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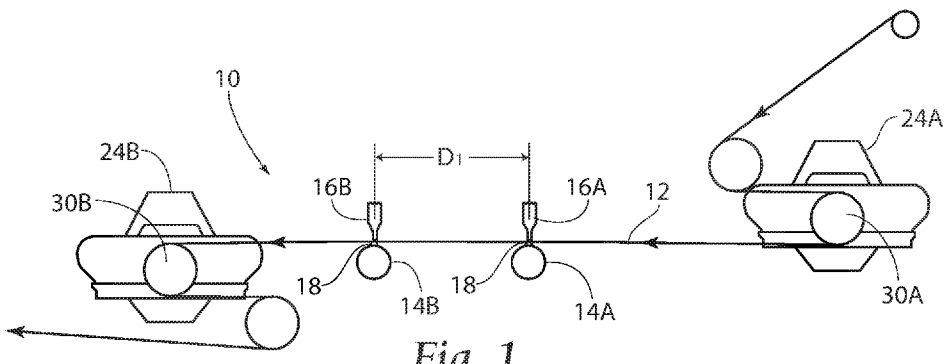

Fig. 1

(57) Abstract: A system and method for producing a disposable undergarment, with the lateral edges of the undergarment bonded by means of an ultrasonic horn. When a blank is formed for an individual undergarment, the lateral edges of opposing edges of the blank will form the seam. When the edges are sealed together, a seam is formed. The individual undergarments may be later separated along the seams.

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Dual Bonder

Related Applications

This application claims the benefit of co-pending U.S. Provisional Patent Application Serial No. 62/395,152, filed 15 September 2016.

Background of the Invention

The present invention relates to disposable hygiene products and more specifically, to methods and apparatuses for processing disposable hygiene products such as baby diapers, adult diapers, disposable undergarments, incontinence devices, sanitary napkins and the like. More specifically, the invention relates to controlling and positioning webs or web segments of a disposable diaper and bonding them. Various types of automatic manufacturing equipment have been developed which produce the desired results with a variety of materials and configurations.

The invention disclosed herein relates to a method for controlling pieces traveling on a production line, specifically a bonding system for bonding a plurality of webs together. Although the description provided relates to diaper manufacturing, the method is easily adaptable to other applications. Although the description provided relates to bonding portions of diapers, the method is easily adaptable to other products, other disposable products, other diaper types and other portions of diapers.

Summary of the Invention

The current invention is a system and method for producing a disposable undergarment, with the lateral edges of the undergarment bonded by means of an ultrasonic horn. When a blank is formed for an individual undergarment, the lateral edges of opposing edges of the blank will form the seam. When the edges are sealed together, a seam is formed. The individual undergarments may be later separated along the seams.

Brief Description of the Drawings

Figure 1 is a schematic view of a system according the present invention.

Figure 2 is a view similar to that of Figure 1, but showing movement of the component parts to vary the distance between bonds.

Figure 3 is an enlarged view of an anvil insert for use with the present system.

Figure 3A is an enlarged perspective view of the anvil insert illustrated in Figure 3.

Figure 4 is a top view of the anvil insert illustrated in Figure 3.

Figure 4A is an enlarged view of Figure 4 and showing a bond pattern.

Figure 4B is a cross sectional view of the anvil insert illustrated in Figure 4A, and taken along lines 4B - 4B thereof.

Figure 4C is an enlarged view of Figure 4A.

Figure 5 is a top plan view showing a web with spaced apart bonds.

Figure 6 is a schematic view similar to that of Figure 1, and showing webs moving at a non-bonding velocity.

Figure 6A is a view similar to that of Figure 6, but showing a front side and a back side of a folded web.

Figure 6B is a cross sectional view taken along

lines 6B -6B of Figure 6A, and showing a back side adjacent an anvil and a front side adjacent a horn.

Figure 7 is a schematic view similar to that of Figure 6, and showing movement of accumulator rollers to slow the web to a bonding velocity.

Figure 8 is a schematic view similar to that of Figures 6 and 7, and showing movement of accumulator rollers to increase the velocity web after bonding.

Figure 9 is a top plan view of webs moving as illustrated in Figure 6.

Figure 10 is a top plan view of webs moving as illustrated in Figure 7.

Figure 11 is a graphic representation of the various web velocities.

Figure 12 is a view similar to that of Figure 1, but showing three anvils and ultrasonic horns.

Figure 13 is a view similar to that of Figure 12, but showing movement of the component parts to vary the distance between bonds.

Figure 14 is a top plan view showing paired anvils and ultrasonic horns.

Figure 15 is a view similar to that of Figure 14, but showing movement of the component parts to vary the distance between bonds.

Figure 16 is a view similar to that of Figures 1, 6, and 7 but showing an accumulator series.

Figure 17 is a view similar to that of Figures 1, 6, 7 and 16 but showing another alternative arrangement for the accumulator series.

Figure 18 is a view similar to that of Figures 1, 6, 7, 16 and 17 but showing another alternative arrangement for the accumulator series.

Figure 19 is a view similar to that of Figures 1, 6, 7, 16, 17 and 18 but showing another alternative arrangement for the accumulator series.

Description of the Preferred Embodiment

Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention which may be embodied in other specific structures. While the preferred embodiment has been described, the details may be changed without departing from the invention.

With attention to Figures 1 and 2, a bonding system 10 is disclosed wherein the positional accuracy of the bonding and quality of the bonding is improved over the prior art. As shown, the system 10 includes an ultrasonic bonder for bonding a plurality webs 12, or a folded web 12 having a front side 12A and a back side 12B. The system 10 includes a first anvil 14A, a second anvil 14B, a first ultrasonic horn 16A, and a second ultrasonic horn 16B. The anvils 14A, 14B are each provided with an anvil insert 18 having a predetermined profile. The first and second anvils 14A, 14B are laterally spaced apart inline and in a machine direction.

The system 10 includes carrying means for carrying the webs 12 so that the webs 12 pass a first gap between the first anvil 14A and the first ultrasonic horn 16A and then a second gap between the second anvil 14B and the second ultrasonic horn 16B. The first and second ultrasonic horns 16A, 16B apply vibration energy to the web 12 simultaneously and in cooperation with a respective anvil 14A, 14B to bond a respective portion of the web 12 that is to be an end portion 20 of an individual finished article (not shown in these views). As mentioned, the first anvil 14A and the first ultrasonic horn 16A are provided inline from the second anvil 14B and the second ultrasonic horn 16B and are spaced apart a predetermined distance *d1* that corresponds to the distance between bonds 22. The predetermined distance *d1* may be changed to accommodate

various sizes of the finished product, since the distance *d1* corresponds to the length of the individual article. Accordingly, the length of the individual article may be changed by adjusting the position of the first or second ultrasonic horn 16A, 16B with respect to the other ultrasonic horn 16A, 16B. Moreover, the system 10 includes a device for linear reciprocation of a selected anvil 14A, 14B and ultrasonic horn 16A, 16B relative another anvil 14A, 14B and ultrasonic horn 16A, 16B and to move in the direction of arrow A, (see Figure 2) and to thereby change the distance *d1, d2* between a selected anvil 14A, 14B and horn 16A, 16B and the adjacent anvil 14A, 14B and horn 16A, 16B. Preferably, the selected anvil 14A, 14B and ultrasonic horn is 16A, 16B slidingly mounted to a base structure (not shown), and its movement manually or computer controlled, as understood by one skilled in the art. Since the distance *d1, d2* intervals of bonding positions may be changed by changing the position of the first or second ultrasonic horn 16A, 16B, the present system may easily produce individual articles of various sizes. It is to be understood that while the view of Figure 2 illustrates movement of the second ultrasonic horn 16B, the position of the first ultrasonic horn 16A may also or alternatively be changeable, as required by a specific application.

