclosed herein is not limited to the outer surface **101***b* being made from the combination of the fourth yarn **103***a*, the fifth yarn **103***b*, and the supplementary yarn **103***c*, but may be made from any combination of the yarns disclosed in the detailed description of FIG. **3**D-**3**E.

The twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** are fed into the knitting needle **501** via the plaiting feeder **401** as disclosed in the detailed description of the FIG. **4**A. The plaiting feeder **401** maintains consistent positions of the inner yarns **102** and the outer yarns **103** relative to each other. The hook **501***a* of the knitting needle **501** holds the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103**. The latch blade **501***b* contacts the hook **501***a*, when the latch blade **501***b* is in a closed position. The latch blade **501***b* is distal to the hook **501***a* when the latch blade **501***b* is in an open position. The latch blade **501***b* in the closed position latches the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** within a space **501***c* defined by the hook **501***a* and the latch blade **501***b* of the knitting needle **501**. In the open position, the knitting needle **501** draws loops **502** of the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** in a backward direction towards the stem **501***d* of the knitting needle **501** via the latch blade **501***b* and allows the hook **501***a* to hold the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103**. A first loop **502***a* of a twisted bundle of inner yarns **102** and a twisted bundle of outer yarns **103** latched in the knitting needle **501** and interwoven with a second loop **502***b* of a twisted bundle of inner yarns **102** and a twisted bundle of outer yarns **103** is exemplarily illustrated in FIG. **5**A.

FIG. **5**B exemplarily illustrates knitting of the twisted bundle of inner yarns **102** with the twisted bundle of outer yarns **103** using a single knitting needle **501**. The knitting of the twisted bundle of inner yarns **102** with the twisted bundle of outer yarns **103** is performed by plaiting. The plaiting procedure requires at least one knitting needle **501**. The plaiting procedure is also called weft knitting. As disclosed in the detailed descriptions of the FIGS. **4**A-**4**B, the plaiting feeder **401** feeds the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** to the knitting needle **501**. The knitting needle **501** operates as disclosed in the detailed description of FIG. **5**A. Consider an example where a first loop **502***a* and a second loop **502***b* of the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** are created by knitting using the single knitting needle **501** as exemplarily illustrated in FIG. **5**B. When the knitting needle **501** moves in a forward direction, the previously created second loop **502***b* of the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** slides in a backward direction over the latch blade **501***b* of the knitting needle **501**, thereby opening the latch blade **501***b*, and lands on the stem **501***d* of the knitting needle **501**. The forward movement of the knitting needle **501** allows the hook **501***a* of the knitting needle **501** to grasp the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** fed by the plaiting feeder **401**. The knitting needle **501**, after grasping the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103**, moves in a backward direction to form a third loop **502***c*. The backward movement of the knitting needle **501** causes the previously created second loop **502***b* to slide on the latch blade **501***b*, thereby closing the latch blade **501***b* and latching the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** grasped by the hook **501***a*, and thereafter move onto the third loop **502***c* formed. Further movement of the knitting needle **501** in the backward direction causes the third loop **502***c* to go through the second loop **502***b*, after which the second loop **502***b* is cast off. The process continues to create a fourth loop (not shown) and so on until the enclosure **101** comprising the inner surface **101***a* and the outer surface **101***b* exemplarily illustrated in FIG. **1**A, is created.

FIG. **5**C exemplarily illustrates positions of the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** in a knit pattern created, for example, by plaiting, using multiple knitting needles **501** of the knitting machine (not shown). Each of the knitting needles **501** operate as disclosed in the detailed description of FIG. **5**A. In an embodiment, the knitting needles **501** knit the twisted bundle of inner yarns **102** and the twisted bundle of outer yarns **103** whether they come through the plaiting feeder **401** exemplarily illustrated in FIG. **4**A and **5**B or through a regular feeder. The method for plaiting the twisted bundle of inner yarns **102** with the twisted bundle of outer yarns **103** is disclosed in the detailed description of FIG. **5**B. The predetermined number of the inner yarns **102** and the predetermined number of the outer yarns **103** defining the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** of the therapeutic garment **100** exemplarily illustrated in FIG. **1**A, respectively are twisted and knitted to create a uniform surface area distribution of the inner yarns **102** and the outer yarns **103** on the inner surface **101***a* and the outer surface **101***b* of the enclosure **101** respectively. The knitted bundle of inner yarns **102** and the knitted bundle of outer yarns **103** contact each other and cover the wearer's body part, for example, the wearer's skin when the therapeutic garment **100** is worn by the wearer.

