Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2933215 A1 2011/11/10

(21) 2 933 215

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) **Date de dépôt/Filing Date:** 2011/03/31

(41) **Mise à la disp. pub./Open to Public Insp.:** 2011/11/10

(62) **Demande originale/Original Application:** 2 797 460

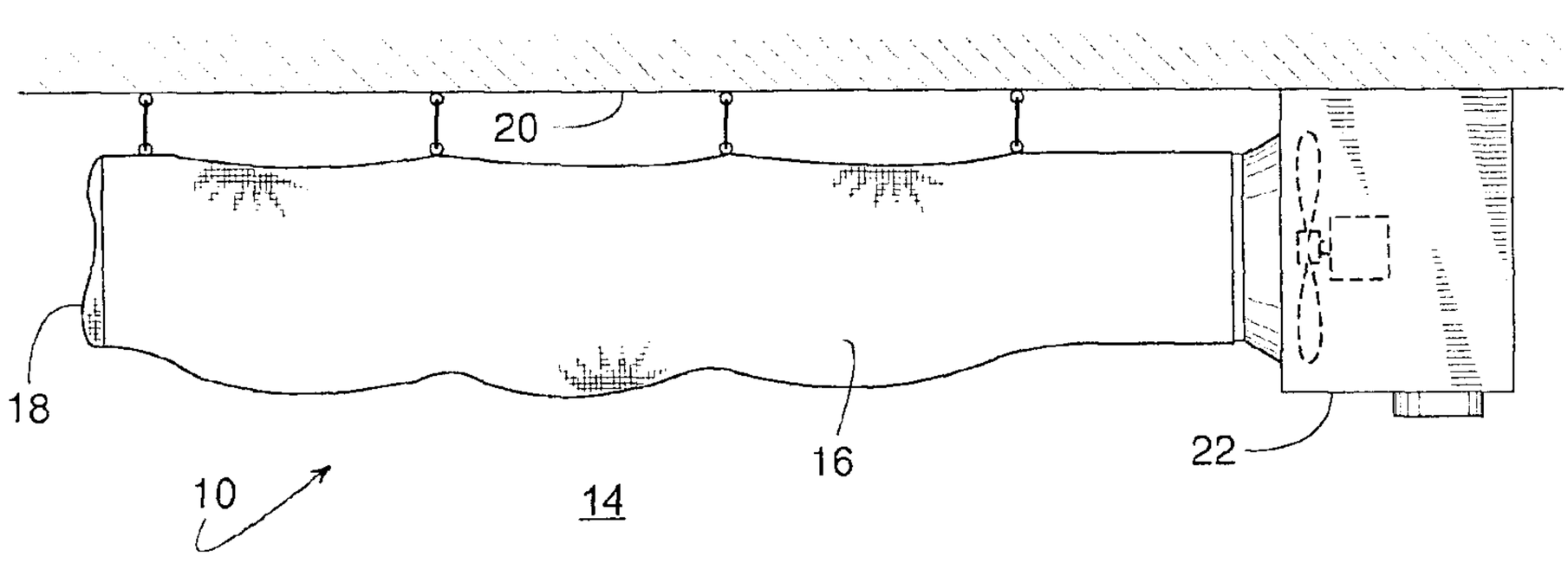
(30) **Priorité/Priority:** 2010/05/03 (US12/772,863)

(51) **Cl.Int./Int.Cl.** ***F24F 13/068*** (2006.01),
F16L 11/00 (2006.01), ***F16L 11/02*** (2006.01),
F24F 13/02 (2006.01), ***F24F 13/075*** (2006.01),
F24F 13/10 (2006.01)

(71) **Demandeur/Applicant:**
RITE-HITE HOLDING CORPORATION, US

(72) **Inventeurs/Inventors:**
GEBKE, KEVIN J., US;
HEIM, FRANK, US;
JACOBSON, MICHAEL A., US;
KAUFMAN, NICHOLAS L., US;
NEIHAUS, WILLIAM A., US;
...

(54) **Titre : CONDUITES D'AIR FLEXIBLES CONFIGURABLES**
(54) **Title: CONFIGURABLE PLIABLE AIR DUCTS**



(57) **Abrégé/Abstract:**
In some example pliable air duct systems, inflatable ducts of various diameters and lengths are created by selectively assembling pre-existing stock pieces in different combinations. In some examples, the stock pieces include disconnectable longitudinal joints and disconnectable circumferential joints, wherein the longitudinal joints enable interconnecting multiple stock pieces to achieve a desired tube diameter, and the circumferential joints allow connecting multiple tube segments end-to-end to produce an air duct assembly of a desired length. To control the volume and/or the direction of air discharged from the duct, the duct assembly, in some examples, includes an adjustable register comprising a movable pliable sheet that overlies a discharge opening in a pliable sidewall of the duct. In some examples, the inflatable duct includes one or more cutout patterns on the duct's sidewall to provide guidance in creating a sidewall discharge opening of a proper size and location.

CA 2933215 A1 2011/11/10

(21) **2 933 215**

(13) **A1**

(72) **Inventeurs(suite)/Inventors(continued):** PINKALLA, CARY, US; STEPHAN, IRENE E., US

(74) **Agent:** GOUDREAU GAGE DUBUC

ABSTRACT

In some example pliable air duct systems, inflatable ducts of various diameters and lengths are created by selectively assembling pre-existing stock pieces in different combinations. In some examples, the stock pieces include disconnectable longitudinal joints and disconnectable circumferential joints, wherein the longitudinal joints enable interconnecting multiple stock pieces to achieve a desired tube diameter, and the circumferential joints allow connecting multiple tube segments end-to-end to produce an air duct assembly of a desired length. To control the volume and/or the direction of air discharged from the duct, the duct assembly, in some examples, includes an adjustable register comprising a movable pliable sheet that overlies a discharge opening in a pliable sidewall of the duct. In some examples, the inflatable duct includes one or more cutout patterns on the duct's sidewall to provide guidance in creating a sidewall discharge opening of a proper size and location.

CONFIGURABLE PLIABLE AIR DUCTS

Field of the Disclosure

[0001] This patent generally pertains to pliable inflatable air ducts and, more specifically, to features that enable such ducts to be selectively set up in various configurations.

Background

[0002] Sheet metal ductwork is often used for conveying conditioned air to a comfort zone, such as a room or other area(s) of a building. Metal ducts, however, can be expensive, unsightly, and susceptible to condensation. Consequently, inflatable air ducts, such as those made of pliable fabric, are often preferred over conventional sheet metal air ducts.

[0003] Inflatable air ducts typically include an inflatable tube made of fabric or otherwise pliable material and are used for conveying conditioned air to comfort zones. A blower at the inlet of the duct is selectively activated to supply conditioned air as needed. The air discharged from the blower inflates the duct to create a radially expanded tubular conduit that conveys the air along the length of the inflated tube. The pliable wall of the tube may be porous and/or may be perforated along a length of the tube for evenly or strategically dispersing air from within the duct into the areas being conditioned or ventilated.

[0004] Inflatable air ducts are often suspended from a horizontal cable or track mounted just below the ceiling of a building. In other examples, inflatable ducts are installed beneath a floor and supply conditioned air to a comfort zone by releasing the air up through one or more openings in the floor.

Brief Description of the Drawings

[0005] Figure 1 is a side view of on example inflatable air duct assembly, wherein the duct is shown deflated.

[0006] Figure 2 is a side view of the air duct of Figure 1 but showing the duct inflated.

[0007] Figure 3 is a front view of an example inventory of example stock sidewall pieces.

[0008] Figure 4 is a perspective view of example sidewall pieces about to be assembled.

[0009] Figure 5 is a perspective view similar to Figure 4 but showing the pieces assembled.

[0010] Figure 6 is a perspective view similar to Figure 5 but showing another example of an assembled air duct assembly.

[0011] Figure 7 is a perspective view similar to Figures 5 and 6 but showing yet another example of an assembled air duct assembly.

[0012] Figure 8 is a perspective view of another example air duct assembly.

[0013] Figure 9 is a perspective view similar to Figure 8 but showing the duct in a smaller diameter configuration.

[0014] Figure 10 is an exploded view showing an example air duct assembly with a configurable elbow.

[0015] Figure 11 is a perspective view of the duct of Figure 10 but showing the duct assembled in an example configuration.

[0016] Figure 12 is a perspective view of the duct of Figure 10 but showing the duct assembled in another example configuration.

[0017] Figure 13 is a perspective view of an example duct assembly with example removable pliable sheets about to be installed over discharge openings in the duct.

[0018] Figure 14 is a perspective view similar to Figure 13 but showing the pliable sheets installed.

[0019] Figure 15 is a perspective view of another example duct assembly with a circumferentially movable sheet for adjusting the airflow through a discharge opening in the duct.

[0020] Figure 16 is a perspective view similar to Figure 15 but showing the example movable sheet in another position.

[0021] Figure 17 is a cross-sectional view taken along line 17-17 of Figure 15.

[0022] Figure 18 is a perspective view of another example duct assembly with two circumferentially movable sheets for adjusting the airflow through two discharge openings in the duct.

[0023] Figure 19 is a cross-sectional view taken along line 19-19 of Figure 18.

[0024] Figure 20 is a perspective view of another example duct assembly with two circumferentially movable sheets for adjusting the airflow through two discharge openings in the duct.

[0025] Figure 21 is a perspective view of another example duct assembly with two movable sheets for adjusting the airflow through two discharge openings in the duct.

[0026] Figure 22 is a perspective view of an example duct assembly with an internal movable sheet for adjusting the airflow through a discharge opening in the duct.

[0027] Figure 23 is a perspective view of an example air duct assembly that includes a movable sheet with example flexible louvers for adjusting the airflow through a discharge opening in the duct.

[0028] Figure 24 is a cross-sectional view taken along line 24-24 of Figure 23.

[0029] Figure 25 is a perspective view of an example inflatable air duct with integrally formed discharge louvers.

[0030] Figure 26 is a perspective view of an example inflatable air duct with a plurality of example cutout patterns.

[0031] Figure 27 is a perspective view similar to Figure 26 but showing the cutout pattern being used as a guide for creating a discharge opening.

[0032] Figure 28 is a perspective view similar to Figures 25 and 26 but showing a cutout being removed to produce the discharge opening.

[0033] Figure 29 is a flow diagram representative of example machine readable instructions that may be executed to develop an inflatable air duct assembly.

[0034] Figure 30 is a schematic illustration of an example processor platform that may be used and/or programmed to execute the example instructions of Figure 29 to implement a system to develop inflatable air duct assemblies and/or orders for inflatable air duct assemblies.

Detailed Description

[0035] Certain examples are shown in the above-identified figures and described in detail below. In describing these examples, like or identical reference numbers are used to identify the same or similar elements. The figures are not necessarily to scale and certain features and certain views of the figures may be shown exaggerated in scale or in schematic for clarity and/or conciseness. Additionally, several examples have been described throughout this specification. Any features from any example may be included with, a replacement for, or otherwise combined with other features from other examples.

[0036] Figures 1 and 2 show an example inflatable air duct or duct 10 set up for delivering air 12 to a comfort zone 14 or other area(s) of a building. In this example, duct 10 includes a pliable tubular sidewall or sidewall 16 with an end cap 18. While the duct 10 may be installed in numerous configurations and/or arrangements, in this example, duct 10 is suspended from an overhead support 20 (e.g., ceiling, rafter, beam, cable, etc.). An air

supply, such as a blower 22, draws in air from an inlet 24 and discharges air 12 through the interior of duct 10, thereby inflating duct 10. The terms, "inflate," "inflating," "inflated," and "inflatable," as used herein, mean that upon pressurizing the interior of a duct, the duct 10 expands noticeably with the internal volume of the duct 10 increasing appreciably. This is the case even though some example inflatable ducts include structure that helps hold the duct in a partially expanded shape when the blower 22 is de-energized. Figure 1 shows blower 22 de-energized with duct 10 deflated, and Figure 2 shows blower 22 energized with duct 10 inflated.

[0037] When duct 10 is inflated, air 12 discharged from blower 22 flows longitudinally (in a direction generally indicated by arrow 26) through duct 10. Various examples of duct 10 releases air 12 from within duct 10 to comfort zone 14 via porosity and/or discrete openings in sidewall 16. Sidewall 16 may be made of one or more similar or different materials. For example, sidewall 16 may include and/or be made of materials including, but not limited to, urethane coated polyester fabric, uncoated polyester fabric, porous fabric, nonporous pliable sheet material, perforated pliable sheet material, and/or various combinations thereof.

[0038] Figures 3 – 7 illustrate a method for creating inflatable air ducts (e.g., the air duct 10) for different installations without having to custom make unique pieces for each system. Figure 3, for example, shows an inventory of a plurality of pliable sidewall pieces 28 including relatively large pieces 30 (e.g., larger circumferential length 32) and smaller pieces 34 (e.g., smaller circumferential length 36). In other examples, the inventories may have any number of sizes (e.g., 1, 2, 3, etc.) and/or shapes (square, rectangular, etc.) and some example inventories have only single-size pieces. In any case, the inventory of pieces can be assembled in different ways to create an assortment of inflatable duct tubes of various diameters and lengths

[0039] For the example illustrated in Figure 3, each piece 30 and 34 includes longitudinal edges 38 with disconnectable longitudinal joints 40 that may be interconnected to combine one or more pieces 30 and/or 34 to provide different tube diameters (e.g., a first diameter, a second diameter, a third diameter, etc.). Large pieces 30 have axial edges 42 with disconnectable circumferential joints 44, and smaller pieces 34 have axial edges 46 with disconnectable circumferential joints 48. Circumferential joints 44 and 48 may be interconnected to combine one or more pieces 30 and/or 34 to provide different tube lengths (e.g., a first length, a second length, a third length, etc.). The expression, "disconnectable joint," means a connection that can be repeatedly connected and separated multiple times without appreciable damage to the adjoining pieces over its expected useful life. Examples

of joints 40, 44 and 48 include, but are not limited to, zippers, touch-and-hold fasteners (e.g., VELCRO, a registered trademark of Velcro Industries B.V.), bead-in-groove fasteners (e.g., ZIPLOC, a registered trademark of S.C. Johnson & Son, Inc.), series of hooks, series of buttons, series of snaps, laces, etc.

[0040] Figure 4 shows one of the large pieces (e.g., a sidewall piece) 30 about to be connected to two smaller pieces (e.g., side wall pieces) 34 and the resulting assembled tube segment 50 about to be connected to the axial end of another tube segment 52. Figure 5 shows the pieces 30 and 34 of Figure 4 in their assembled configuration as tube segments 50 and 52. Figure 6 shows two large pieces (e.g., sidewall pieces) 30 interconnected to provide a tube segment 54 with a diameter that is relatively smaller than the tube formed by pieces 30 and 34 of Figure 5. Figure 7 shows a single large piece (e.g., a single sidewall piece) 30 with its longitudinal edges 38 connected at a disconnectable joint 40 to provide an even smaller diameter tube segment 56. In examples where a tube is not perfectly cylindrical, the term, "diameter," refers to the effective diameter of the tube, which is defined herein as $(4A/3.14)^{0.5}$, wherein "A" is the cross-sectional area of the air passageway of the tube.

[0041] The example tube assemblies in Figures 5 – 7 are shown having a common sidewall piece (e.g., sidewall piece 30) to illustrate the universal application of the pieces as opposed to having to custom make each one. It should be noted that the inventory of pieces shown in Figure 3 illustrates an example of providing a plurality of sidewall pieces. Figures 5 – 7 illustrate examples of suggesting a plurality of different design arrangements in which at least some of the plurality of sidewall pieces can be interconnected circumferentially to create an assortment of inflatable tubes of various diameters. The plurality of different design arrangements includes a larger diameter tube design (Fig. 5) that employs the common sidewall piece, and the plurality of different design arrangements includes a smaller diameter tube design (Figs. 6 or 7) that employs the common sidewall piece. A comparison of Figures 4 and 5 illustrates an example of assembling a chosen set of sidewall pieces from the plurality of sidewall pieces to create a certain inflatable tube (e.g., a tube having a particular diameter and/or flow characteristics).

[0042] Figures 8 and 9 show an example inflatable air duct or duct 58 that can be selectively configured to a larger diameter configuration (Fig. 8) or a smaller diameter configuration (Fig. 9). The larger diameter configuration provides an expanded cross-sectional flow area, and the smaller diameter configuration provides a reduced cross-sectional flow area.

[0043] In this example, duct 58 includes a first pliable sidewall section 60 and a second pliable sidewall section 62. The two sections 60 and 62 are divided by a first longitudinal border 64 and a second longitudinal border 66. Duct 58 includes a disconnectable longitudinal joint 68 extending along borders 64 and 66. Examples of joint 68 include, but are not limited to, zippers, touch-and-hold fasteners (e.g., VELCRO), bead-in-groove fasteners (e.g., ZIPLOC), series of hooks, series of buttons, series of snaps, laces, etc. Disconnecting joint 68 to separate borders 64 and 66 places duct 58 in the larger diameter configuration, as shown in Figure 8. Closing or connecting joint 68 brings borders 64 and 66 together and positions second sidewall 62 within the reduced cross-sectional flow area of duct 58, which places duct 58 in the smaller diameter configuration, as shown in Figure 9. In either configuration, a circumferential joint 70 can connect duct 58 to the end of another appropriately sized tube segment, such as segment 72 or 74, for example.