With attention to Figures 6 – 11, the present system 10 may be seen to further comprise a velocity-changing device for increasing and decreasing the moving velocity of the web 12. The velocity-changing device preferably includes a first web festoon accumulator 24A having a first accumulator roller 30A, and a second web festoon accumulator 24B having a second accumulator roller 30B. The first web festoon accumulator 24A receives the webs 12 flowing from an upstream side and releases the webs toward the ultrasonic horns 16A, 16B while the second web festoon accumulator 24B receives the webs 12 from the

ultrasonic horns 16A, 16B and moves the webs 12 toward a downstream side. The velocity-changing device further includes means for moving the first and second accumulator rollers 30A, 30B in a unison, linear manner to thereby change the velocity V1 of the web 12 received. As seen in Figure 7, when the first and second accumulator rollers 30A, 30B move in the direction of arrow B, the velocity V1 of the web 12 from the upstream side is moved to second, slower velocity V2, such that the dwell time of the web 12 during the bonding operation is adequate for proper bonding. The anvil rolls 14A, 14B are preferably synchronized such that the device 10 will produce two bonds 22 simultaneously during the slower V2 velocity. Once the web 12 is bonded, the accumulator rollers 30A, 30B move in the direction of arrow C (see Figure 8) and the webs 12 move at velocity V3 to be ultimately transported by the second web festoon accumulator 24B at the first V1 velocity and in a downstream direction.

The surfaces of the anvils 14A, 14B used in cooperation with the ultrasonic horns 16A, 16B may preferably include an anvil insert 18, as is shown in Figures 3 -4C. The anvil insert 18 may include a seal surface, an embossing surface, or a combination thereof. The anvil insert 18 illustrated in these views includes a pair of spaced apart seal surfaces 26 having a recess 28 therebetween and wherein the seal surfaces 26 are provided with a series of canted rectangular patterns or teeth 32 thereon. The canted orientation of the rectangular pattern 32 provides both trailing edge and leading edge coverage in a cross-machine direction. This arrangement allows even wear on the horns 16A, 16B interfacing with the anvils 14A, 14B such that the need to re-grind worn horns 16A, 16B is greatly reduced. Moreover, the cost associated with anvil 14A, 14B assembly is reduced because the anvil 14A, 14B and the insert 18 may be manufactured separately and less

material is required. Further, maintenance of the anvil 14A, 14B is easier and less costly since the user requires only a spare insert 18 rather than an entire anvil 14A, 14B when replacement is needed. Typical bond patterns produced by typical anvils (not shown) are not canted and are often merely a series of parallel rectangles (not shown). During use, these typical bond patterns may wear grooves into the surface of the horn 16A, 16B causing downtime for horn 16A, 16B maintenance. The pattern 32 disclosed in Figures 4, 4A, 4B and 4C reduces downtime for horn 16A, 16B maintenance. With particular reference to Figures 4A and 4B, it may be seen that the canted arrangement of the rectangles or teeth 32, creates a bond pattern that will evenly wear a corresponding ultrasonic horn 16A, 16B. As shown, the edges 34 of adjacent teeth 32 are parallel to one another for facile manufacture. Moreover, the teeth 32 are angled relative to the machine direction at a predetermined angle F (see Figure 4A) that provides a following tooth 32 to fill in any gaps G (See Figure 4C) existing between any preceding tooth 32. The view of Figure 4C illustrates this particular feature in greater detail. Depending on the geometry, such as width of gap between teeth 32 rows, width of gap between teeth 32, and the like, the predetermined angle F may provide full coverage of the ultrasonic horn 16A, 16B to achieve the goal of even wear. While angling the teeth 32 provides more even wear of the ultrasonic horn 16A, 16B, structural liability of the teeth 32 may increase with the angle F. Structural integrity of the teeth 32 may be increased through the use of various radii between the teeth 32 (see Figure 4B for example). By varying the radii between the teeth 32 such that each tooth has a small radius R2 on one side and a large radius R1 on the other, individual teeth 32 are more structurally sound and the chance of breaking a tooth 32 is greatly reduced. The anvil insert 18 of these views may be used to

simultaneously bond adjacent article end portions 20, while reserving a boundary between the sealed end portions for a later severing operation.

With attention to Figures 12 - 15, it may be seen that a bonding system 10 according to the present invention may include a first anvil 14A, a second anvil 14B, a third anvil 14C, a first ultrasonic horn 16A, a second ultrasonic horn 16B, and a third ultrasonic horn 16C. The anvils 14A, 14B, 14C may be each provided with an anvil insert 18 having a predetermined profile, as described above. The anvils 14A, 14B, 14C are laterally spaced apart inline and in a machine direction. As in the previous embodiment, the ultrasonic horns 16A, 16B, 16C apply vibration energy to the web 12 simultaneously and in cooperation with a respective anvil 14A, 14B, 14C to bond a respective portion of the web 12 that is to be an end portion 20 of an individual finished article (not shown in these views). As previously described, the first anvil 14A and the first ultrasonic horn 16A are provided inline from the second anvil 14B and the second ultrasonic horn 16B, with the third anvil 14C and the third ultrasonic horn 16C provided inline from the second anvil 14B and the second ultrasonic horn 16B. The anvils 14A, 14B, 14C with the corresponding horns 16A, 16B, 16C are spaced apart a predetermined distance *d3* that corresponds to the distance between bonds 22. The predetermined distance *d3* may be changed to accommodate various sizes of the finished product, since the distance *d3* corresponds to the length of the individual article. Accordingly, the length of the individual article may be changed by adjusting the position of the first, second, or third ultrasonic horn 16A, 16B, 16C with respect to any other ultrasonic horn 6A, 16B, 16C. Moreover, the system 10 includes a device for linear reciprocation of a selected anvil 14A, 14B, 14C and ultrasonic horn 16A, 16B, 16C relative to another anvil

14A, 14B, 14C and ultrasonic horn 16A, 16B, 16C and to move in the direction of arrow D, (see Figure 13) and to thereby change the distance *d3, d4* between a selected anvil 14A, 14B, 14C and horn 16A, 16B, 16C and the adjacent anvil 114A, 14B, 14C and horn 16A, 16B, 16C. As in the previously described arrangement, a selected anvil 14A, 14B, 14C and ultrasonic horn is 16A, 16B, 16C is preferably slidingly mounted to a base structure (not shown), and the movement manually or computer controlled, as understood by one skilled in the art. Since the distance *d3, d4* intervals of bonding positions may be changed by changing the position of the first, second, or third ultrasonic horn 16A, 16B, 16C the present system may easily produce individual articles of various sizes. It is to be understood that while the views of Figures 12 and 13 illustrate movement of the first and third ultrasonic horns 16A, 16C, the position of the second ultrasonic horn 16B may also or alternatively be changeable, as required by a specific application. Moreover, the bonding system 10 may include any combination of fixed and moveable ultrasonic horns 16A, 16B, 16C, such as, but not limited to: one fixed ultrasonic horn, with two movable ultrasonic horns; two fixed ultrasonic horns and one movable ultrasonic horn; three fixed ultrasonic horns; and three movable ultrasonic horns, by way of non-limiting example.

Figures 14 and 15 illustrate another arrangement of anvils and ultrasonic horns. In these views anvil pairs 114A, 114B are utilized rather that the single anvils 14A, 14B, 14C illustrated in previous views. Moreover, ultrasonic horn pairs 116A, 116B correspond to and cooperate with the anvil pairs 114A, 114B.