FIGS. **6**A-**6**B exemplarily illustrate energy harvesting, heat managing, multi-effect therapeutic garments **100** configured as therapeutic gloves, herein referenced by the numeral **100**, and constructed in accordance with the method exemplarily illustrated in FIG. **2** and as disclosed in the detailed description of FIG. **2**. Each of the therapeutic gloves **100** exemplarily illustrated in FIGS. **6**A-**6**B, comprises the finger section **101***c* and the palm section **101***d* collectively forming the enclosure **101** having the inner surface **101***a* and the outer surface **101***b*. The constructed therapeutic glove **100** exemplarily illustrated in FIG. **6**A, is a solid colored therapeutic glove **100** where the inner yarns **102** comprising the first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* define the inner surface **101***a* proximal to the skin of the wearer's hand, and the outer yarns **103** comprising the fourth yarn **103***a,* the fifth yarn **103***b,* and the supplementary yarn **103***c* define the outer surface **101***b* distal to the skin of the wearer's hand. The constructed therapeutic glove **100** exemplarily illustrated in FIG. **6**B, is a striated therapeutic glove **100** where the inner yarns **102** comprising the first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* define the inner surface **101***a* proximal to the skin of the wearer's hand, and the outer yarns **103** comprising the fifth yarn **103***b,* the third yarn **102***c* and the supplementary yarn **103***c* define the outer surface **101***b* distal to the skin of the wearer's hand.

FIG. **7** exemplarily illustrates an energy harvesting, heat managing, multi-effect therapeutic garment **100** configured as a therapeutic glove and seamlessly constructed to provide a snug fit across a palm of a wearer. The palm section **101***d* and the finger section **101***c* collectively forming the enclosure **101**, and the outer surface **101***b* of the therapeutic garment **100** configured as a therapeutic glove are exemplarily illustrated in FIG. **7**. The therapeutic garment **100** is knitted in a single piece, free of seams as a complete garment or a whole garment, resulting in an improved fit on the wearer's palm with improved construction integrity. The structure of the therapeutic garment **100** provides a statistically even surface area distribution of the yarns **102** and **103** exemplarily illustrated in FIGS. **6**A-**6**B, that cover the wearer's skin and that contact each other, which is achieved by bundling the yarns **102** and **103** prior to knitting. The therapeutic garment **100** is knit using a complete garment or three-dimensional knitting technique to create a three-dimensional seamless full garment. Computerized knitting machines perform direct movement of hundreds of knitting needles **501** exemplarily illustrated in FIG. **5**C, to construct and connect several tubular knitted forms to create the therapeutic garment **100** in a single production step as per the instructions given. The complete garment knitting technique reduces wastage of materials by eliminating seam allowances and eliminates the conventional sewing technique of a material, thereby facilitating a faster time to market. Hence, the complete garment knitting technique is a cost effective technique. A predetermined number of yarns is fed to a complete garment knitting machine that manipulates the knitting needles **501**. Each of the inner yarns **102** and the outer yarns **103** is controlled by a machine head capable of knitting a known or programmed knit pattern. The complete garment knitting technique can be used for knitting various forms of clothing, for example, the therapeutic garment **100**.