[0044] Figures 10, 11 and 12 show an example inflatable air duct assembly or duct assembly 76 that can be selectively configured to direct airflow in different directions. In this example, duct assembly 76 includes a disconnectable circumferential joint 78 that connects a pliable tube 80 to a pliable elbow 82 in multiple configurations. A longitudinal joint 84 connects the longitudinal edges of tube 80. Examples of joints 78 and 84 include, but are not limited to, zippers, touch-and-hold fasteners (e.g., VELCRO), bead-in-groove fasteners (e.g., ZIPLOC), series of hooks, series of buttons, series of snaps, laces, etc.

[0045] In the illustrated example, circumferential joint 78 includes a first tube joint segment 86a on tube 80, a second tube joint segment 86b on tube 80, a first elbow joint segment 88a on elbow 82, and a second elbow joint segment 88b on elbow 82. First tube joint segment 86a is selectively connectable to elbow joint segments 88a and 88b. Likewise, second tube joint segment 86b is selectively connectable to elbow joint segments 88a and 88b.

[0046] When first tube joint segment 86a and second tube joint segment 86b are connected respectively to first elbow joint segment 88a and second elbow joint segment 88b, as shown in Figure 11, the inflatable air duct assembly 76 is in the first direction configuration to direct air 12 in a first direction 90. When first tube joint segment 86a and second tube joint segment 86b are connected respectively to second elbow joint segment 88b and first elbow joint segment 88a, as shown in Figure 12, duct assembly 76 is in the second direction configuration to direct air 12 in a second direction 92. In some examples, directions 90 and 92 are in opposite directions, 180-degrees apart, which can be achieved by having joint segments 86a, 86b, 88a and 88b be of substantially equal circumferential length with

longitudinal joint 84 being positioned circumferentially between tube joint segments 86a and 86b. However, the directions 90 and 92 may be arranged at any suitable angle relative to one another (e.g., 45-degrees apart, 90-degrees apart, etc.) and, accordingly, any number (e.g., 1, 2, 3, etc.) of joint segments 86 and 88 may be provided.

[0047] Figures 13 and 14 show an example inflatable air duct assembly 94 that can be selectively configured to establish the volume of airflow discharged at various locations along the length of duct assembly 94. In this example, duct assembly 94 includes an inflatable tube 96 with a pliable sidewall 98 that includes a plurality of discharge openings 100. The discharge openings 100 may be similarly or differently sized. To restrict the airflow discharged through openings 100, a pliable sheet or patch 102 is placed over one or more openings 100. The example sheets 102 may define an opening though which air may flow that may be differently sized than opening 100. Alternatively, sheets 102 may not define an opening. The openings of sheet 102 may be similarly or differently sized (e.g., a first size, a second size, etc.) and/or shaped (e.g., a first shape, a second shape, etc.). Any suitable fastener 104 (e.g., touch-and-hold fastener) can be used to help hold sheet 102 to sidewall 98. In other examples, sheet 102 may additionally or alternatively be secured to sidewall 98 using an adhesive or glue. In the illustrated examples, a sheet 102a has a relatively small opening 106 for greatly restricting the airflow through opening 100 when sheet 102a is moved from its more-open position (Fig. 13) to its obstructed position (Fig. 14). A sheet 102b has no opening, so sheet 102b completely blocks airflow through opening 100 when sheet 102b is moved from its more-open position (Fig. 13) to its obstructed position (Fig. 14) (e.g., when sheet 102b is affixed to sidewall 98 via fastener 104). A sheet 102c has a moderately sized opening 108 for providing some flow resistance through opening 100 when sheet 102c is moved from its more-open position (Fig. 13) to its obstructed position (Fig. 14).

[0048] Figures 15, 16 and 17 show an example inflatable air duct assembly 110 that can be selectively configured to establish or change the volume of airflow discharged through an opening 112 in a pliable sidewall 114 of duct assembly 110. The duct assembly 110 may include one or more pliable pieces that are coupled together. To restrict the airflow discharged through opening 112, a pliable sheet 116 is attached to sidewall 114 such that sheet 116 can be moved circumferentially around duct assembly 110 to adjust the extent to which sheet 116 covers opening 112. In some examples, the sheet 116 may be additionally secured relative to the sidewall 114 with a fastener such as a touch-and-hold fastener. Figure 15 shows sheet 116 in a more-open position, and Figure 16 shows sheet 116 is an obstructed

position. In the illustrated example, duct assembly 110 includes a pair of axially spaced-apart circumferential lips, or fasteners 118 that at least partially holds sheet 116 against sidewall 114. For example, opposing portions of sheet 116 may be at least partially positioned within a groove, channel or slot defined by the lips 118 and the sidewall 114 (e.g., similar to a tongue-and-groove) such that the interaction between sheet 116 and lips 118 and sidewall 114 holds sheet 116 relatively securely against sidewall 114 while enabling sheet 116 to be moveable (e.g., circumferentially moveable) relative to sidewall 114. Lips 118 may be made of a similar or different material as sidewall 114 and/or sheet 116. For example, lips 118 may be made at least partially of a relatively rigid material to ensure that sheet 116 maintains its position adjacent to sidewall 114. In some examples, lips 118 may have a similar or different thickness as sidewall 114 and/or sheet 116. In some examples, edges of sheet 116 may be made of a different material than the remainder of sheet 116 and/or include an insert(s) adjacent to the edges to increase the rigidity of edges and substantially ensure that sheet 116 maintains its position adjacent to sidewall 114 and lip 118. In some examples, lips 118 can be coupled to sidewall 114 by sewing, glue or adhesive, touch-and-hold fasteners, etc.

[0049] To control the volume of airflow, in this example, sheet 116 includes a relatively small opening 120 and a moderately-sized opening 122, either of which can be move in or out of registry with opening 112 in sidewall 114, thereby determining the flow restriction therethrough. In some examples, lips 118 also provide a cover for circumferential joints 124 (e.g., a zipper).

[0050] Figures 18 and 19 show an example of how the examples illustrated in Figures 15 – 17 can be expanded to include multiple pliable sheets 116 for adjustably covering multiple discharge openings 112 in a pliable sidewall 126 of a duct 128. The duct 128 may include one or more pliable pieces that are coupled together. In this example, to hold two sheets 116 in position, an intermediate circumferential lip or fastener 130 is installed between lips 118. In some examples, the sheets 116 may additionally be secured relative to the duct 128 with a fastener such as a touch-and-hold fastener.

[0051] Figure 20 is an example similar to that of Figures 18 and 19; however, a pliable sidewall 132 of an inflatable duct 134 includes a relatively large discharge opening 136 and a relatively small discharge opening 138. The duct 134 may include one or more pliable pieces that are coupled together. The volume of air flowing through openings 136 and 138 is controlled by adjusting the extent to which pliable sheets 140 cover openings 136 and 138. One sheet 140 is shown completely covering opening 136, and the other sheet 140 only partially covers opening 138.

[0052] An example inflatable air duct 142, shown in Figure 21, includes a pliable sidewall 144 with one or more discharge openings 146 with airflow therethrough being adjustable by way of a movable pliable sheet in the form of a band that encircles duct 142. A sheet 148, for example, is a band created by a fastener 150 connecting opposite ends 152 of the band together. Examples of fastener 150 include, but are not limited to, a zipper, a touch-and-hold fastener (e.g., VELCRO), a bead-in-groove fastener (e.g., ZIPLOC), a series of hooks, a series of buttons, a series of snaps, laces, etc. The duct 142 may include one or more pliable pieces that are coupled together. Sheet 148, in this example, includes an opening 154 that can be moved in or out of registry with opening 146a by adjustably rotating sheet 148 around or relative to duct 142. In some examples, the sheet 148 may additionally be secured relative to the duct 142 with a fastener such as a touch-and-hold fastener. The openings 146a and 154 may be similarly or differently sized. In some examples, an elongate member 156 (e.g., string, cable, chain, strap, cord, rod, etc.) attached to sheet 148 facilitates the positional adjustment of sheet 148.

[0053] Additionally or alternatively, a sheet 158 similar to sheet 148 but without opening 154 is used in some examples to control the airflow through opening 146b by adjusting the position of sheet 158 along the length of duct 142. Figure 21, for example, shows sheet 158 partially covering opening 142b to restrict the airflow therethrough.

[0054] In some examples, as shown in Figure 22, airflow through a discharge opening 160 in a pliable sidewall 162 of an inflatable duct 164 is controlled by the position of a band-like sheet 165. The sheet 165 may be installed inside of duct 164, against and/or adjacent to an inner surface of duct 164 (terms "tube" and "duct" being used interchangeably herein). In this example, sheet 165 includes an opening 166 that can be moved in or out of registry with opening 160 by adjustably rotating sheet 165 within duct 164. The openings 160 and 166 may be similarly or differently sized. An elongate member 168 (e.g., string, cable, chain, strap, cord, rod, etc.) threaded or extending through a small hole or aperture 170 in sidewall 162 and connected to sheet 165 can facilitate the circumferential adjustment of sheet 165. The duct 164 may include one or more pliable pieces that are coupled together.

[0055] Figures 23 and 24 show an example duct assembly 172 similar to that of Figures 15 – 17 in that a pliable sidewall 174 includes a discharge opening 176 through which airflow is controlled by the degree of registry that opening 176 has with an opening 178 in an overlying and/or adjacent to pliable sheet 180. In this example, duct assembly 172 includes a pair of circumferential lips or fasteners 182 that help hold sheet 180 in a selected position. The

adjustable circumferential position of sheet 180 around duct assembly 172 determines the registry of openings 176 and 178.

[0056] In the example of Figures 23 and 24, one or more flexible flaps 184 (louvers) extend at least partially across opening 178 of sheet 180. In some examples, an elongate member 186 (e.g., string, cable, chain, strap, cord, rod, etc.) coupled to flap 184 serves as an actuator (controlled manually or otherwise) that deflects flap 184 to adjustably direct airflow through opening 178. Additionally or alternatively, while elongate member 186 controls the direction of airflow, another elongate member 188 connected to sheet 180 adjusts the circumferential position of sheet 180 to control the volume of air discharged through openings 176 and 178.

[0057] In some examples, as shown in Figure 25, louvered discharge openings 190 are cut directly into a pliable sidewall 192 of an example duct 194. In this example, one or more flaps 196 (resiliently flexible louvers) are a seamless integral extension of sidewall 192, and the flexibility of the sidewall material causes flaps 196 to deflect in response to the air pressure within duct 194. Thus, both the direction and volume of discharge air is adjustable by adjusting the air pressure within duct 194. In other examples, one or more flaps 196 may be coupled to sidewall 192 adjacent to opening 190. In such examples, one or more flaps 196 may be coupled adjacent to opening 190 in a manner that controls and/or directs the flow of air through opening 190. Moreover, in some examples, two relatively adjacent discharge openings 190 have flaps 196 that direct air 12 is two different directions, generally away from each other, to more broadly disperse discharge air 12 into the comfort zone.

[0058] Figures 26 – 28 illustrate an example inflatable air duct 198 comprising a pliable tubular sidewall 200 with a cutout pattern 202 thereon. The duct 198 may include one or more pieces coupled together. Cutout pattern 202 provides guidance for creating a certain size and shape discharge opening 204 (Fig. 28) through sidewall 200 at a predetermined location. The term, "cutout," as used herein means removable by any means, examples of which include, but are not limited to, cutting, tearing, breaking, etc. Examples of cutout pattern 202 include, but are not limited to, a printed ink image, a perforated line, a laser burned line, etc. Some examples of duct 198 include a plurality of cutout patterns distributed across duct 198. In some examples, a plurality of multiple-size cutout patterns 206 are at the same general location on duct 198. Alternatively, the cutout patterns 206 may be differently arranged along the duct 198. The cutout patterns 206 may be similar or different from one another and may have any suitable shape (e.g., circular, oval, square, etc.) or size, for example.

[0059] A marker 208 and an arrow 210 in Figure 26 illustrate marking a cutout pattern on a pliable tubular sidewall. A knife or tool 212 in Figure 27 and an arrow 214 in Figure 28 illustrate creating a discharge opening through the pliable tubular sidewall at the cutout pattern.

[0060] In order to facilitate ordering and/or selecting inflatable tube assemblies, a webpage or other user interface may be provided. For example, a webpage provided on the Internet may enable customers to enter design parameters (e.g., building dimensions, ceiling heights, room dimensions, airflow requirements, etc) and receive an indication identifying one or more inflatable air duct designs that meet the design parameters. The customer may then select from among the various potential air duct designs, or change the parameters to get a different set of potential air ducts. Once the customer selects the desired set of air ducts (e.g., by making a selection with a mouse or other user input device), the selected air ducts are identified to the manufacturer who can then process the order by assembling and shipping the desired inflatable air ducts using the inventory of sidewall pieces. Of course, payment information (e.g., credit card information, user identification information such as name and address, etc) may be obtained when accepting the order.

[0061] Additionally or alternatively, the above website could be used by a salesperson of the manufacturer, a distributor or other middleman to assist in soliciting, building or otherwise obtaining sales. Also, although the above is described in the context of the Internet, the user interface could be implemented by locally executing software rather than (or addition to) being hosted on the Internet.

[0062] Figure 29 is a flow diagram representing example machine readable instructions 2900 that may be executed to identify and/or select inflatable air duct assemblies meeting certain design parameters. The machine readable instructions of Figure 29 may be executed using a processor, a controller and/or any other suitable processing device. For example, the example instructions of FIG. 29 may be implemented using coded instructions (e.g., computer readable instructions) stored on a tangible computer readable medium such as a flash memory, a read-only memory (ROM), and/or a random-access memory (RAM). As used herein, the term tangible computer readable medium is expressly defined to include any type of computer readable storage and to exclude propagating signals. Additionally or alternatively, the example instructions of FIG. 29 may be implemented using coded instructions (e.g., computer readable instructions) stored on a non-transitory computer readable medium such as a flash memory, a read-only memory (ROM), a random-access memory (RAM), a cache, or any other storage media in which information is stored for any

duration (e.g., for extended time periods, permanently, brief instances, for temporarily buffering, and/or for caching of the information). As used herein, the term non-transitory computer readable medium is expressly defined to include any type of computer readable medium and to exclude propagating signals.

[0063] Alternatively, some or all of the example processes of FIG. 29 may be implemented using any combination(s) of application specific integrated circuit(s) (ASIC(s)), programmable logic device(s) (PLD(s)), field programmable logic device(s) (FPLD(s)), discrete logic, hardware, firmware, etc. Also, some or all of the example processes of FIG. 29 may be implemented manually or as any combination(s) of any of the foregoing techniques, for example, any combination of firmware, software, discrete logic and/or hardware. Further, although the example processes of FIG. 29 are described with reference to the flow diagrams of FIG. 29, other methods of implementing the processes of FIG. 29 may be employed. For example, the order of execution of the blocks may be changed, and/or some of the blocks described may be changed, eliminated, sub-divided, or combined. Additionally, any or all of the example processes of FIG. 29 may be performed sequentially and/or in parallel by, for example, separate processing threads, processors, devices, discrete logic, circuits, etc.

[0064] Referring to FIG. 29, at block 2902, a user enters design parameters indicative of the environment in which the air ducts are to perform. These parameters may include desired air flows, room dimensions, ceiling heights, etc. Once the parameters are received (block 2902), the instructions identify one or more inflatable air duct designs that meet the design parameters input by the user (block 2904). Preferably, the suggestions are displayed to the user, for example, via a computer display. The suggested air duct design(s) may include a plurality of sidewall pieces that can be interconnected circumferentially to create an assortment of inflatable tubes meeting the air flow requirements for the environment of use specified by the design parameters. The instructions of Figure 29, then await a user selection of one of the suggested designs or entry of different design parameters (e.g., selection of a start over icon) (block 2905). When a user selects one of the design suggestions (block 2905), the instructions of Figure 29 identify a set of sidewall pieces required to assemble the inflatable air duct(s) identified by the user selection (block 2906). The identification of the sidewall pieces may then be compiled in a job order or other list and forwarded to a manufacturing site. The identified inflatable air ducts are then assembled at the manufacturing site and/or the pieces are forwarded to the job site for on-site assembly (block

2907). At 2908, the instructions determine whether or not another project is to be processed. If so, control returns to block 2902. If not, the instructions of Figure 29 terminate.

[0065] FIG. 30 is a block diagram of an example processor system 3010 that may be used to execute the instructions of Figure 29. As shown in FIG. 30, the processor system 3010 includes a processor 3012 that is coupled to an interconnection bus 3014. The processor 3012 may be any suitable processor, processing unit or microprocessor. Although not shown in FIG. 30, the system 3010 may be a multi-processor system and, thus, may include one or more additional processors that are identical or similar to the processor 3012 and that are communicatively coupled to the interconnection bus 3014.

[0066] The processor 3012 of FIG. 30 is coupled to a chipset 3018, which includes a memory controller 3020 and an input/output (I/O) controller 3022. A chipset typically provides I/O and memory management functions as well as a plurality of general purpose and/or special purpose registers, timers, etc. that are accessible or used by one or more processors coupled to the chipset 3018. The memory controller 3020 performs functions that enable the processor 3012 (or processors if there are multiple processors) to access a system memory 3024 and a mass storage memory 3025.