Figures 16 and 17 illustrate an alternative arrangement and showing a vertical accumulator series 140 rather than the web festoon accumulator 24A, 24B and accumulator rollers 30A, 30B arrangement previously

described. As shown, the accumulator series 140 may include any number of roll assemblies 130. It is to be understood that while specific numbers and arrangements of assemblies 130 are shown in the Figures, any number and arrangement of roll assemblies 130 may be envisioned without departing from the invention. Moreover, while not specifically shown, it is to be understood that the accumulator series 140 shown in Figures 16 and 17 may be used with any of the anvils 14A, 14B, 14C and ultrasonic horns 16A, 16B, 16C described and illustrated in previous views.

Figures 18 and 19 illustrate an alternative arrangement similar to that of Figures 16 and 17 but showing a horizontal accumulator series 140A. As shown, the accumulator series 140A may include any number of roll assemblies 130. As in the arrangements shown n Figures 16 and 17, it is to be understood that the specific number and arrangement of assemblies 130 shown in the Figures should not be considered limiting, and any number and arrangement of roll assemblies 130 may be envisioned without departing from the invention. Moreover, while not specifically shown, it is to be understood that accumulator series 140A shown in Figures 18 and 19 may be used with any of the anvils 14A, 14B, 14C and ultrasonic horns 16A, 16B, 16C described and illustrated in previous views.

The foregoing is considered as illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.

I claim:

1. A bonding system for bonding webs including:

a first anvil and a corresponding first ultrasonic horn;

a second anvil and a corresponding second ultrasonic horn, wherein each of the first anvil and the second anvil includes an anvil insert having a predetermined profile and wherein the first anvil and the second anvil are laterally spaced apart inline and in a machine direction.

2. The system of claim 1 further including a web velocity-changing device.

3. The system of claim 1 wherein the anvil profile includes an anvil insert having a pair of spaced apart seal surfaces having a recess therebetween.

4. A method of bonding webs including the steps of:

providing a first anvil having a corresponding first ultrasonic horn, the first anvil and the first ultrasonic horn spaced apart at a first gap;

providing a second anvil having a corresponding second ultrasonic horn, the second anvil and the second ultrasonic horn spaced apart at a second gap, the first anvil and the first ultrasonic horn being inline from the second anvil and the second ultrasonic horn and spaced apart a predetermined distance;

moving the webs in a machine direction through the first gap and the second gap;

applying vibration energy to the web via the first ultrasonic horn and the second ultrasonic horn in cooperation with a respective anvil to bond respective portions of the web, the portions being spaced apart at the predetermined distance.

5. The method of claim 4 including the further step of changing the predetermined distance between the first ultrasonic horn and the second ultrasonic horn.

6. The method of claim 4 including the further step of providing a web velocity-changing device.

7. The method of claim 4 including the further step of providing each of the first and second anvils with an anvil insert, the anvil insert including a pair of spaced apart seal surfaces having a recess therebetween.