FIGS. **8**A-**8**B exemplarily illustrate tables containing construction data of yarns in multiple test samples of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. The construction data is represented as x (y denier), that is, x number of spools totalling y denier. FIG. **8**A exemplarily illustrates a table showing construction data of the inner yarns **102** used for the construction of the test samples, for example, test sample A to test sample I along with the number of spools and the total denier. The inner yarns **102** represented in the table exemplarily illustrated in FIG. **8**A, comprise the first yarn **102***a,* the second yarn **102***b,* the third yarn **102***c,* and the sixth yarn **102***d* exemplarily illustrated in FIGS. **6**A-**6**B. FIG. **8**B exemplarily illustrates a table showing construction data of the outer yarns **103** used for the construction of the test samples, for example, test sample A to test sample I along with the number of spools and the total denier. The outer yarns **103** represented in the table exemplarily illustrated in FIG. **8**B, comprise the third yarn **102***c,* the fifth yarn **103***b,* and a supplementary yarn **103***c* made of spandex exemplarily illustrated in FIGS. **6**A-**6**B. On performing a linear regression on the construction data, if the skin temperature increases while the wearer sits in a cold environment, the slope is a positive number. If the skin temperature remains uniform, the slope is zero. When there is a decrease in the skin temperature over a test period, the slope is a negative number. As exemplarily illustrated in FIGS. **8**A-**8**B, the slope is a negative number for all the test samples, that is, test sample A to test sample I, that were tested as disclosed in the detailed description of FIGS. **9**A-**15**H. The slope of the linear regression is multiplied by 1000.

FIGS. **9**A-**9**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample A and test sample B of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample A of the therapeutic garment **100** comprises the first yarn **102***a,* the second yarn **102***b,* and the third yarn **102***c* as the inner yarns **102** that form the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c,* the fifth yarn **103***b,* and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample B of the therapeutic garment **100** comprises the first yarn **102***a,* the second yarn **102***b,* and the third yarn **102***c* as the inner yarns **102** that form the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c,* the fifth yarn **103***b,* and the supplementary yarn **103***c* as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100**. The skin temperature measurements of the wearer wearing the test sample A and the test sample B of the therapeutic garment **100** are taken as follows. The wearer wears the test sample A on his/her right hand and the test sample B on his/her left hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. Probes are positioned on the tips of the middle fingers of the wearer's right hand and left hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probes, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **9**A-**9**H. This test shows that the second yarn **102***b* transforms the conductive heat energy into far infrared radiation energy from the heat of the wearer's hands and from the heat in the first yarn **102***a*. The increase in skin temperature by wearing the test sample A and the test sample B of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **9**A-**9**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

FIGS. **10**A-**10**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample D and test sample C of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample D of the therapeutic garment **100** comprises the first yarn **102***a* and the third yarn **102***c* as the inner yarns **102** that form the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample C of the therapeutic garment **100** comprises the first yarn **102***a* and the second yarn **102***b* as the inner yarns **102** that form the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100**. The skin temperature measurements of the wearer wearing the test sample D and the test sample C of the therapeutic garment **100** are taken as follows. The wearer wears the test sample D on his/her right hand and the test sample C on his/her left hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. Probes are positioned on the tips of the middle fingers of the wearer's right hand and left hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probes, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **10**A-**10**H. This test shows that the second yarn **102***b* transforms the conductive heat energy into far infrared radiation energy from the heat of the wearer's hands and from the heat in the first yarn **102***a*. The increase in skin temperature by wearing the test sample D and the test sample C of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **10**A-**10**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

FIGS. **11**A-**11**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample E of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample E of the therapeutic garment **100** comprises the second yarn **102***b* and the third yarn **102***c* as the inner yarns **102** that form the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. The skin temperature measurements of the wearer wearing the test sample E of the therapeutic garment **100** are taken as follows. The wearer wears the test sample E of the therapeutic garment **100** on his/her right hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. A probe is positioned on the tip of the middle finger of the wearer's right hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probe, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **11**A-**11**H. The increase in skin temperature by wearing the test sample E of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **11**A-**11**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