[0067] The system memory 3024 may include any desired type of volatile and/or non-volatile memory such as, for example, static random access memory (SRAM), dynamic random access memory (DRAM), flash memory, read-only memory (ROM), etc. The mass storage memory 3025 may include any desired type of mass storage device including hard disk drives, optical drives, tape storage devices, etc. The instructions of Figure 29 may be stored in the system memory 3024.

[0068] The I/O controller 3022 performs functions that enable the processor 3012 to communicate with peripheral input/output (I/O) devices 3026 and 3028 and a network interface 3030 via an I/O bus 3032. The I/O devices 3026 and 3028 may be any desired type of I/O device such as, for example, a keyboard, a video display or monitor, a mouse, etc. The network interface 3030 may be, for example, an Ethernet device, an asynchronous transfer mode (ATM) device, an 802.11 device, a DSL modem, a cable modem, a cellular modem, etc. that enables the processor system 3010 to communicate with another processor system.

[0069] While the memory controller 3020 and the I/O controller 3022 are depicted in FIG. 30 as separate blocks within the chipset 3018, the functions performed by these blocks may be integrated within a single semiconductor circuit or may be implemented using two or more separate integrated circuits. The system of Figure 30 may represent, for example, a server executing the instructions of Figure 29 in response to HTTP requests received over the

Internet. The server may serve one or more webpages to requesting clients in order to solicit the design parameters, display air duct design suggestions and/or receive user selections of one or more of the suggested designs. Additionally, the server may receive payment information and/or authorization from a user and/or interact with a third party payment server to process payments associated with orders for air ducts.

[0070] Some of the aforementioned examples may include one or more features and/or benefits including, but not limited to, the following:

[0071] In some examples, inflatable ducts of various diameters and lengths can be created by selectively assembling pre-existing stock pieces in different combinations.

[0072] In some examples, an elbow is attachable in different orientations to an inflatable tube to direct airflow in alternate directions.

[0073] In some examples, a pliable sheet provides a flexible register that can deflect with the inflation and deflation of an inflatable tube.

[0074] In some examples, a flexible sheet register in the form of a band that encircles an inflatable tube such that when the tube is inflated, the radially expanded tube helps hold the band in position.

[0075] In some examples, a pliable inflatable tube includes integral flaps or louvers that deflect open in response to air pressure within the tube.

[0076] In some examples, a pliable inflatable air duct includes one or more cutout patterns that provide guidance in creating a discharge opening of the proper size and location.

[0077] More specifically, an example inflatable air duct assembly for conveying air is disclosed herein. The inflatable air duct assembly includes a first sidewall piece that is pliable and a second sidewall piece that is pliable. The air duct assembly also includes a first disconnectable longitudinal joint and a second disconnectable longitudinal joint spaced apart from the first disconnectable longitudinal joint. The first and second longitudinal joints connect the first sidewall piece to the second sidewall piece to provide a first tube segment. The first tube segment includes the first sidewall piece, the second sidewall piece, the first disconnectable longitudinal joint and the second disconnectable longitudinal joint. The air duct assembly further includes a second tube segment that is pliable and a disconnectable circumferential joint connecting the first and second tube segments end-to-end. In some examples, the first sidewall piece is larger circumferentially than the second sidewall piece.

[0078] In another example, an inflatable air duct assembly method is disclosed that includes suggesting a plurality of different design arrangements in which at least some of a plurality of sidewall pieces are to be interconnected circumferentially to create an assortment of inflatable

tubes of various diameters. Each of the sidewall pieces being pliable and including a common sidewall piece. The plurality of different design arrangements includes a larger diameter tube design that employs the common sidewall piece. The plurality of different design arrangements includes a smaller diameter tube design that employs the common sidewall piece. The inflatable air duct assembly method further includes selecting a chosen set of sidewall pieces from the plurality of sidewall pieces to create an inflatable tube. In some examples, the plurality of sidewall pieces vary in circumferential length. In some examples, the inflatable tube includes a plurality of longitudinal joints interconnecting the chosen set of sidewall pieces. The plurality of longitudinal joints to be distributed circumferentially around the certain inflatable tube.

[0079] In yet another example, an inflatable air duct for conveying air in a longitudinal direction and being selectively configurable in a smaller diameter configuration or a larger diameter configuration is disclosed. The inflatable air duct includes a first sidewall section and a second sidewall section. The first sidewall section is to be pliable. The first sidewall section to include a first longitudinal border and a second longitudinal border. The first and second longitudinal borders are to be adjacent each other when the inflatable air duct is in the smaller diameter configuration. The first and second longitudinal borders are to be spaced apart from each other when the inflatable air duct is in the larger diameter configuration. The second sidewall section is to extend between the first longitudinal border and the second longitudinal border. The first sidewall section is to provide the inflatable air duct with a reduced cross-sectional flow area therethrough when the inflatable air duct is in the smaller diameter configuration. The first sidewall section in combination with the second sidewall section is to provide the inflatable air duct with an expanded cross-sectional flow area therethrough when the inflatable air duct is in the larger diameter configuration. The expanded cross-sectional flow area is to be larger than the reduced cross-sectional flow area. In some examples, the air duct further includes a disconnectable joint. The disconnectable joint is to be disposed at the first and second longitudinal borders of the first sidewall section. The disconnectable joint is to be disconnected when the inflatable air duct is in the larger configuration. The disconnectable joint is to be connected when the inflatable air duct is in the smaller configuration. In some examples, the second sidewall section is disposed within the reduced cross-sectional flow area when the inflatable air duct is in the smaller diameter configuration.

[0080] In another example, an inflatable air duct assembly being selectively configurable in a first direction configuration to direct air in a first direction and a second direction

configuration to convey the air in a second direction is disclosed. The inflatable air duct assembly includes a tube that is pliable, an elbow that is pliable, and a disconnectable circumferential joint removably connecting the tube to the elbow. The disconnectable circumferential joint is to include a first tube joint segment on the tube, a second tube joint segment on the tube, a first elbow joint segment on the elbow, and a second elbow joint segment on the elbow. The first tube joint segment is to be selectively connectable to at least one of the first elbow joint segment or the second elbow joint segment. The second tube joint segment is to be selectively connectable to at least one of the first elbow joint segment or the second elbow joint segment. The inflatable air duct assembly is to be in the first direction configuration to direct the air in the first direction when the first tube joint segment and the second tube joint segment are connected respectively to the first elbow joint segment and the second elbow joint segment. The inflatable air duct assembly is to be in the second direction configuration to direct the air in the second direction when the first tube joint segment and the second tube joint segment are connected respectively to the second elbow joint segment and the first elbow joint segment. In some examples, the disconnectable circumferential joint includes two zippers. In some examples, the tube includes a longitudinal joint positioned circumferentially between the two zippers. In some examples, the first direction and the second direction point substantially 180 degrees away from each other.

[0081] In another example, an inflatable air duct assembly is disclosed that includes a tube comprising a pliable sidewall. The pliable sidewall defining a first opening therethrough. The air duct assembly further includes a pliable sheet extending circumferentially at least partially around the tube to overlie the pliable sidewall. The pliable sheet relative to the first opening is to be selectively positionable between an obstructed position and an at least partially open position. The pliable sheet is to provide more resistance to airflow through the first opening when the pliable sheet is in the obstructed position than when the pliable sheet is in the at least partially open position. In some examples, the pliable sheet defines a second opening that is in adjustable registry with the first opening by virtue of the pliable sheet being movable between the obstructed position and the at least partially open position. In some examples, the pliable sheet defines a plurality of second openings that includes the second opening. The plurality of second openings is to be of various sizes. In some examples, the pliable sidewall defines a plurality of first openings that includes the first opening. The plurality of first openings is to be of various sizes.

[0082] In some examples, the pliable sheet is adjustably movable circumferentially at least partially around the tube. In some examples, the pliable sheet extends fully circumferentially

around the tube. In some examples, the pliable sheet is a band joined at opposite ends thereof. In some examples, the pliable sheet is inside the tube adjacent an inner surface of the tube. In some examples, the pliable sheet is adjacent to an exterior surface of the tube. In some examples, the pliable sheet is a patch defining a second opening that is smaller than the first opening in the pliable sidewall. In some such examples, the inflatable air duct assembly further includes a touch-and-hold fastener that connects the patch to the pliable sidewall of the tube.

[0083] In some examples, the pliable sidewall includes a pair of lips extending circumferentially around the tube. The pair of lips is to be spaced apart axially from each other. The pliable sheet is to be interposed between the pair of lips such that the pair of lips helps hold the pliable sheet to the tube. In some examples, the inflatable air duct assembly further includes an elongate member attached to the pliable sheet. The elongate member is to serve as an actuator that moves the pliable sheet between the obstructed position and a more-open position.

[0084] In some examples, the inflatable air duct assembly further includes a flexible flap disposed on the pliable sheet. The flexible flap is to extend at least partially across the first opening. The flexible flap is to deflect in reaction to air pressure within the tube. In some examples, the inflatable air duct assembly further includes a flexible flap to be disposed on the pliable sheet and extending at least partially across the first opening. In some such examples, the inflatable air duct assembly also includes an elongate member coupled to the flexible flap. The elongate member is to serve as an actuator that deflects the flexible flap to adjustably direct airflow through the first opening. In some examples, the inflatable air duct assembly further includes a plurality of flexible flaps to be disposed on the pliable sheet and extending at least partially across the first opening. . In some such examples, the inflatable air duct assembly also includes an elongate member coupled to the plurality of flexible flaps. The elongate member is to serve as an actuator that deflects the plurality of flexible flaps to adjustably direct airflow through the first opening. In some examples, the inflatable air duct assembly further includes a plurality of flexible flaps disposed on the pliable sheet. The plurality of flexible flaps is to extend at least partially across the first opening. The plurality of flexible flaps is further to point in different directions to direct airflow through the first opening in different directions.

[0085] In still another example, an inflatable air duct is disclosed that includes a pliable sidewall defining a discharge opening therethrough. In some such examples, the inflatable air duct further includes a flexible flap extending at least partially across the discharge opening.

The flexible flap is to deflect in reaction to air pressure within the inflatable air duct. In some examples, the flexible flap is a seamless integral extension of the pliable sidewall. In some examples, the inflatable air duct further includes an elongate member coupled to the flexible flap. In some such examples, the elongate member is to serve as an actuator that further deflects the flexible flap to adjustably direct airflow through the discharge opening. In some examples, the inflatable air duct further includes a plurality of flexible flaps disposed on the pliable sidewall. The plurality of flexible flaps is to extend at least partially across the discharge opening. The plurality of flexible flaps is to include the flexible flap. The inflatable air duct also includes an elongate member coupled to the plurality of flexible flaps. The elongate member is to serve as an actuator that deflects the plurality of flexible flaps to adjustably direct airflow through the discharge opening. In some examples, the plurality of flexible flaps are to point in different directions to direct airflow through the discharge opening in different directions.

[0086] In another example, an inflatable air duct is disclosed that includes a pliable tubular sidewall. The inflatable air duct further includes a cutout pattern on the pliable tubular sidewall. The cutout pattern is to provide guidance for creating a discharge opening through the pliable tubular sidewall at the cutout pattern. In some examples, the inflatable air duct further includes a plurality of multiple-size cutout patterns on the pliable tubular sidewall. The plurality of multiple-size cutout patterns is to include the cutout pattern. In some examples, the cutout pattern includes a perforated line. In some examples, the cutout pattern includes a printed image.

[0087] In yet another example, an inflatable air duct method is disclosed that includes marking a cutout pattern on a pliable tubular sidewall of an inflatable air duct. The inflatable air duct method further includes creating a discharge opening through the pliable tubular sidewall at the cutout pattern. In some example, the inflatable air duct method further includes marking a plurality of cutout patterns of different sizes at one general area on the pliable tubular sidewall. The cutout pattern being one of the plurality of cutout patterns. In some example, marking the cutout pattern involves printing. In some example, the cutout pattern includes a perforated line. In some example, creating the discharge opening includes cutting the pliable tubular sidewall at the cutout pattern.

[0088] In another example, a tangible article of manufacture storing machine readable instructions which, when executed, cause a machine to suggest a plurality of potential inflatable air duct assemblies. The potential inflatable air duct assemblies are to include sidewall pieces which are interconnected circumferentially to create inflatable tubes. Each of

the sidewall pieces is to be pliable. The potential inflatable air duct assemblies are to include a large diameter tube piece and a small diameter tube piece releasably joined by a common sidewall. The instructions further case the machine to respond to a user selection to identify a set of sidewall pieces from the sidewall pieces to create an inflatable air duct assembly.

[0089] Although certain example methods, apparatus and articles of manufacture have been described herein, the scope of the coverage of this patent is not limited thereto. On the contrary, this patent covers all methods, apparatus and articles of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

Claims

1. A tangible article of manufacture storing machine readable instructions which, when executed, cause a machine to:

suggest a plurality of potential inflatable air duct assemblies including sidewall pieces which are interconnected circumferentially to create inflatable tubes, each of the sidewall pieces being pliable, the potential inflatable air duct assemblies including a large diameter tube piece and a small diameter tube piece releasably joined by a common sidewall; and

respond to a user selection to identify a set of sidewall pieces from the sidewall pieces to create an inflatable air duct assembly.

2. The tangible article of manufacture of claim 1, wherein different ones of the inflatable tubes correspond to different diameters.

3. The tangible article of manufacture of claim 1, wherein a first one of the inflatable tubes corresponds to a larger diameter tube design that employs the common sidewall, a second one of the inflatable tubes corresponds to a smaller diameter tube design that employs the common sidewall.

4. The tangible article of manufacture of claim 1, wherein the sidewall pieces vary in circumferential length.

5. The tangible article of manufacture of claim 1, wherein a first one of the inflatable tubes includes a plurality of longitudinal joints interconnecting the identified set of sidewall pieces, the longitudinal joints to be distributed circumferentially around the first one of the inflatable tubes.