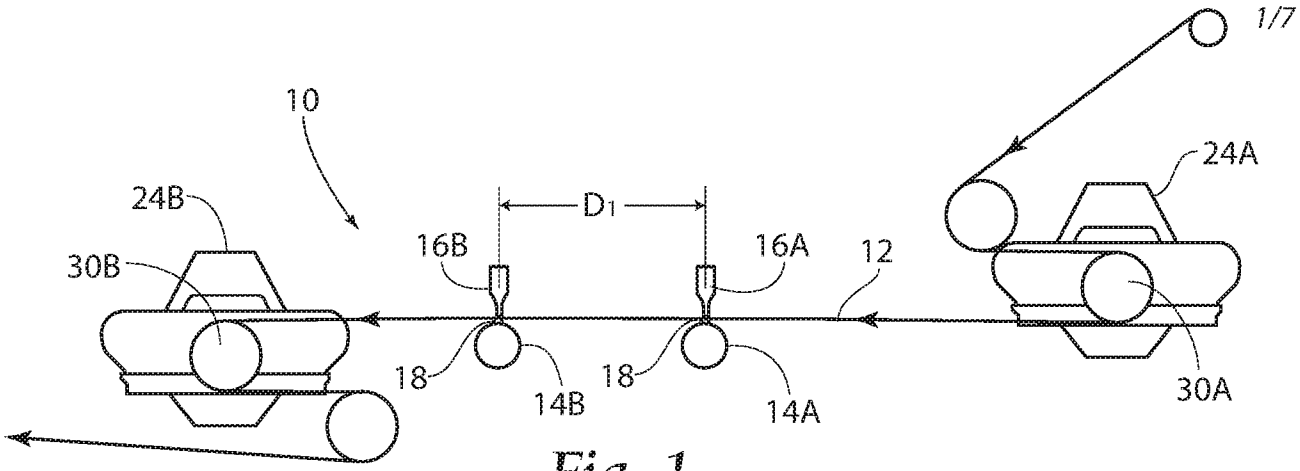


Fig. 1

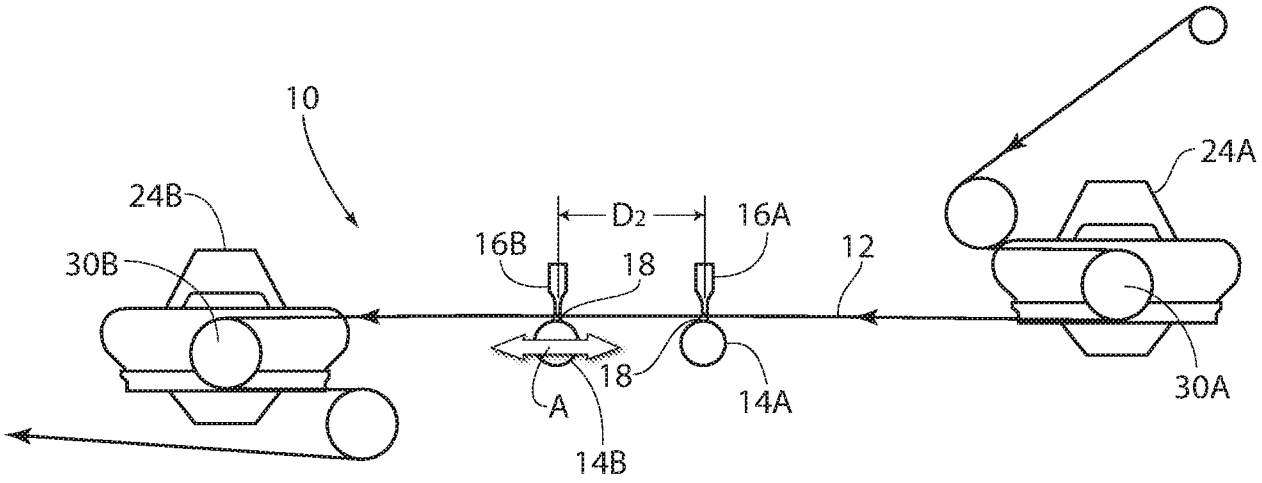


Fig. 2

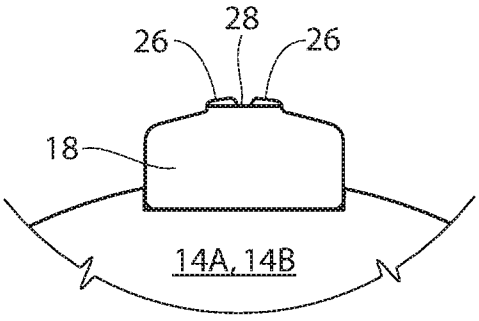


Fig. 3

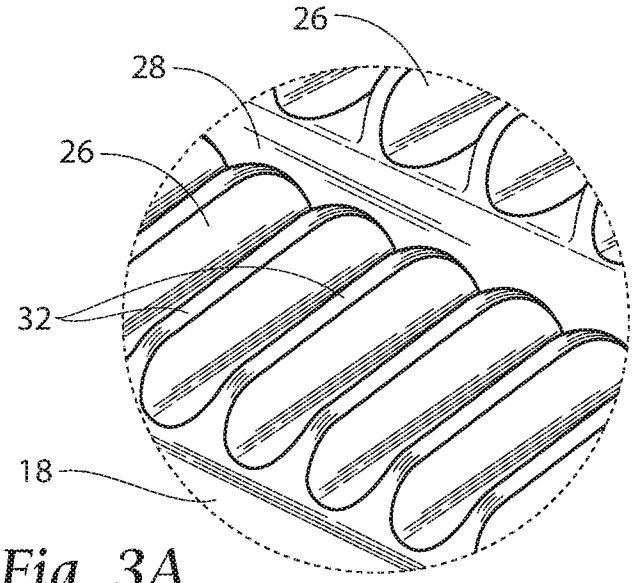


Fig. 3A

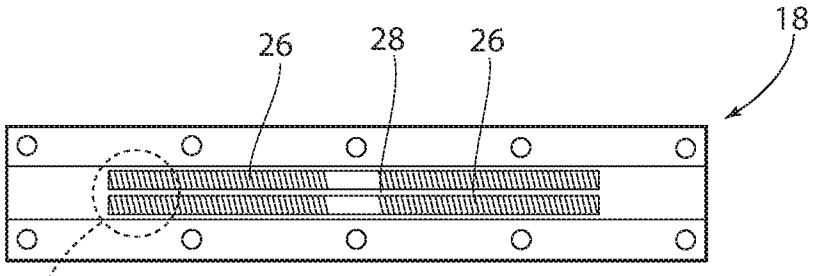


Fig. 4

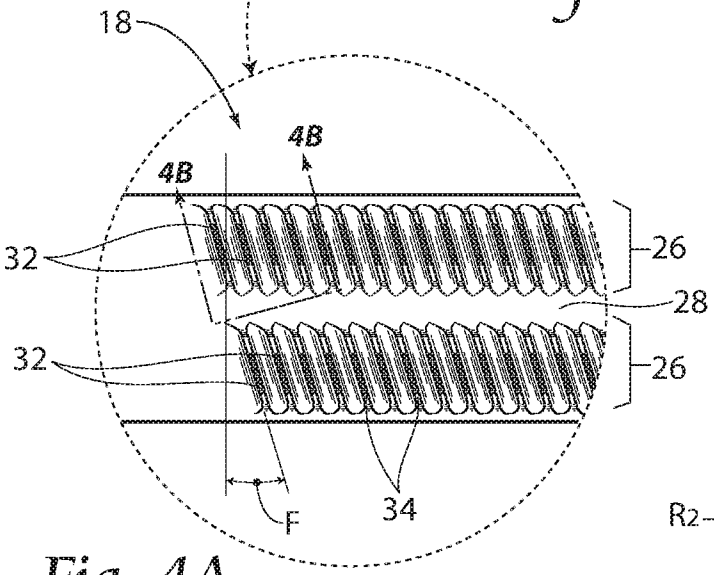