FIGS. **12**A-**12**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample F of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample F of the therapeutic garment **100** comprises the third yarn **102***c* as the inner yarn **102** that forms the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. The skin temperature measurements of the wearer wearing the test sample F of the therapeutic garment **100** are taken as follows. The wearer wears the test sample F of the therapeutic garment **100** on his/her right hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. A probe is positioned on the tip of the middle finger of the wearer's right hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probe, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **12**A-**12**H. The increase in skin temperature by wearing the test sample F of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **12**A-**12**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

FIGS. **13**A-**13**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample G of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample G of the therapeutic garment **100** comprises the second yarn **102***b* as the inner yarn **102** that forms the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. The skin temperature measurements of the wearer wearing the test sample G of the therapeutic garment **100** are taken as follows. The wearer wears the test sample G of the therapeutic garment **100** on his/her left hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. A probe is positioned on the tip of the middle finger of the wearer's left hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probe, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **13**A-**13**H. The increase in skin temperature by wearing the test sample G of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **13**A-**13**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

FIGS. **14**A-**14**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample H of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample H of the therapeutic garment **100** comprises the first yarn **102***a* as the inner yarn **102** that forms the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. The skin temperature measurements of the wearer wearing the test sample H of the therapeutic garment **100** are taken as follows. The wearer wears the test sample H of the therapeutic garment **100** on his/her left hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. A probe is positioned on the tip of the middle finger of the wearer's left hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probe, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **14**A-**14**H. The increase in skin temperature by wearing the test sample H of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **14**A-**14**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

FIGS. **15**A-**15**H exemplarily illustrate a table containing skin temperature measurements of a wearer wearing test sample I of the energy harvesting, heat managing, multi-effect therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. Test sample I of the therapeutic garment **100** comprises the first yarn **102***a*, the second yarn **102***b*, the third yarn **102***c*, and the sixth yarn **102***d* as the inner yarns **102** that form the inner surface **101***a* of the therapeutic garment **100**, and the third yarn **102***c*, the fifth yarn **103***b*, and a supplementary yarn **103***c* made of spandex as the outer yarns **103** that form the outer surface **101***b* of the therapeutic garment **100** exemplarily illustrated in FIGS. **6**A-**6**B. The skin temperature measurements of the wearer wearing the test sample I are taken as follows. The wearer wears the test sample I of the therapeutic garment **100** on his/her left hand. The user is then seated in an environmental chamber with the temperature controlled, for example, at about 40 degree Fahrenheit to about 45 degree Fahrenheit. A probe is positioned on the tip of the middle finger of the wearer's left hand, where the blood vessels close. The skin temperature on the wearer's skin is measured by the probe, for example, at fifteen second intervals, for up to one hour. The skin temperatures are analyzed as a function of elapsed time and tabulated as exemplarily illustrated in FIGS. **15**A-**15**H. By performing infrared imaging, for example, through a FLIR ONE® thermal imaging camera of Flir Systems, Inc., it is shown that heat from the sixth yarn **102***d*, that is, the carbon nanofiber, is conductively moved from an inner palm area that is the warmest part of the wearer's hand towards the wearer's fingers. This test also shows that the second yarn **102***b* transforms the conductive heat energy into far infrared radiation energy from the heat of the wearer and from the heat in the first yarn **102***a*. The increase in skin temperature by wearing the test sample I of the therapeutic garment **100** as exemplarily illustrated by the measured data in FIGS. **15**A-**15**H, can help persons with Raynaud's syndrome or rheumatoid arthritis, or those seeking effective protection against cold hands in cold weather.

The foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the therapeutic garment **100** and the method of construction thereof disclosed herein. While the therapeutic garment **100** and the method have been described with reference to various embodiments, it is understood that the words, which have been used herein, are words of description and illustration, rather than words of limitation. Further, although the therapeutic garment **100** and the method have been described herein with reference to particular means, materials, and embodiments, the therapeutic garment **100** and the method are not intended to be limited to the particulars disclosed herein; rather, the therapeutic garment **100** and the method extend to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims. Those skilled in the art, having the benefit of the teachings of this specification, may effect numerous modifications thereto and changes may be made without departing from the scope and spirit of the therapeutic garment **100** and the method disclosed herein in their aspects.