FIG. 1

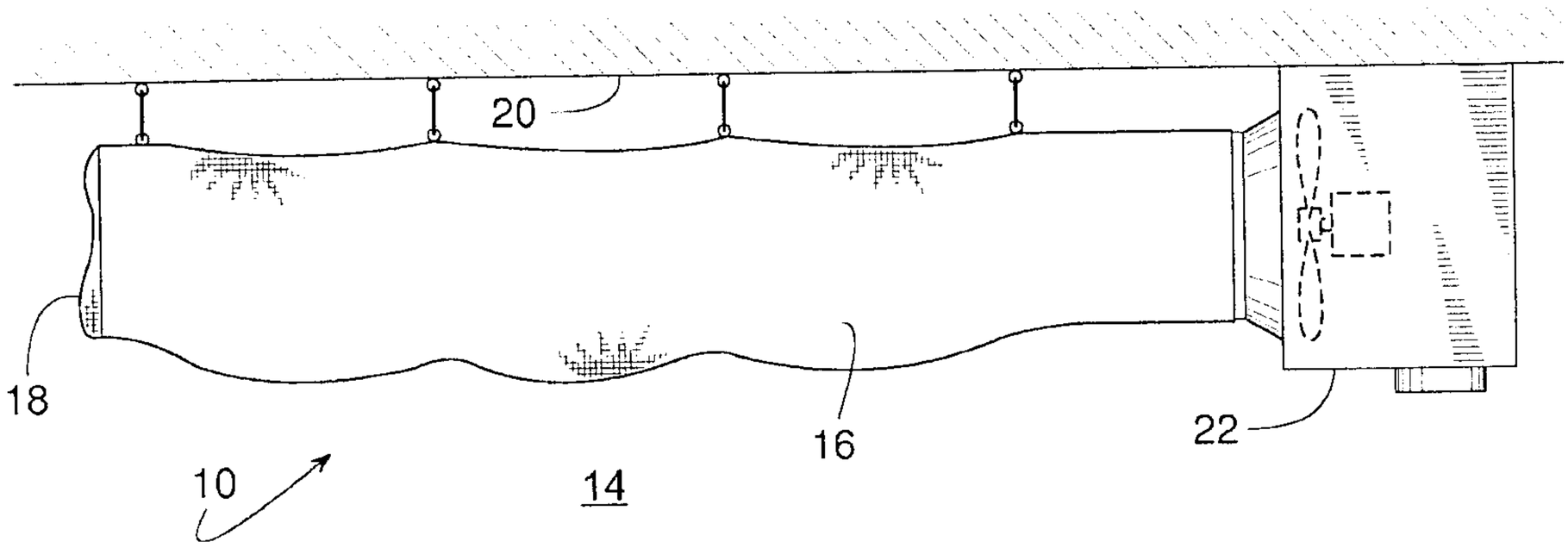


FIG. 2

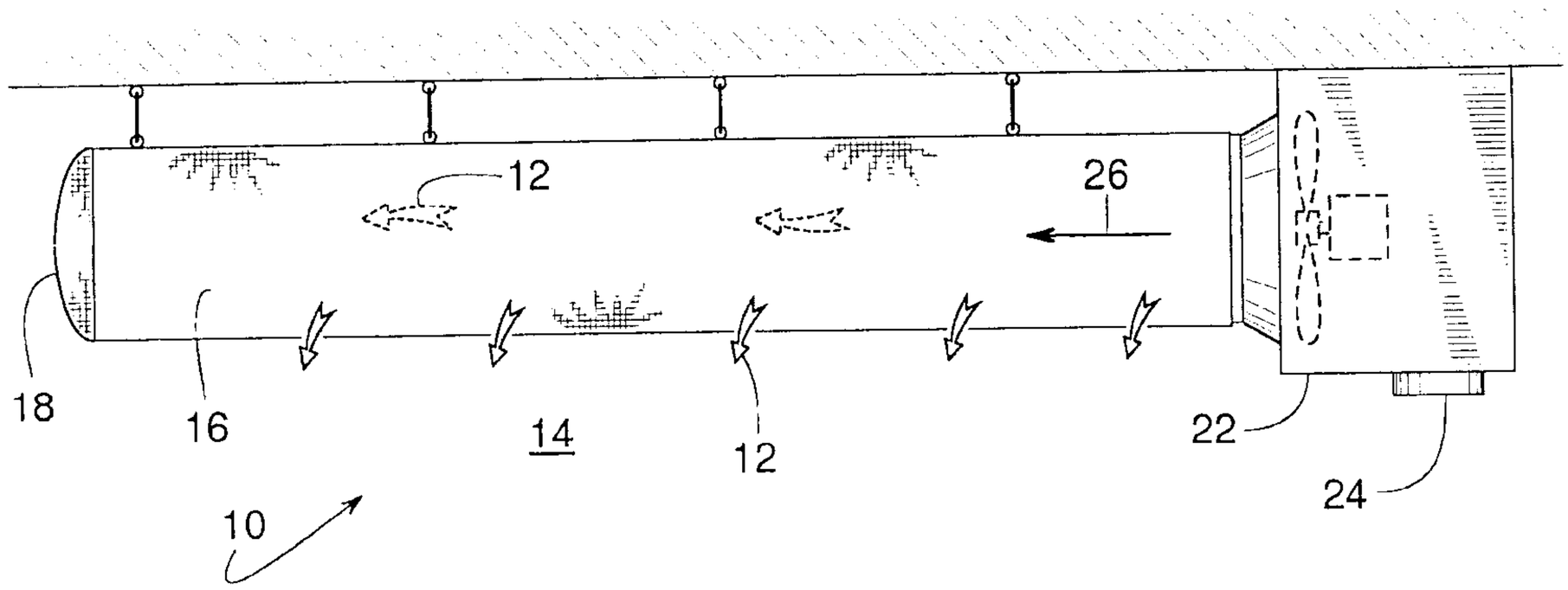


FIG. 3

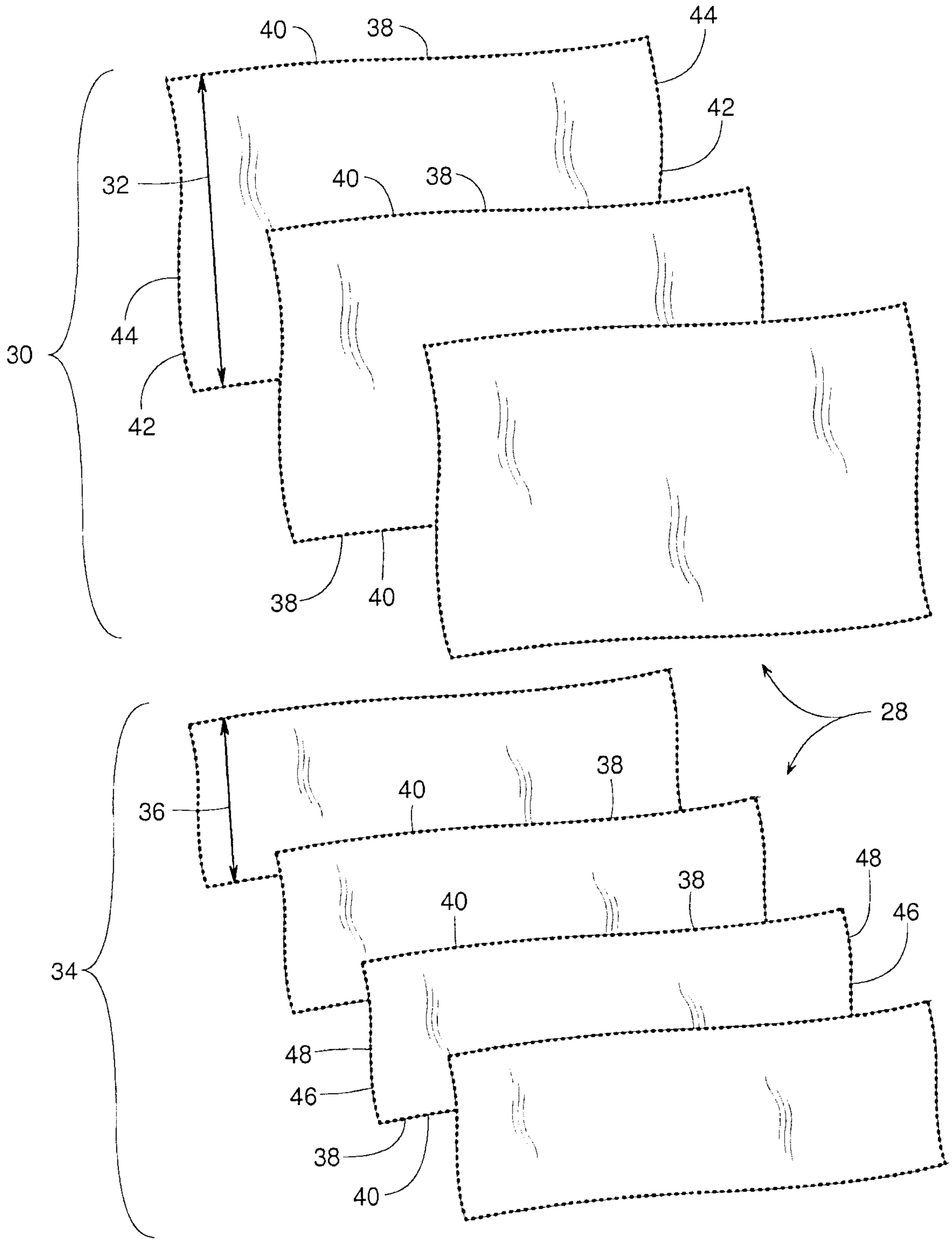


FIG. 4

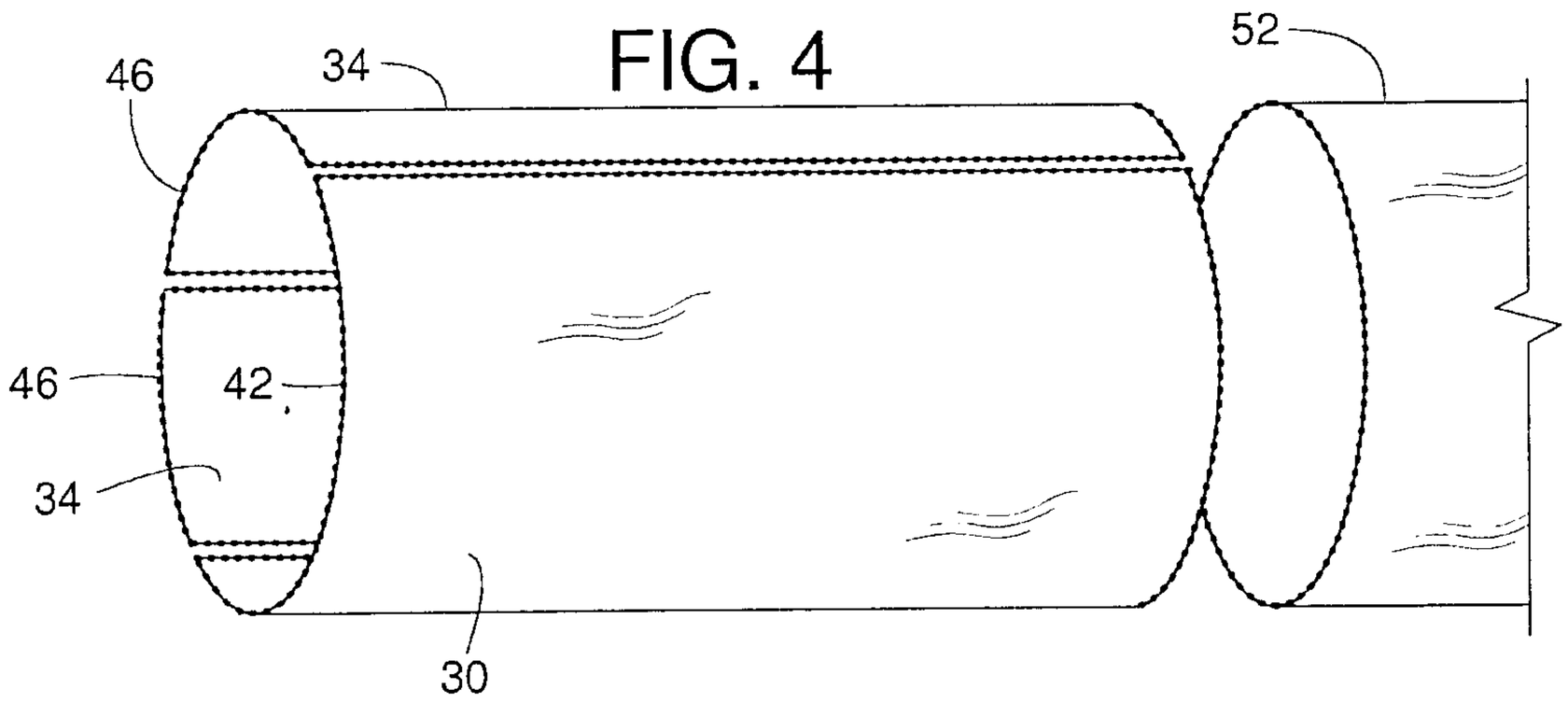


FIG. 5

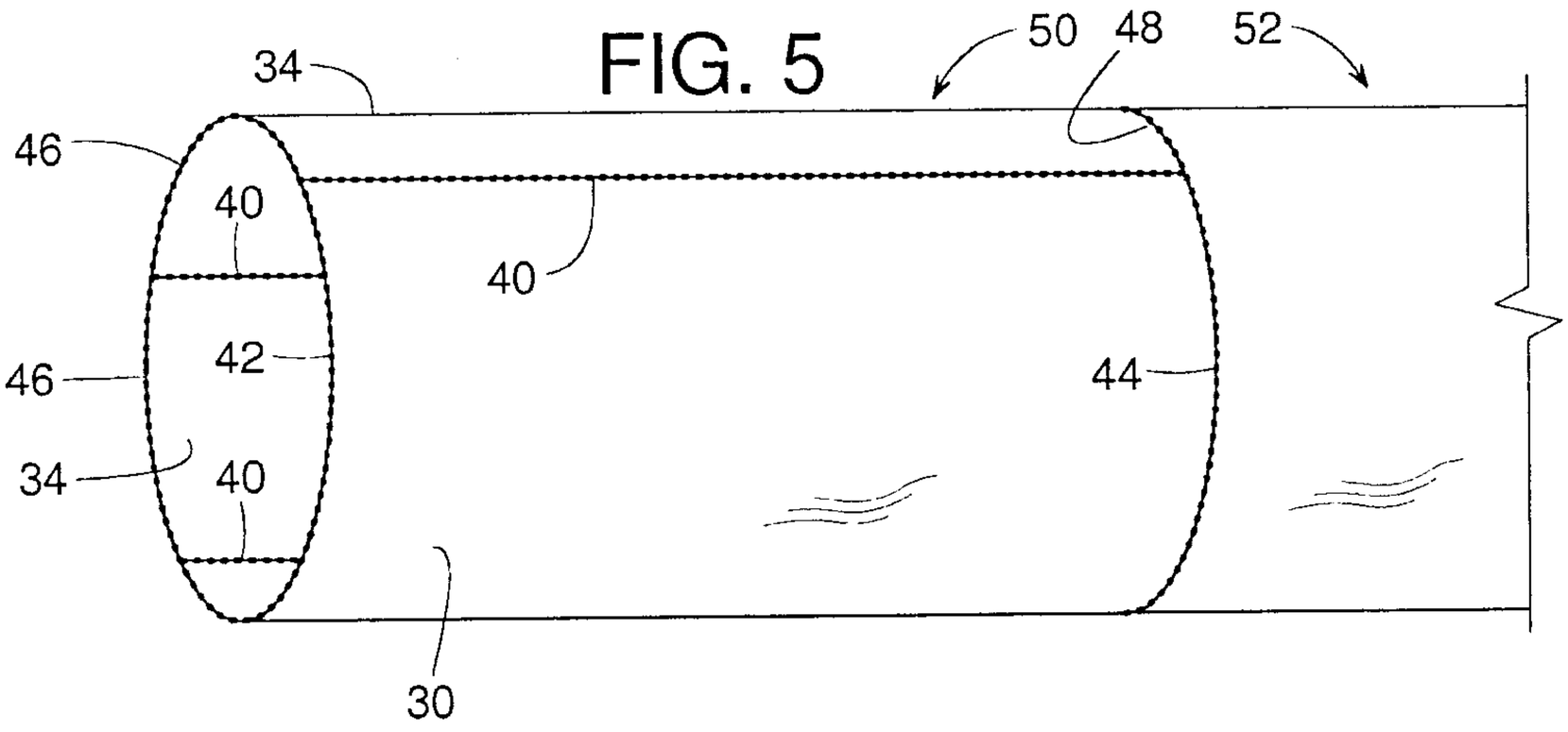


FIG. 6

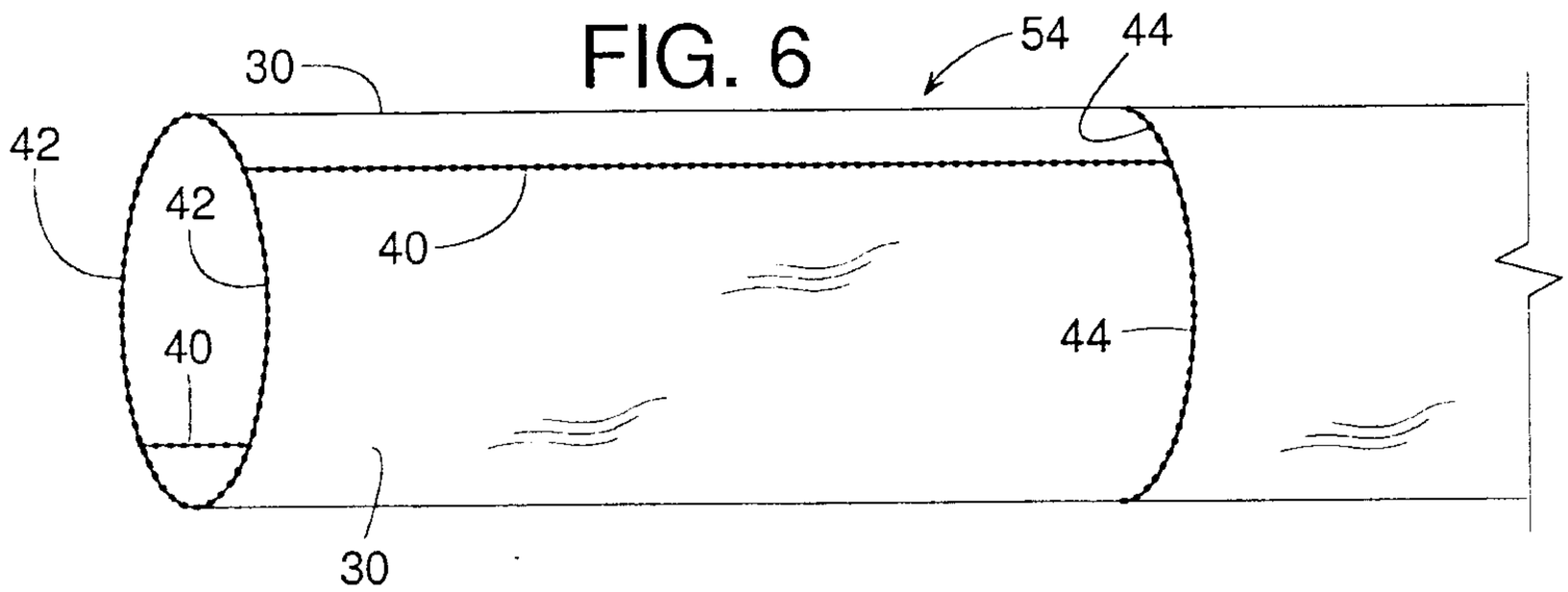


FIG. 7