Fig. 4A

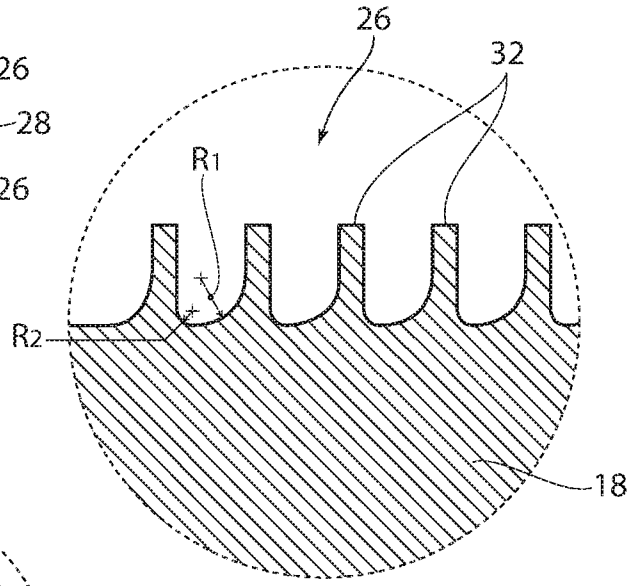


Fig. 4B

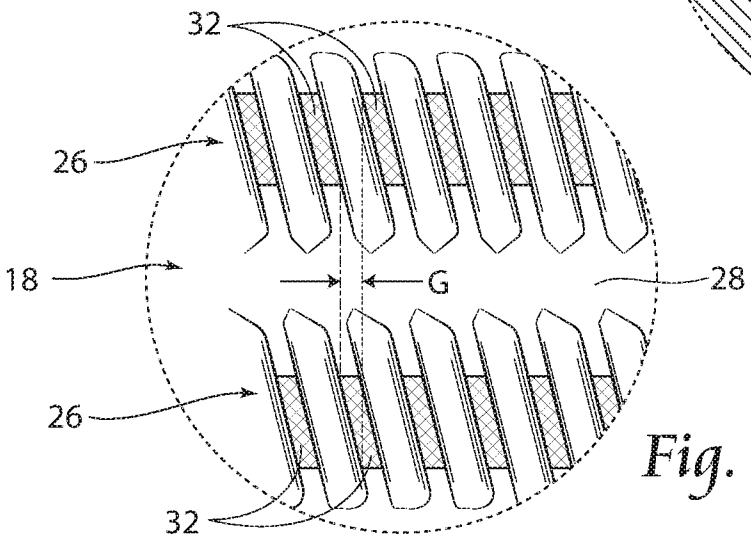


Fig. 4C

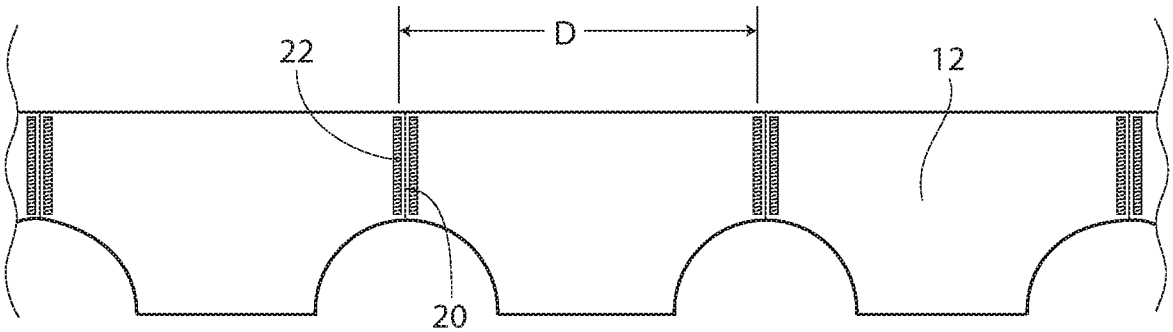


Fig. 5

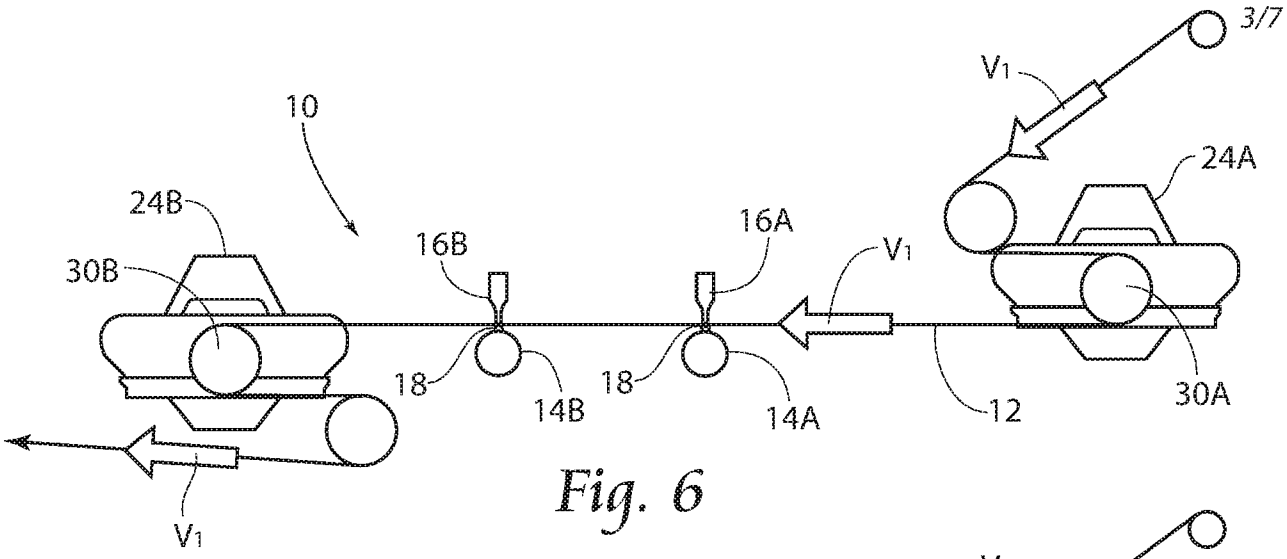


Fig. 6

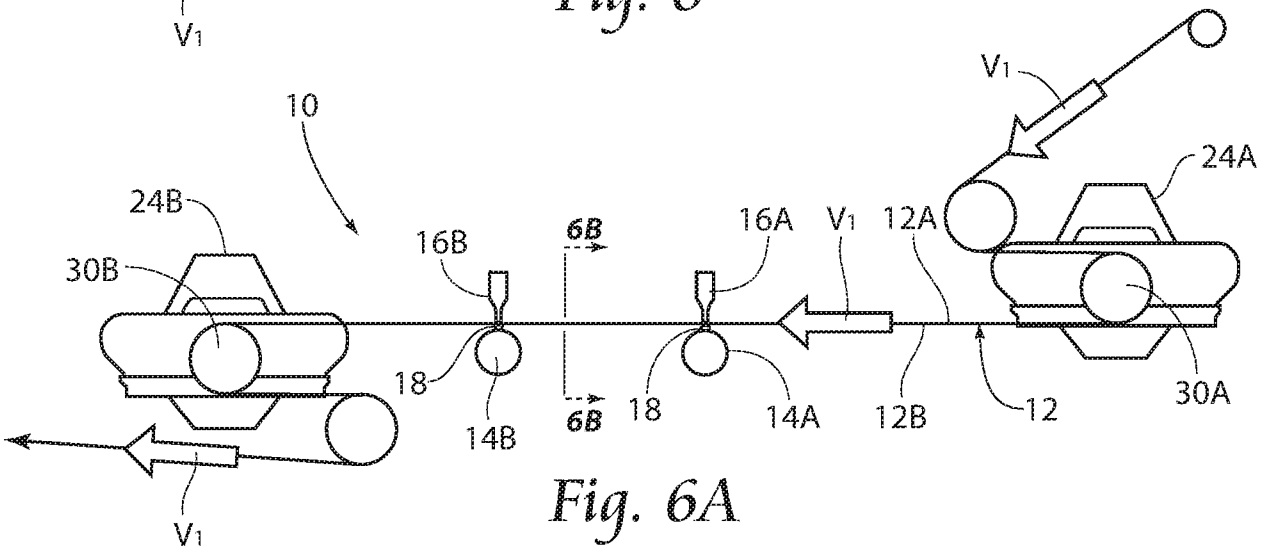


Fig. 6A