We claim:

1. An energy harvesting, heat managing, multi-effect therapeutic garment comprising:

an enclosure, the enclosure configured to conform to a body part of a wearer, the enclosure comprising an inner surface and an outer surface, the inner surface being proximal to the body part of the wearer and the outer surface being distal to the body part of the wearer when the wearer is wearing the enclosure; and

a combination of seven different types of yarns knitted to create the inner surface and the outer surface of the enclosure, wherein the seven different types of yarns comprise:

a first yarn for absorbing, storing, and releasing heat energy through a phase change;

a second yarn for converting the heat energy into far infrared radiation energy and radiating the far infrared radiation energy to the other yarns and to the body part of the wearer;

a third yarn for adsorbing moisture from one or more of the body part of the wearer and ambient environment and generating the heat energy through an exothermic reaction between the moisture and the third yarn;

a fourth yarn for converting ultraviolet radiation energy from sunlight into the far infrared radiation energy and radiating the far infrared radiation energy to other of the yarns and to the body part of the wearer;

a fifth yarn for providing heat insulation and for repelling the moisture;

a sixth yarn for conducting heat and maintaining a uniform temperature within the yarns; and

a supplementary yarn for enhancing heat conductivity between the body part of the wearer and the inner surface of the enclosure;

wherein a bundle of selected inner yarns is knitted with a bundle of selected outer yarns for said creation of the enclosure, wherein the knitted bundle of the selected inner yarns defines the inner surface of the enclosure, wherein a knitted bundle of the selected outer yarns defines the outer surface of the enclosure, wherein a sum of total number of yarns in the bundle of selected inner yarns and a total number of yarns in the bundle of selected outer yarns is at least six, and wherein a uniform surface area distribution of the inner yarns and the outer yarns is created on the inner surface and the outer surface of the enclosure respectively, wherein the knitted bundle of inner yarns is exposed on the inner surface of the enclosure and the knitted bundle of outer yarns is exposed on the outer surface of the enclosure, and wherein the knitted bundle of inner yarns and the knitted bundle of outer yarns contact each other and cover the body part of the wearer when the energy harvesting, heat managing, multi-effect therapeutic garment is worn by the wearer.

2. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein at least one of the yarns in the bundle of outer yarns comprises a plurality of threads of the fifth yarn.

3. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein the sixth yarn is a carbon nanofiber.

4. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein the second yarn, the third yarn, and the fourth yarn are configured to interact with each other and with one or more of the body part of the wearer and the ambient environment to harvest the heat energy.

5. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein the first yarn is configured to absorb the far infrared radiation energy from the second yarn and the fourth yarn and receive the heat energy from the third yarn.

6. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein the first yarn, in conjunction with the sixth yarn having a high heat conductivity, is further configured to maintain the uniform temperature within the yarns.

7. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein the supplementary yarn is bundled with at least one of the outer yarns to define the outer surface of the enclosure.

8. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **1**, wherein the bundle of inner yarns and the bundle of outer yarns are twisted prior to knitting.

9. An energy harvesting, heat managing, multi-effect therapeutic garment comprising:

an enclosure, the enclosure configured to conform to a body part of a wearer, the enclosure comprising an inner surface and an outer surface, the inner surface being proximal to the body part of the wearer and the outer surface being distal to the body part of the wearer when the wearer is wearing the enclosure; and