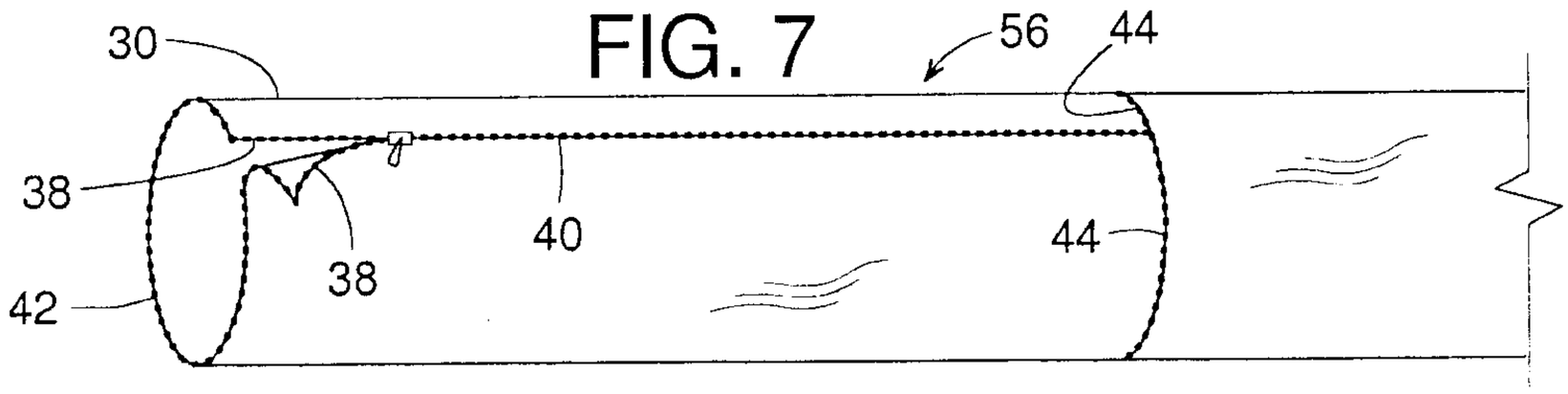


FIG. 8

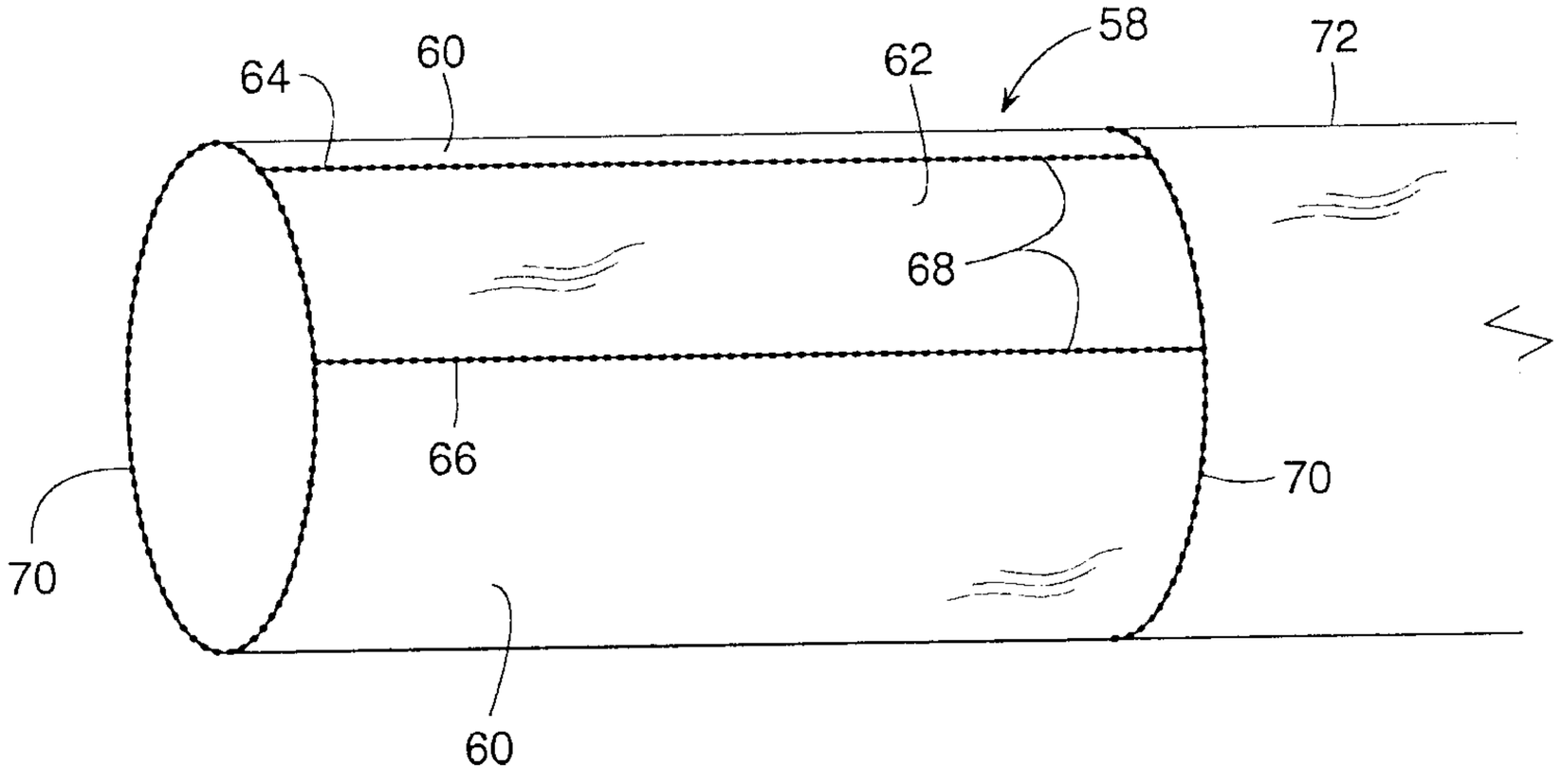


FIG. 9

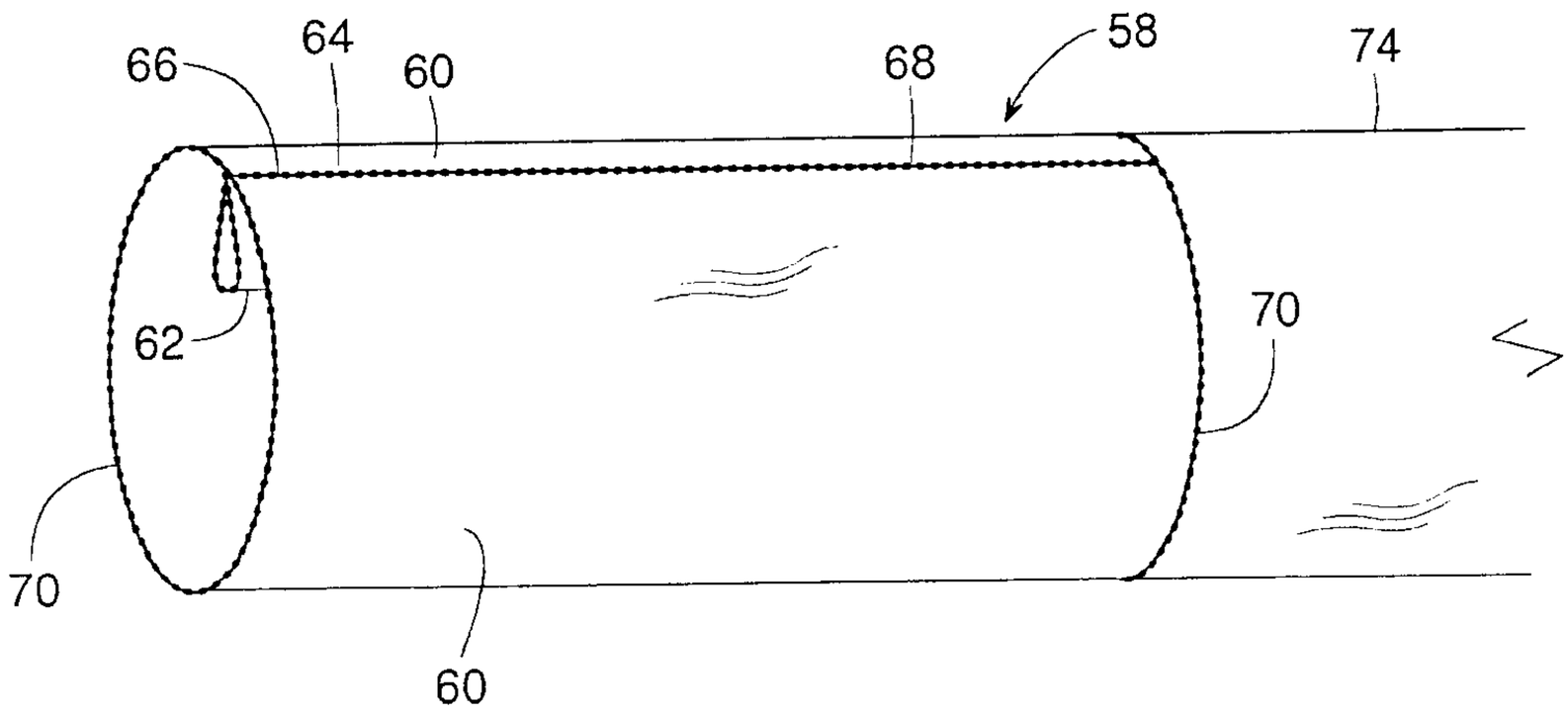


FIG. 10

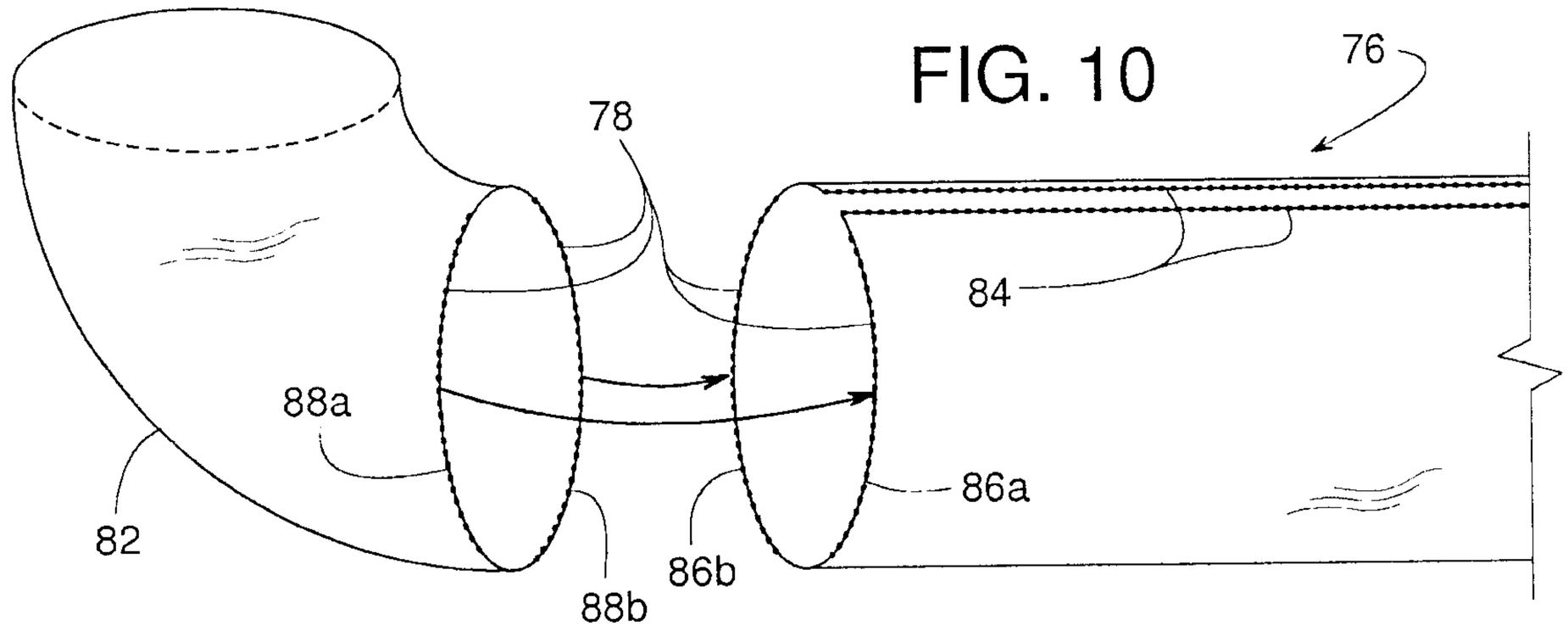


FIG. 11

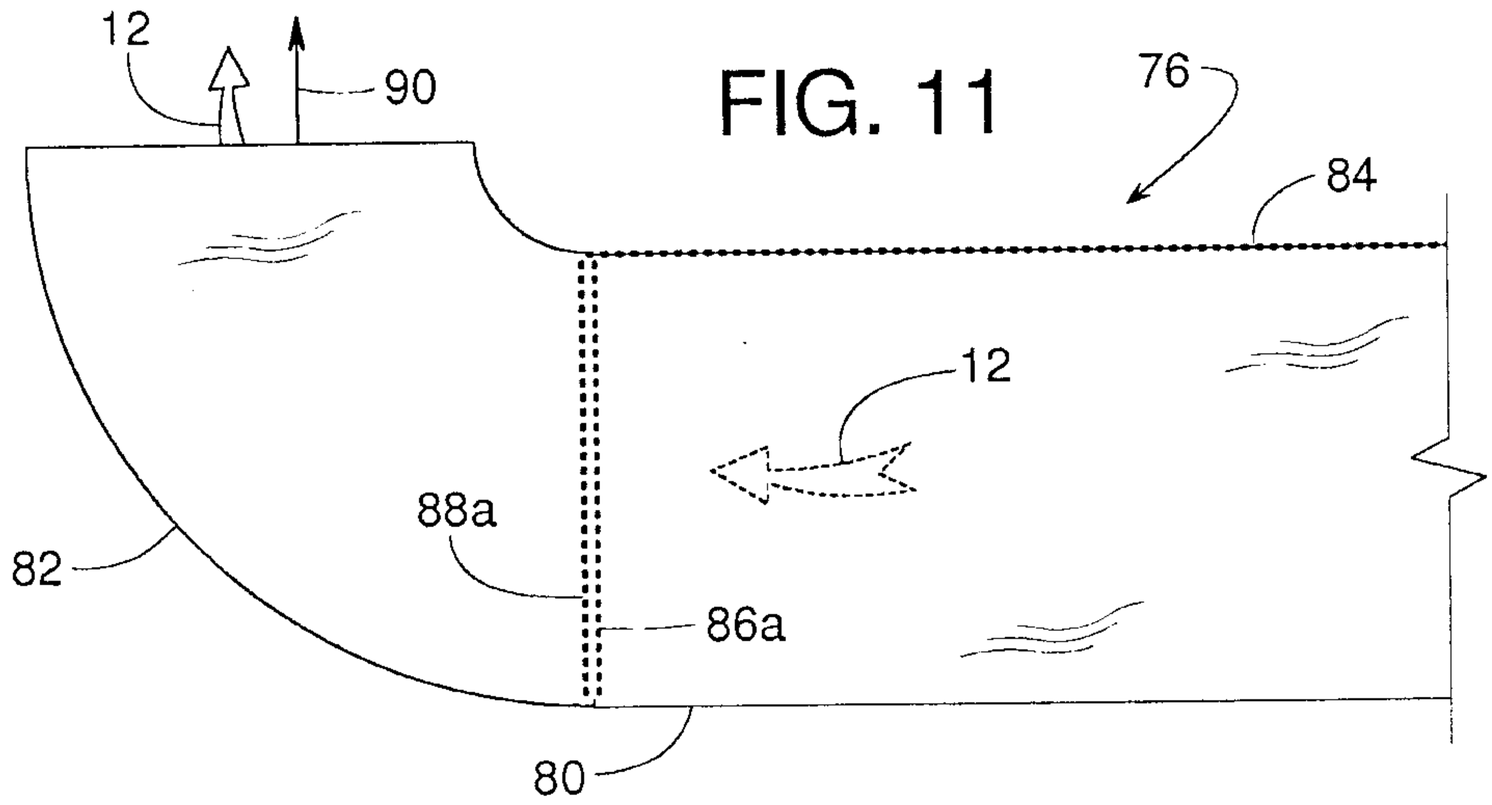


FIG. 12

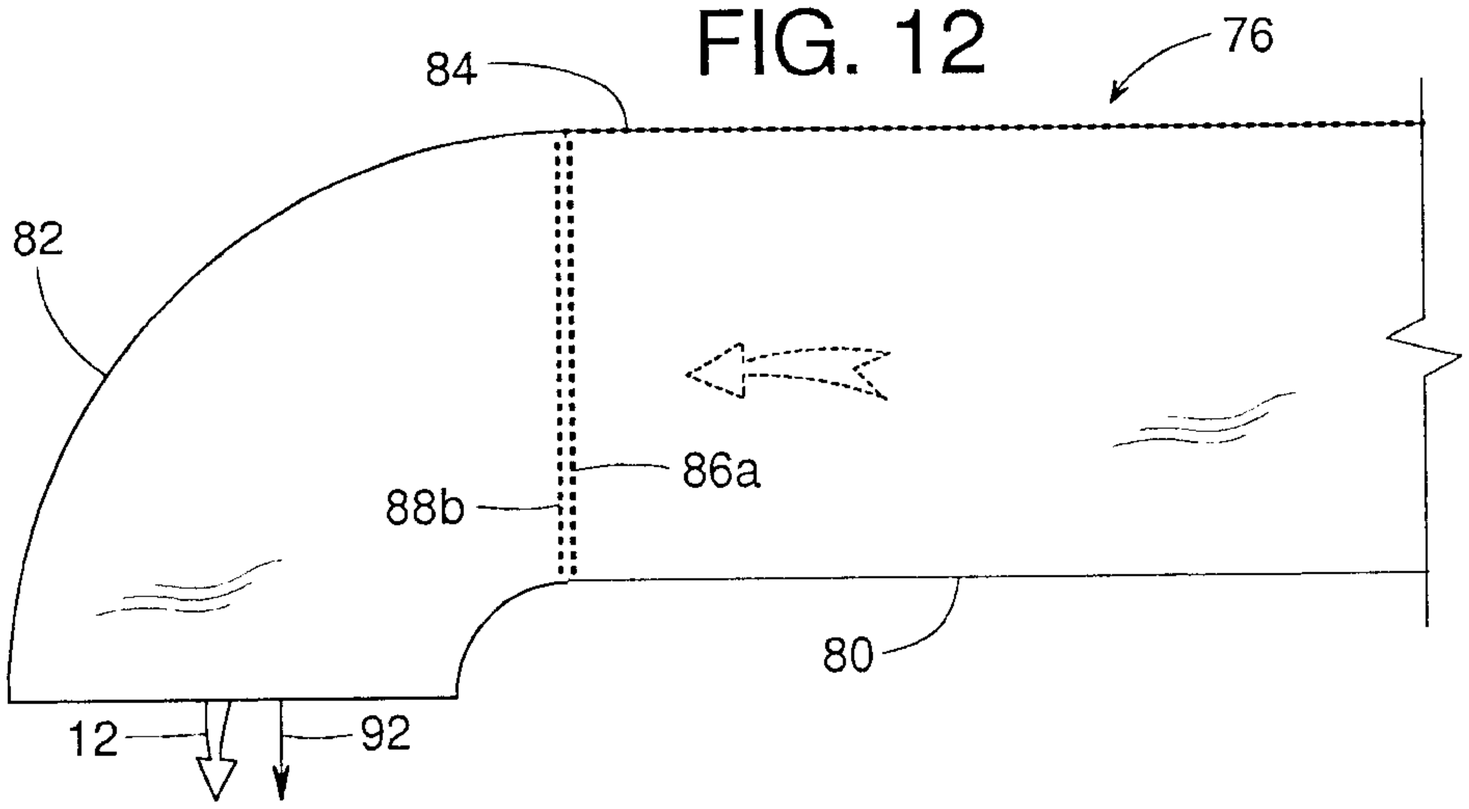


FIG. 13