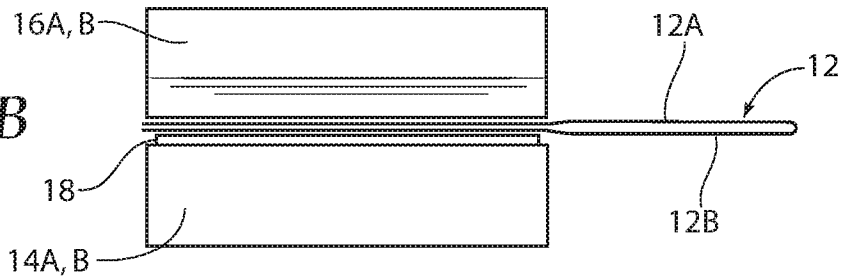


Fig. 6B

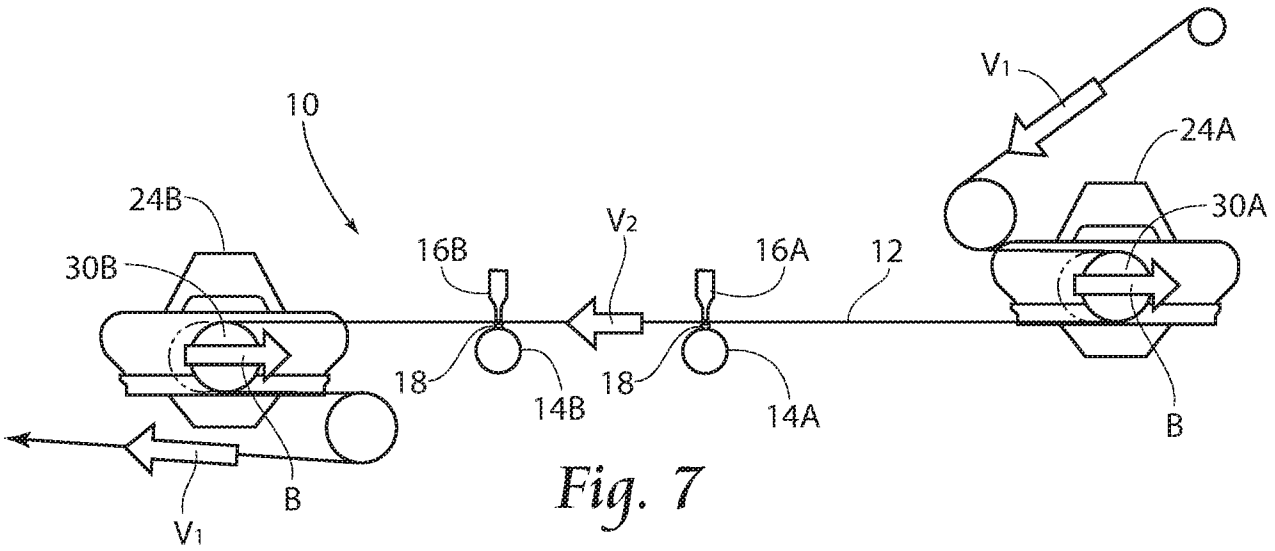


Fig. 7

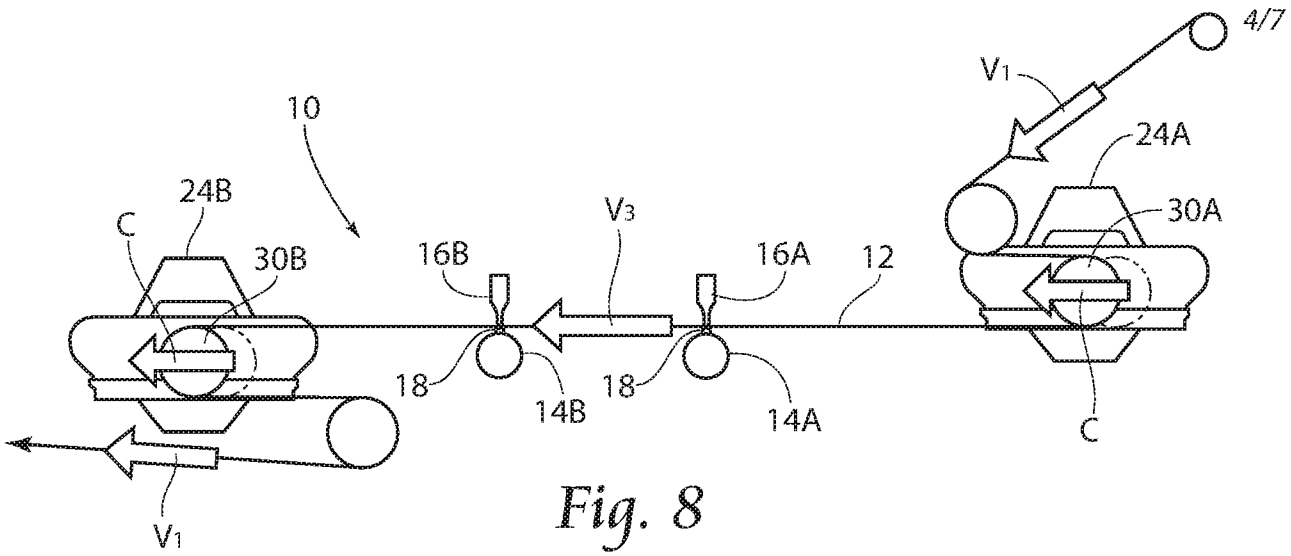


Fig. 8

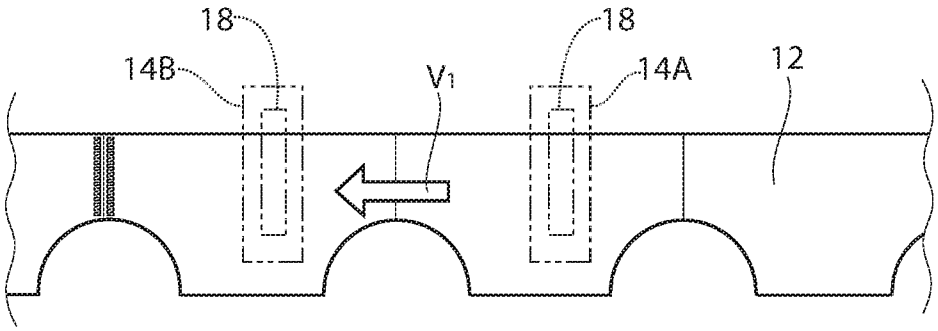


Fig. 9

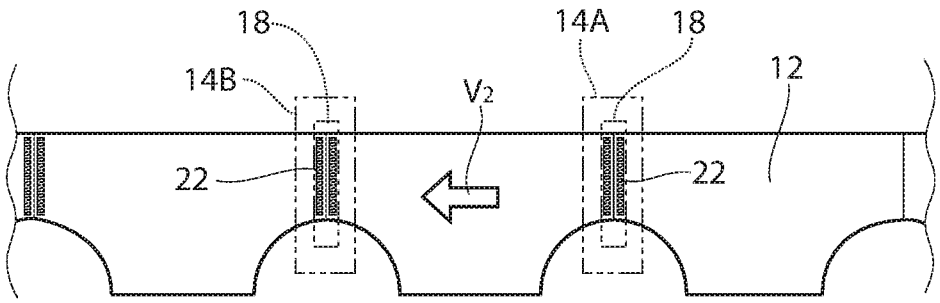


Fig. 10

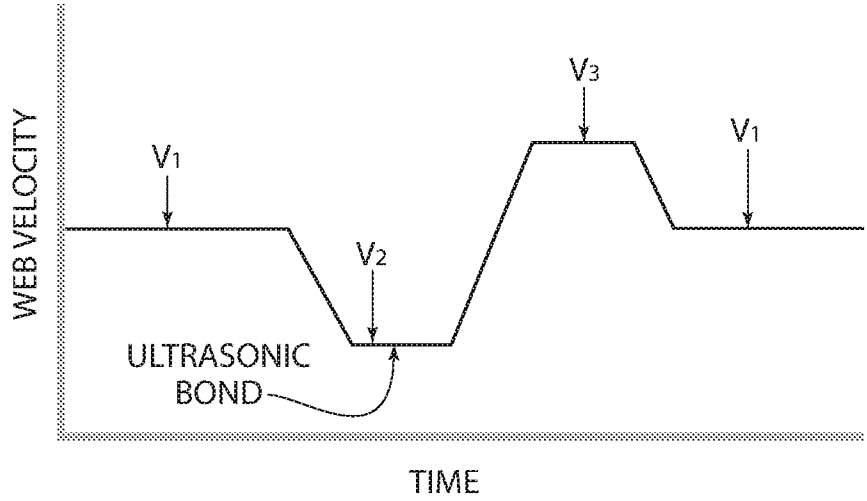


Fig. 11