said enclosure created by knitting a bundle of pre-selected inner yarns and a bundle of pre-selected outer yarns, wherein the pre-selection of the inner yarns comprises selecting at least three yarns from a first yarn, a second yarn, a third yarn, and a sixth yarn, to define the inner surface of the enclosure, wherein the pre-selection of the outer yarns comprises selecting at least two yarns from the third yarn, a fourth yarn, and a fifth yarn, to define the outer surface of the enclosure, wherein a sum of a total number of yarns in the bundle of pre-selected inner yarns and a total number of yarns in the bundle of pre-selected outer yarns is at least six, wherein the yarns in the bundle of pre-selected inner yarns and the bundle of pre-selected outer yarns are configured to interact with each other, interact with a body part of the wearer, and interact with an ambient environment, for creating the energy harvesting, heat managing, multi-effect therapeutic garment, and wherein seven different types of yarns are available for the pre-selection comprising:

said first yarn configured to absorb, store, and release heat energy through a phase change;

said second yarn configured to convert the heat energy into far infrared radiation energy and radiate the far infrared radiation energy to other yarns and to the body part of the wearer;

said third yarn configured to adsorb moisture from the body part of the wearer and the ambient environment and generate the heat energy through an exothermic reaction between the moisture and the third yarn;

said fourth yarn configured to convert ultraviolet radiation energy from sunlight into the far infrared radiation energy and radiate the far infrared radiation energy to other yarns and to the body part of the wearer;

said fifth yarn configured to provide heat insulation and for repelling the moisture;

said sixth yarn configured to conduct heat and maintain a uniform temperature within the yarns; and

a supplementary yarn for enhancing heat conductivity between the body part of the wearer and the inner surface of the enclosure.

10. The energy harvesting, heat managing, multi-effect therapeutic garment of claim **9**, wherein the supplementary yarn is bundled with at least one of the outer yarns to define the outer surface of the enclosure.

11. An energy harvesting, heat managing, multi-effect therapeutic garment comprising:

an enclosure, the enclosure configured to conform to a body part of a wearer, the enclosure comprising an inner surface and an outer surface, the inner surface being proximal to the body part of the wearer and the outer surface being distal to the body part of the wearer when the wearer is wearing the enclosure; and

a combination of seven different types of yarns knitted to create the inner surface and the outer surface of the enclosure, wherein a third yarn is selected as part of both the inner and outer surfaces, wherein the inner surface of the enclosure further comprises two or more yarns selected from a first yarn, a second yarn, and a sixth yarn, wherein the outer surface of the enclosure further comprises one or more yarns selected from a fourth yarn and a fifth yarn, wherein total number of the selected yarns in the enclosure is at least six, and wherein the seven different types of yarns available for selection comprise:

said first yarn for absorbing, storing, and releasing heat energy through a phase change;

said second yarn for converting the heat energy into far infrared radiation energy and radiating the far infrared radiation energy to the other yarns and to the body part of the wearer;

said third yarn for adsorbing moisture from one or more of the body part of the wearer and ambient environment and generating the heat energy through an exothermic reaction between the moisture and the third yarn;

said fourth yarn for converting ultraviolet radiation energy from sunlight into the far infrared radiation energy and radiating the far infrared radiation energy to other of the yarns and to the body part of the wearer;

said fifth yarn for providing heat insulation and for repelling the moisture;

said sixth yarn for conducting heat and maintaining a uniform temperature within the yarns; and a supplementary yarn for enhancing heat conductivity between the body part of the wearer and the inner surface of the enclosure;

wherein a bundle of selected inner yarns is knitted with a bundle of selected outer yarns for said creation of the enclosure, wherein the knitted bundle of the selected inner yarns defines the inner surface of the enclosure, wherein a knitted bundle of the selected outer yarns defines the outer surface of the enclosure, wherein a sum of total number of yarns in the bundle of selected inner yarns and a total number of yarns in the bundle of selected outer yarns is at least six, wherein a uniform surface area distribution of the inner yarns and the outer yarns is created on the inner surface and the outer surface of the enclosure respectively, wherein the knitted bundle of inner yarns is exposed on the inner surface of the enclosure and the knitted bundle of outer yarns is exposed on the outer surface of the enclosure, and wherein the knitted bundle of inner yarns and the knitted bundle of outer yarns contact each other and cover the body part of the wearer when the energy harvesting, heat managing, multi-effect therapeutic garment is worn by the wearer.

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