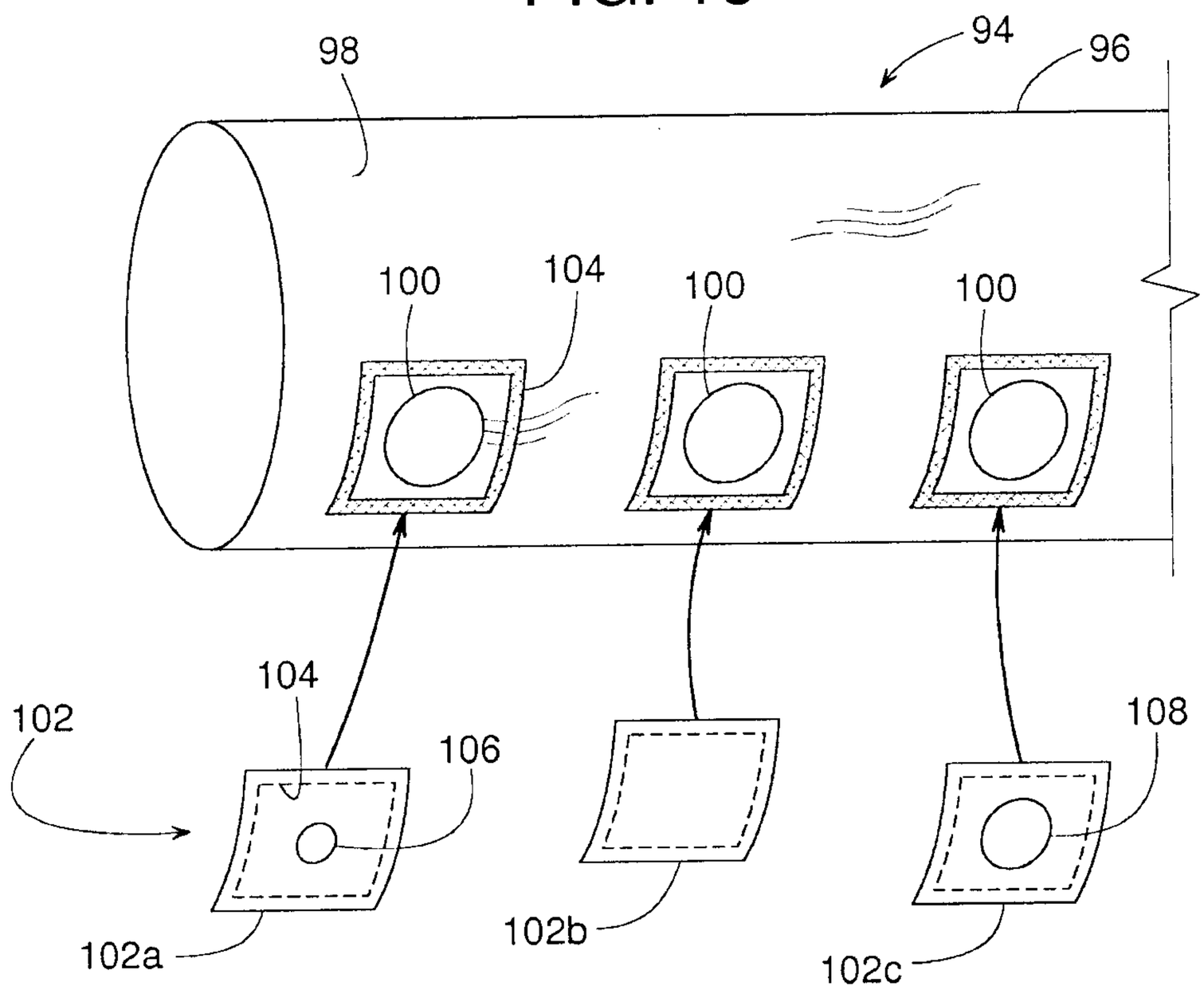

98
94
96
100
104
100
100
104
102
106
108
102a
102b
102c

FIG. 14

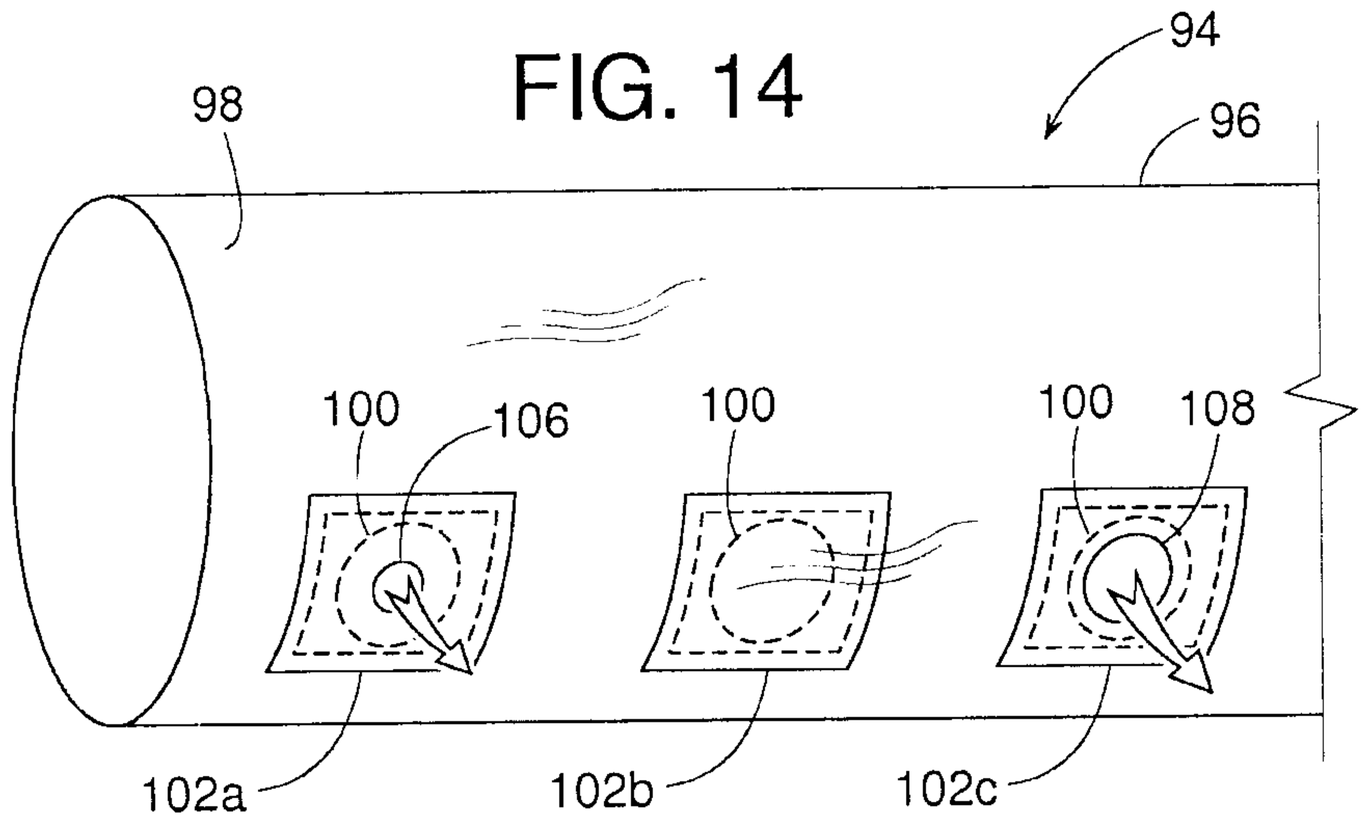

98
94
96
100
106
100
100
108
102a
102b
102c

FIG. 15

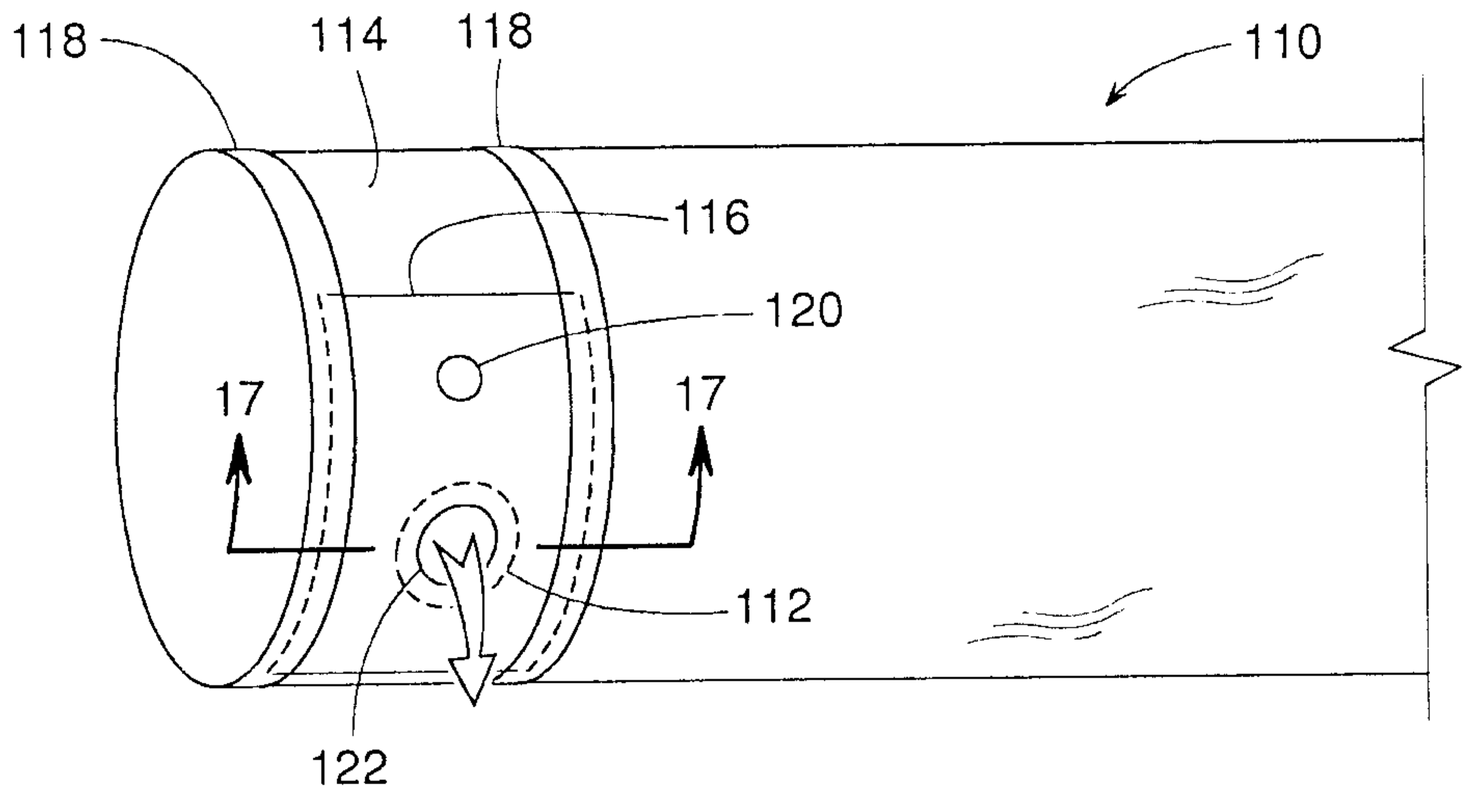


FIG. 16

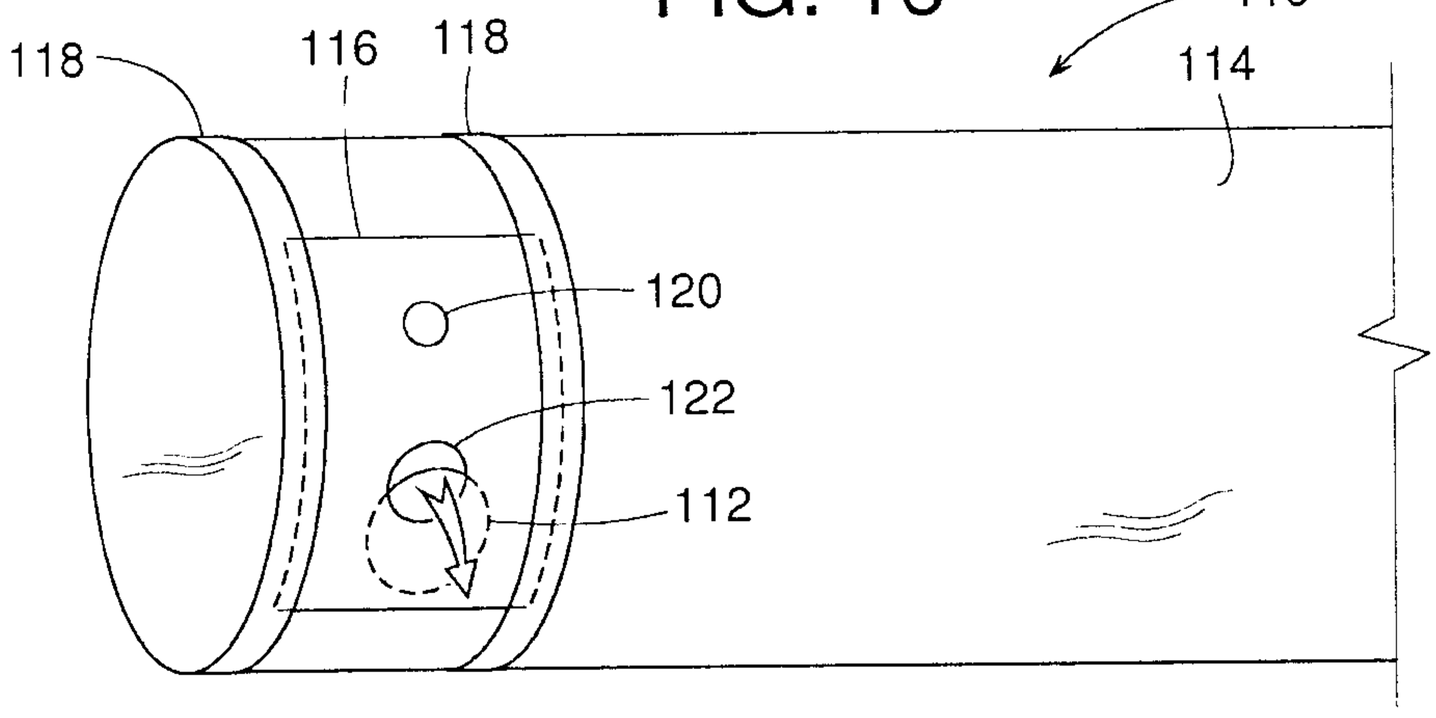


FIG. 17