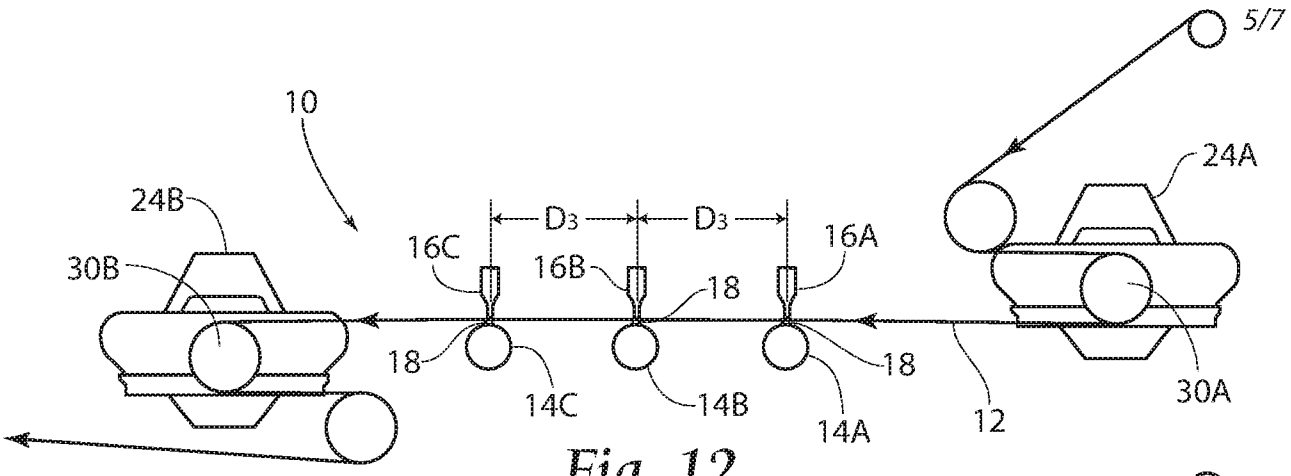


Fig. 12

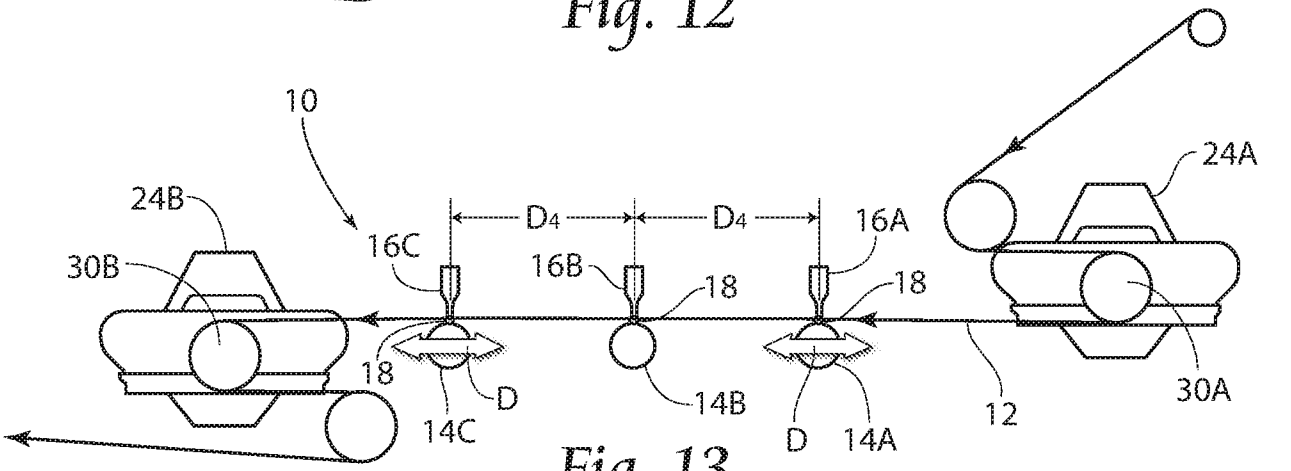


Fig. 13

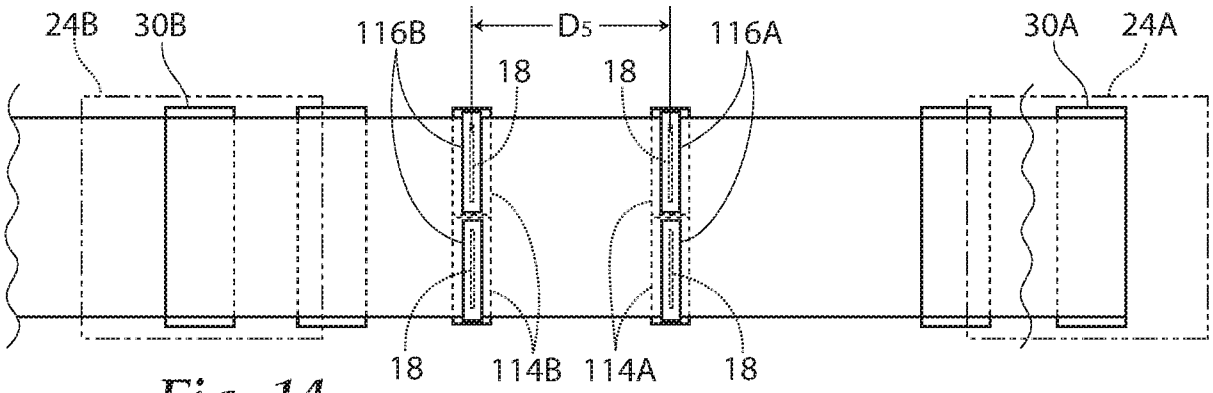


Fig. 14

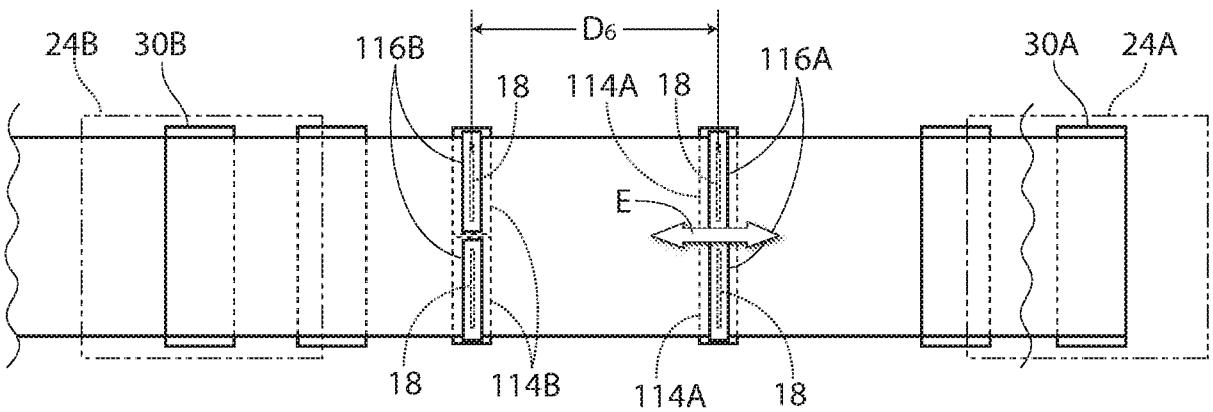


Fig. 15

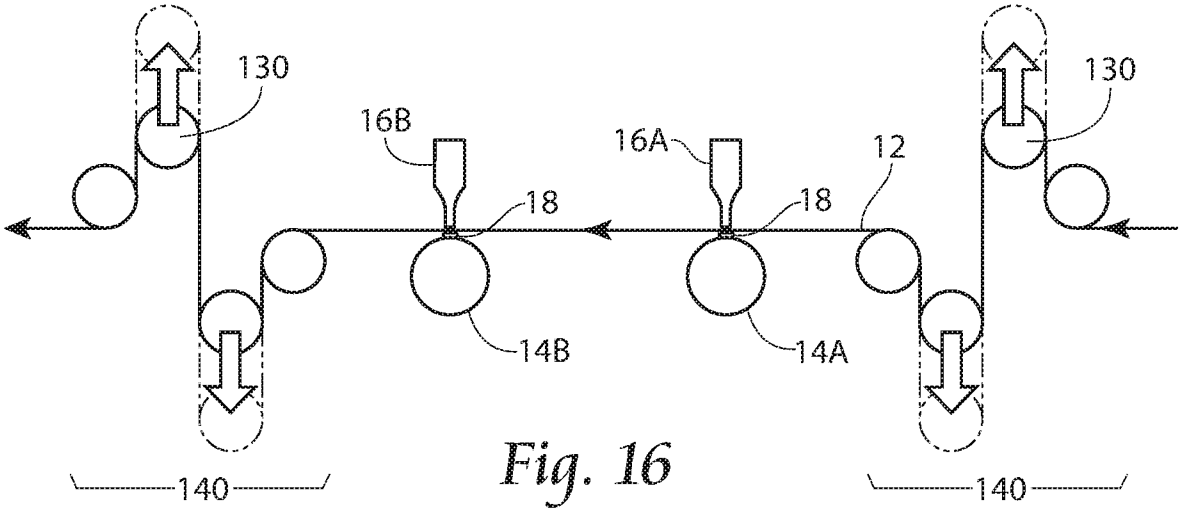
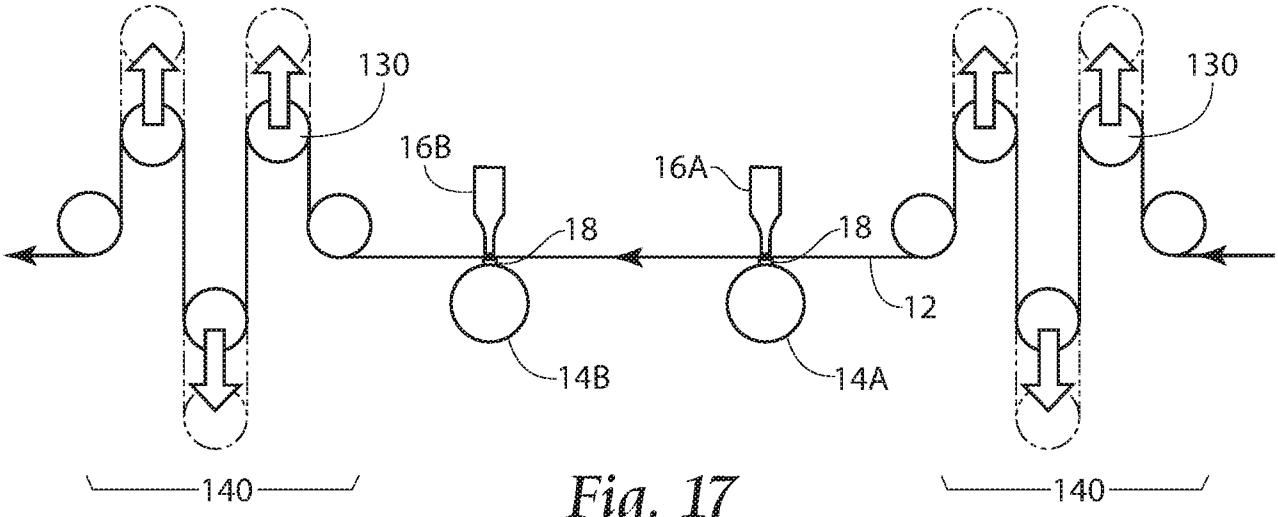