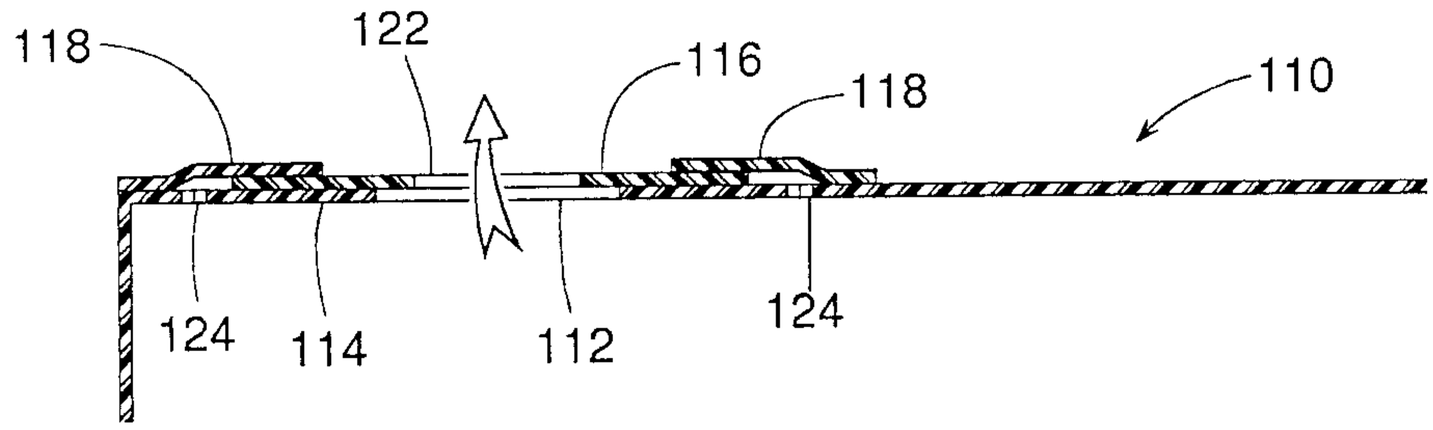


FIG. 18

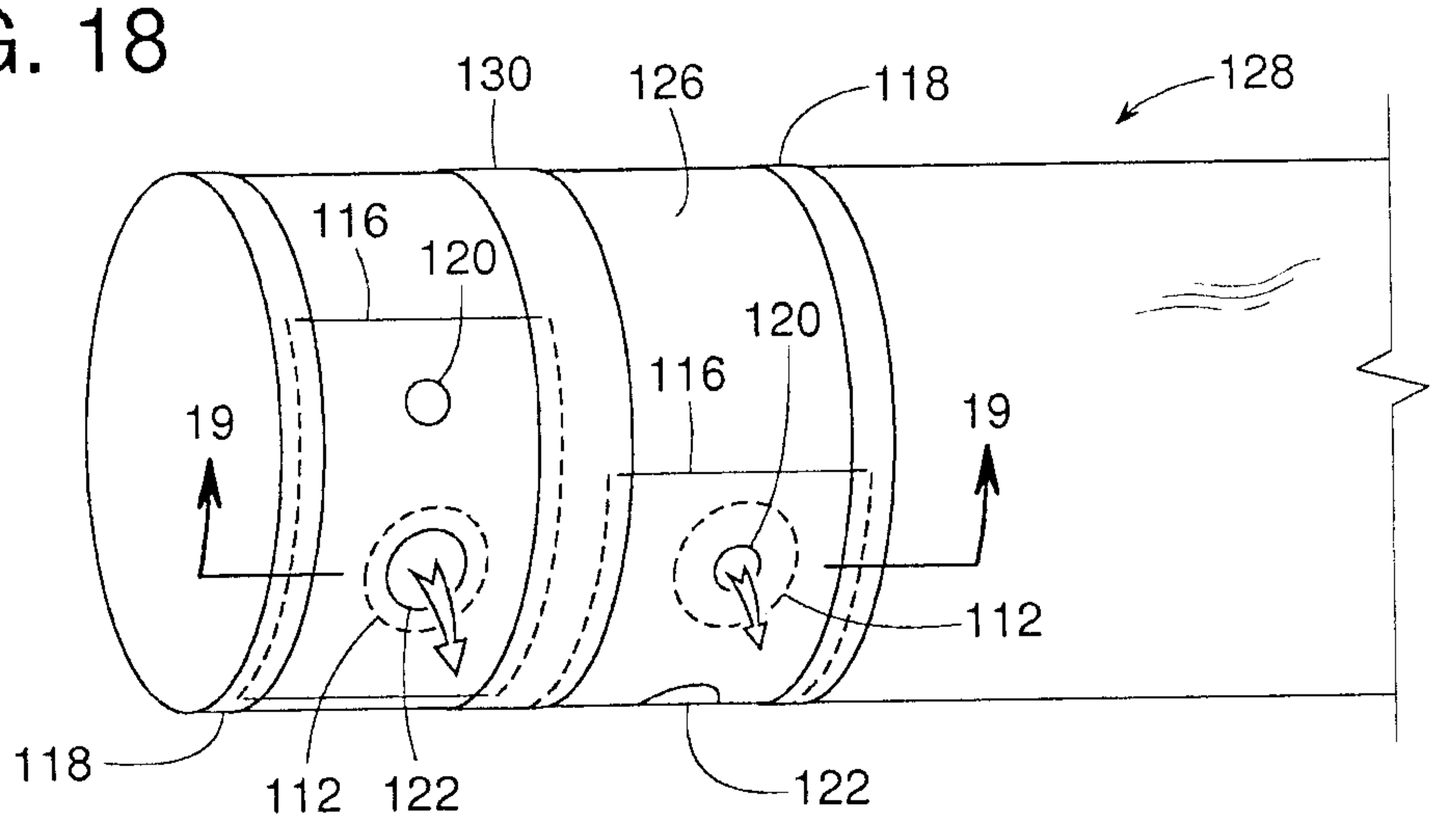


FIG. 19

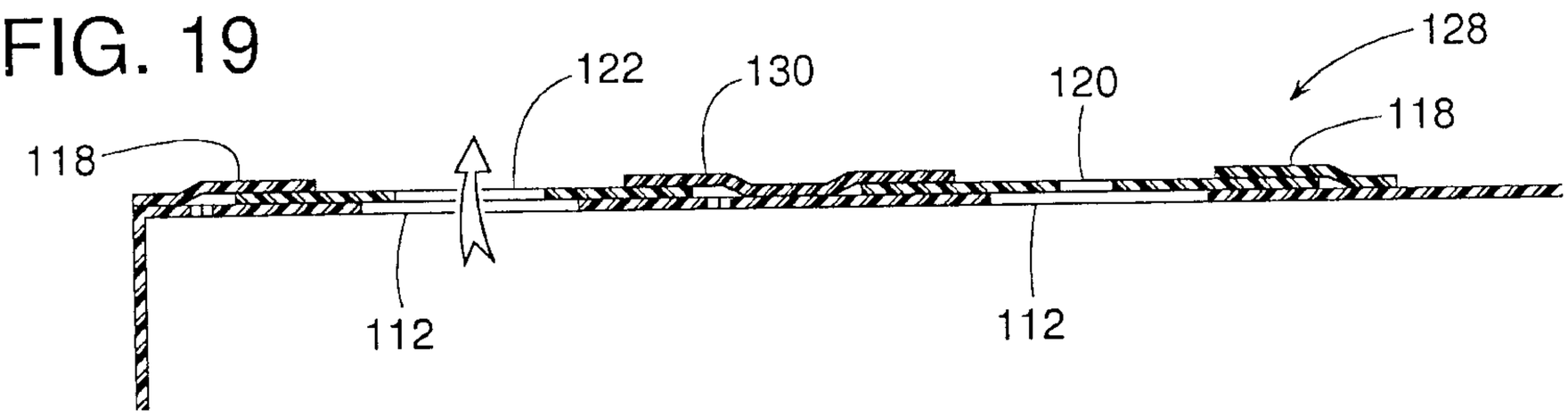


FIG. 20

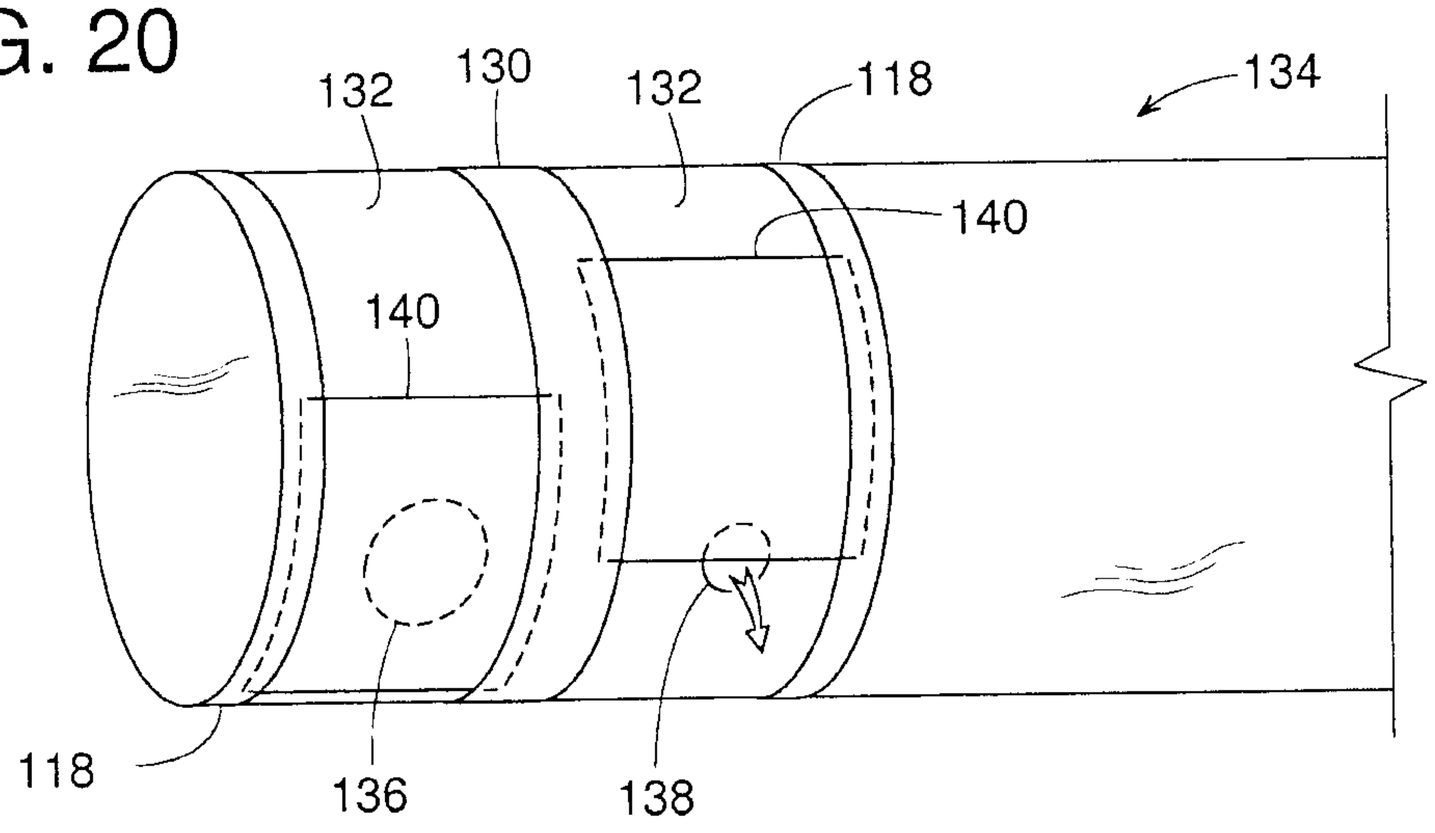


FIG. 21

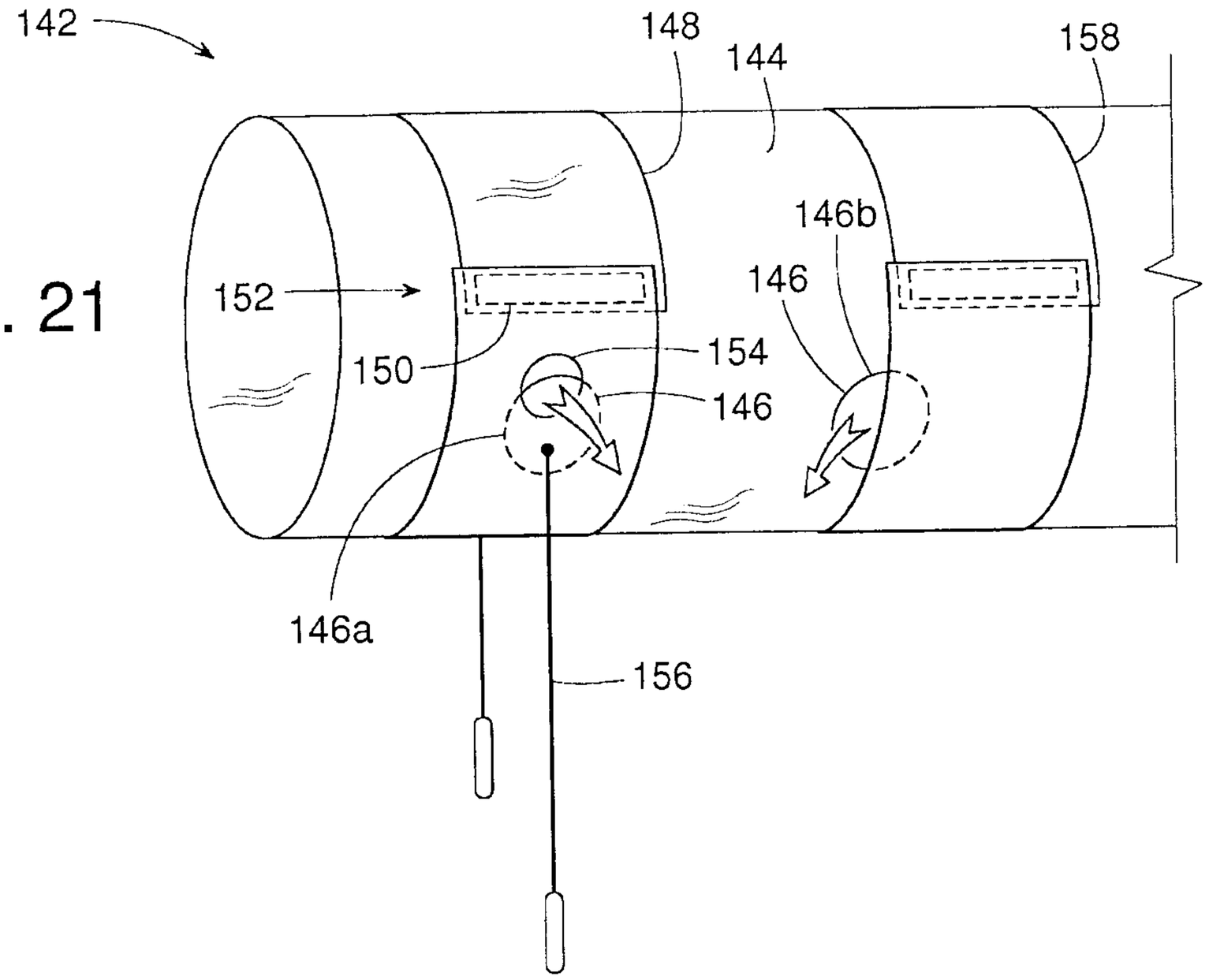

142
148
144
158
146b
146
152
150
154
146
146a
156

FIG. 22