130
16B
18
16A
18
12
130
14B
14A
140
140

Fig. 16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16A
18
12
130
14B
14A
140
140

Fig. 17

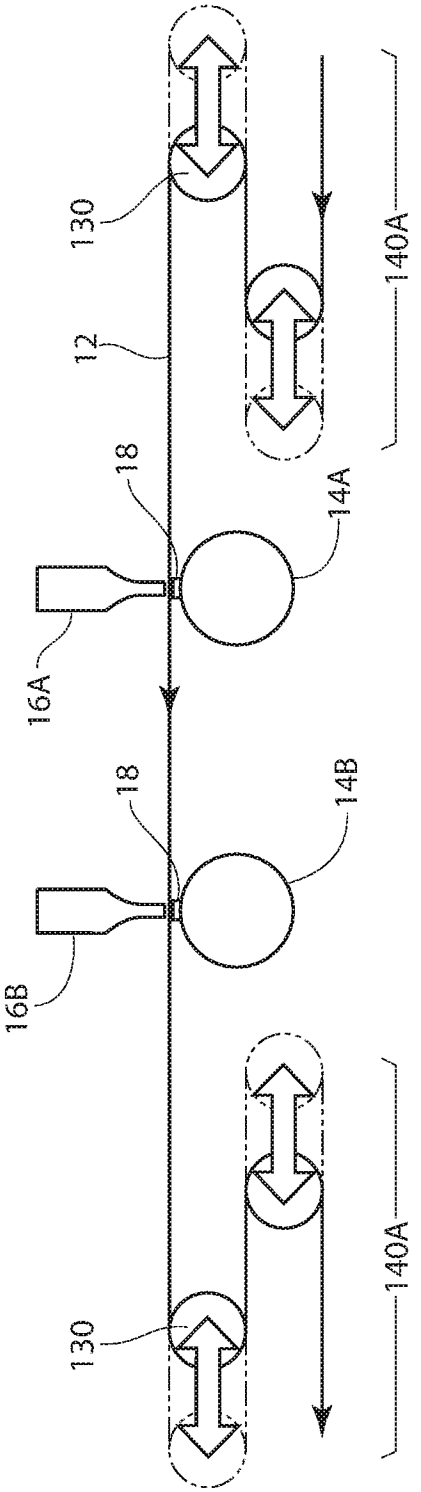
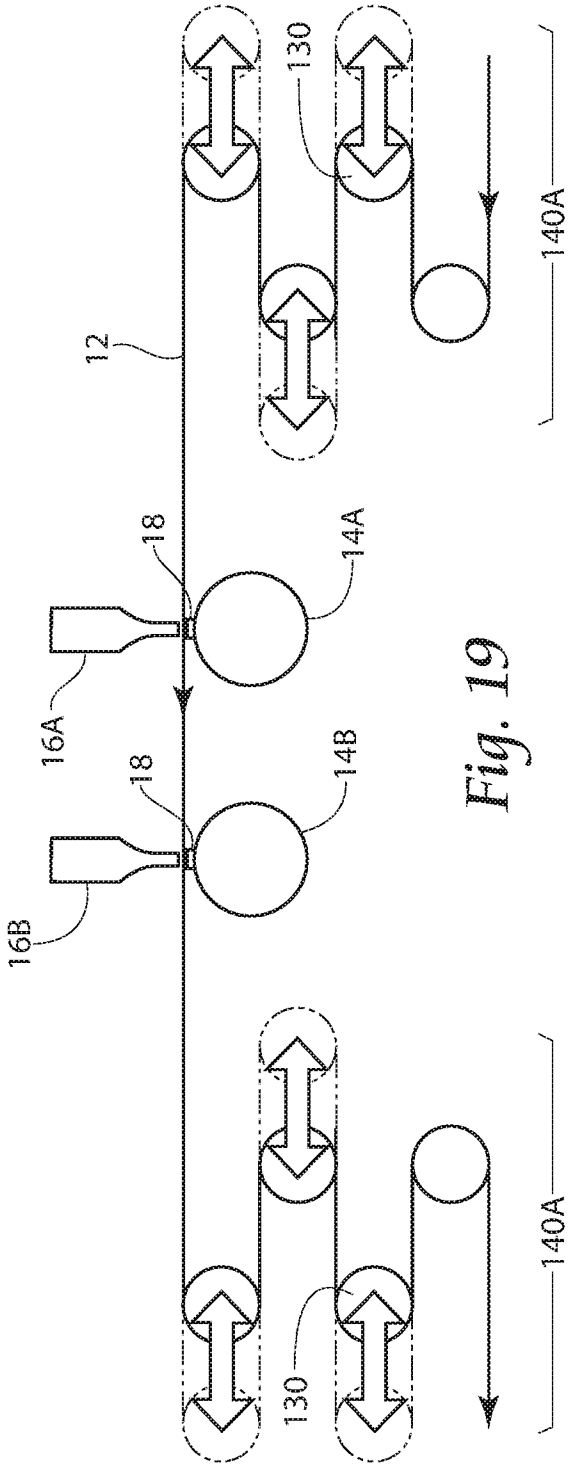

130
12
140A
18
14A
16A
18
14B
16B
130
140A

Fig. 18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12
140A
18
14A
16A
18
14B
16B
130
140A

Fig. 19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/51848

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B29C 65/08; D04H 1/555 (2017.01)
CPC - B29C 65/08; D04H 1/555; B29C 66/729, B29C 66/7294, B29C 66/82, B29C 66/934; B29L 2031/4878

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,454,890 B1 (Couillard et al.) 24 September 2002 (24.09.2002), Figs. 1A-1B, 4A, 5B, col. 10, ln. 24-44, col. 13, ln. 59-63, col. 15, ln. 24-42	1, 3-4 and 7 --- 2
X --- Y	US 2015/0298390 A1 (Shimada) 22 October 2015 (22.10.2015), Figs. 1-2, para [0031]-[0033], [0072], [0106]	4-6 --- 2
A	US 2002/0017366 A1 (Inagaki et al.) 14 February 2002 (14.02.2002), Fig. 21, para [0104]-[0110]	1-7
A	US 2001/0040014 A1 (Green et al.) 15 November 2001 (15.11.2001), Fig. 4', para [0072]-[0074]	1-7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 October 2017	01 DEC 2017
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774