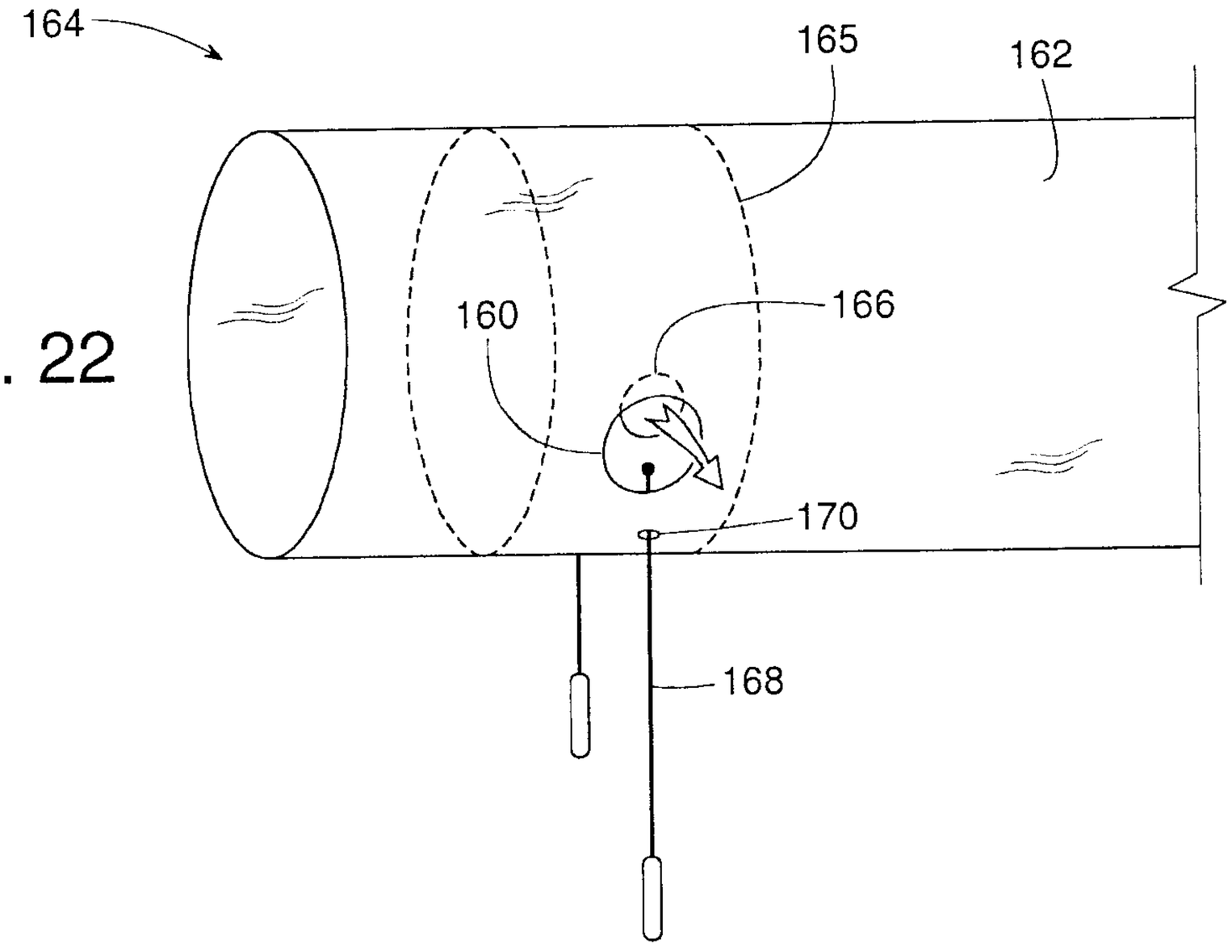

164
165
162
160
166
170
168

FIG. 23

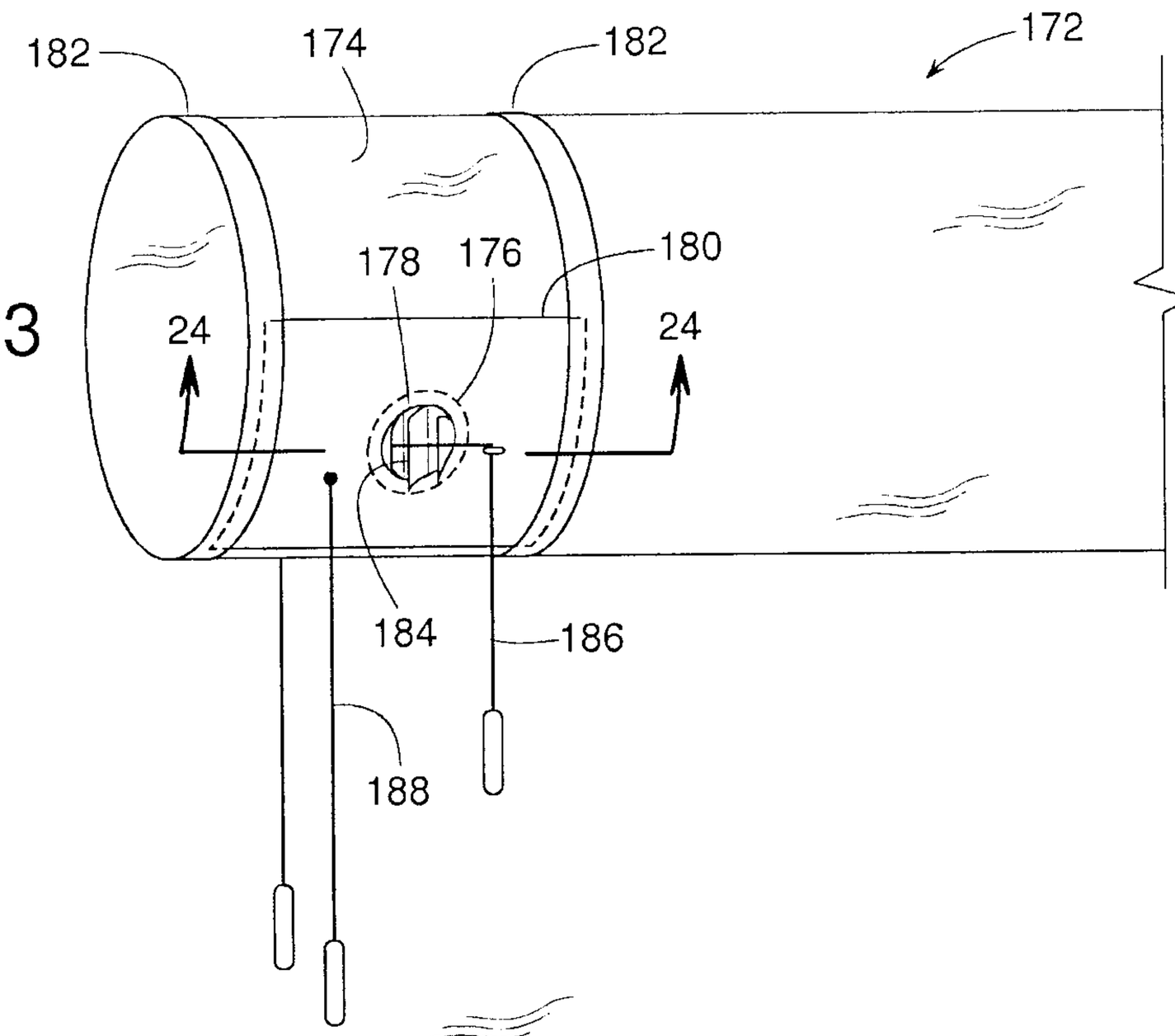


FIG. 24

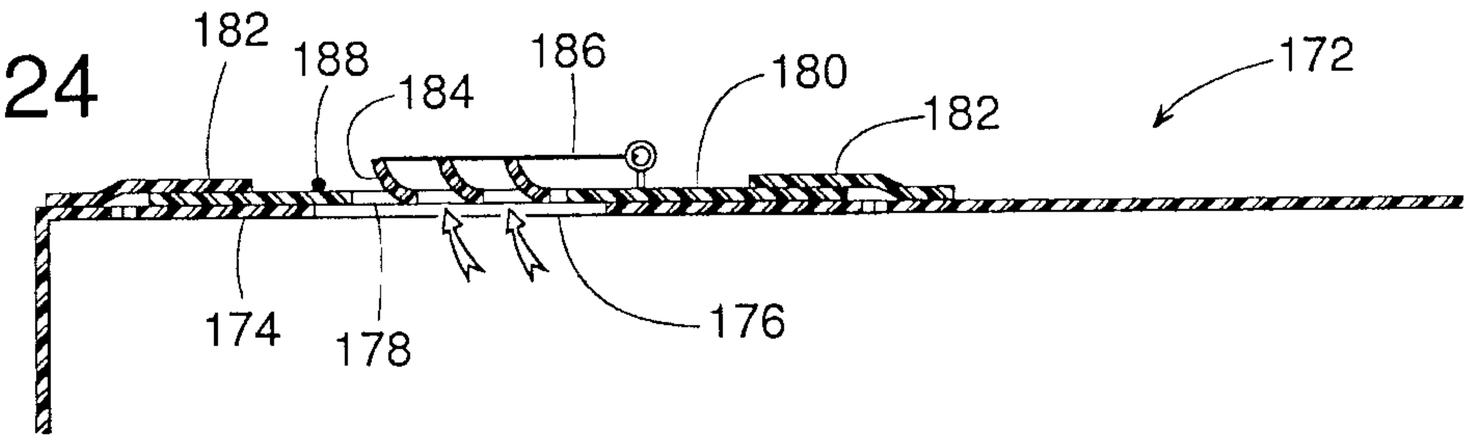


FIG. 25

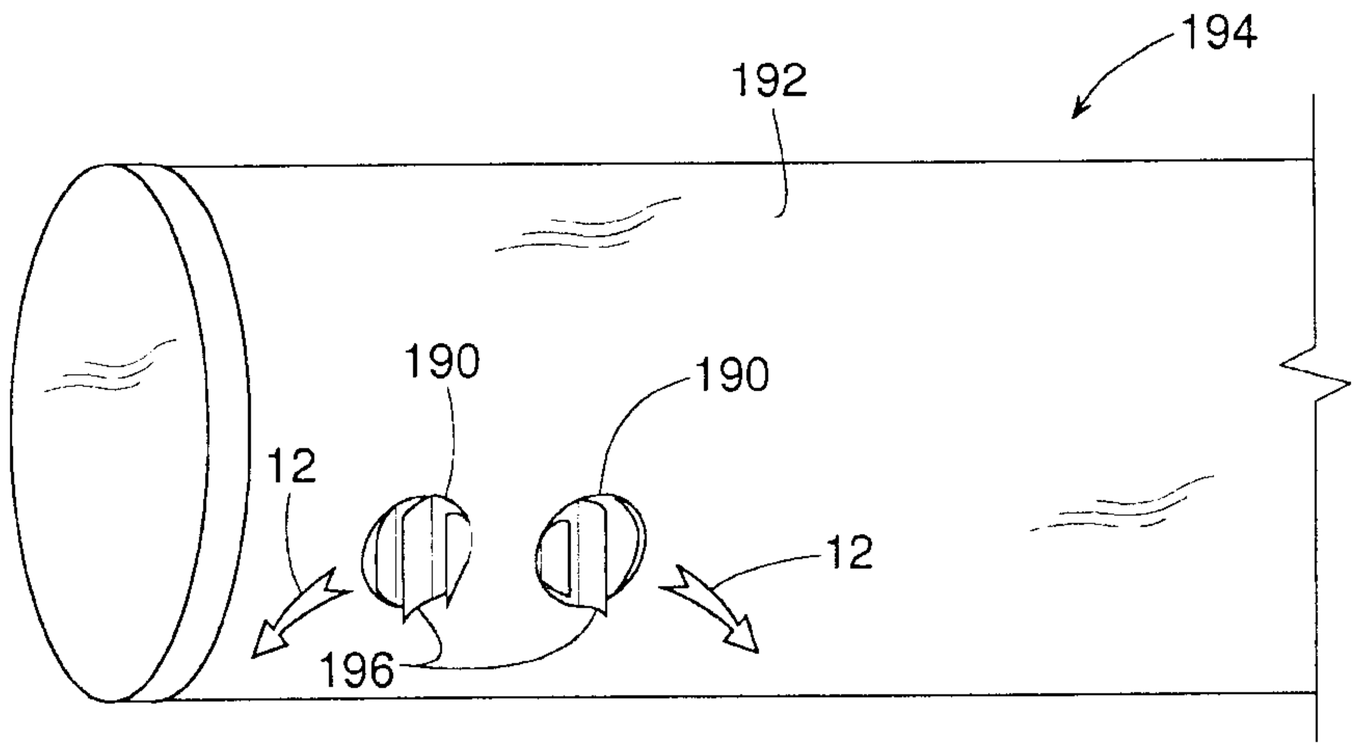


FIG. 26

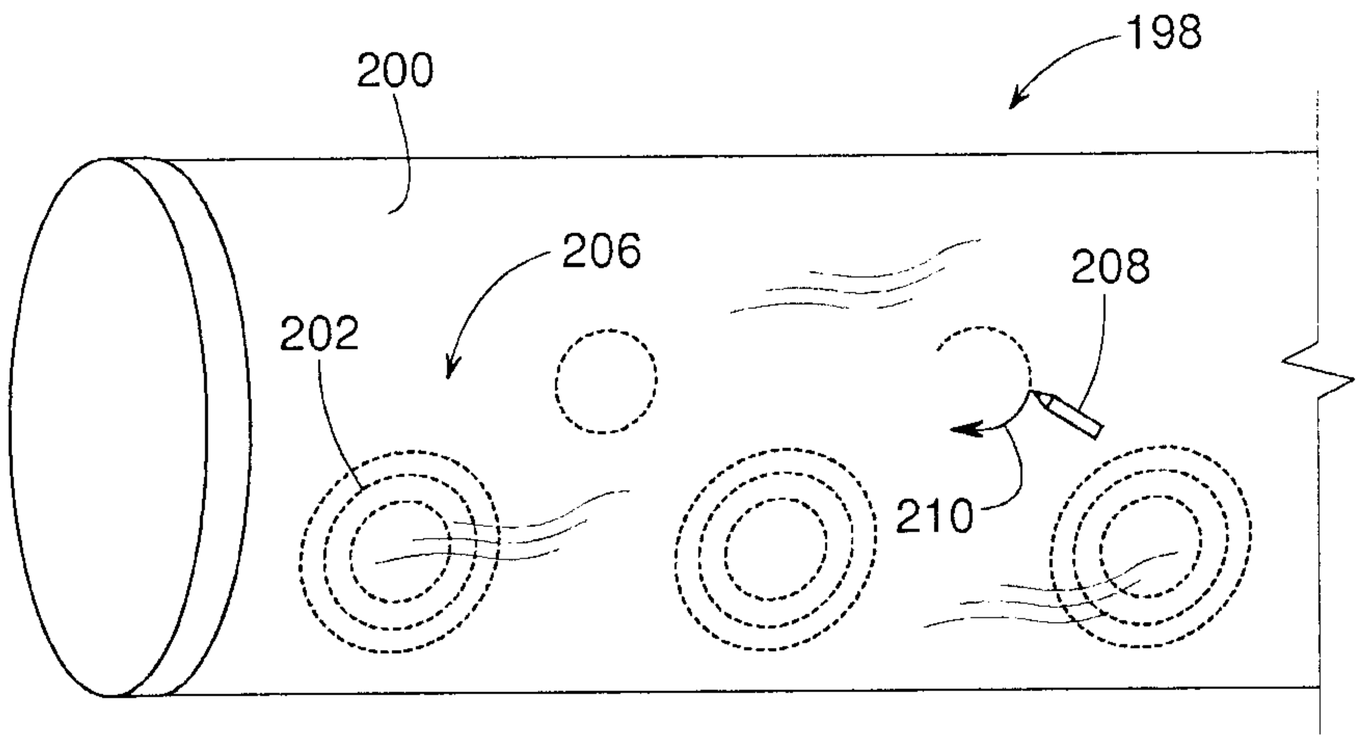


FIG. 27

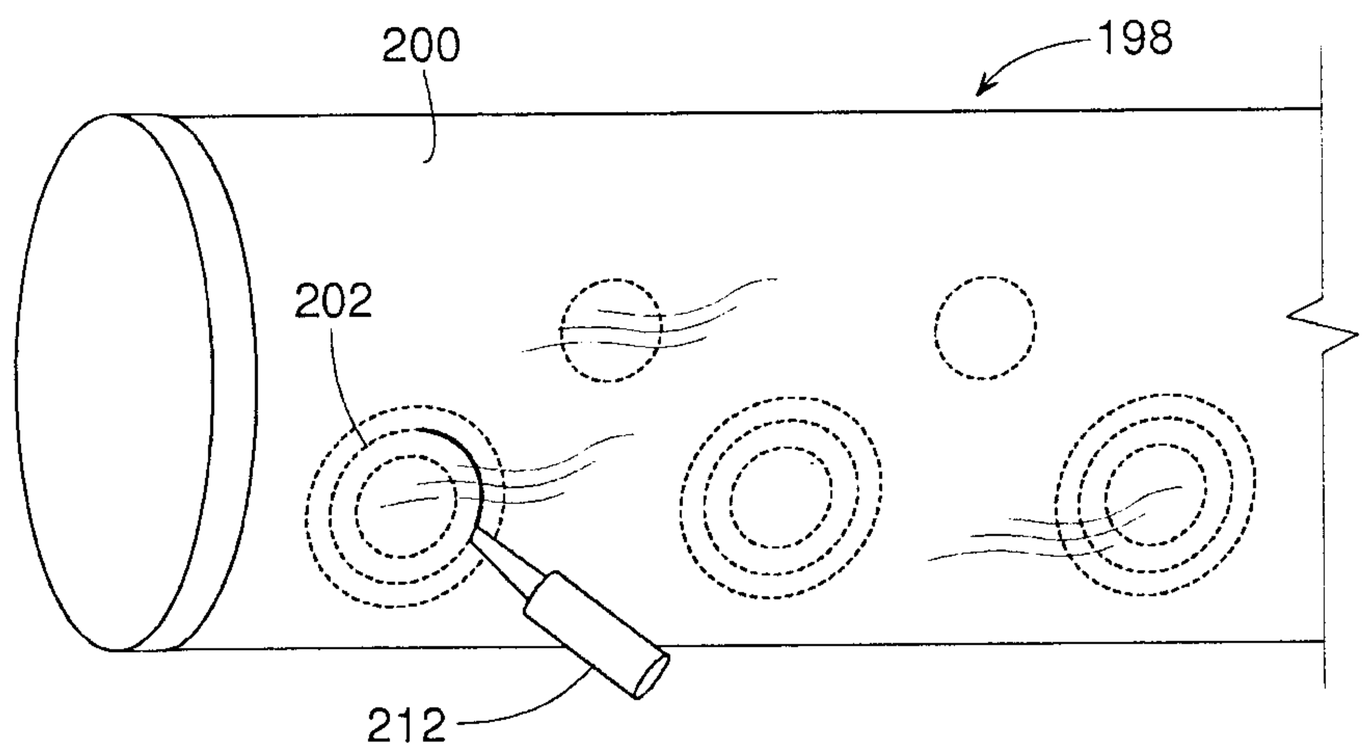
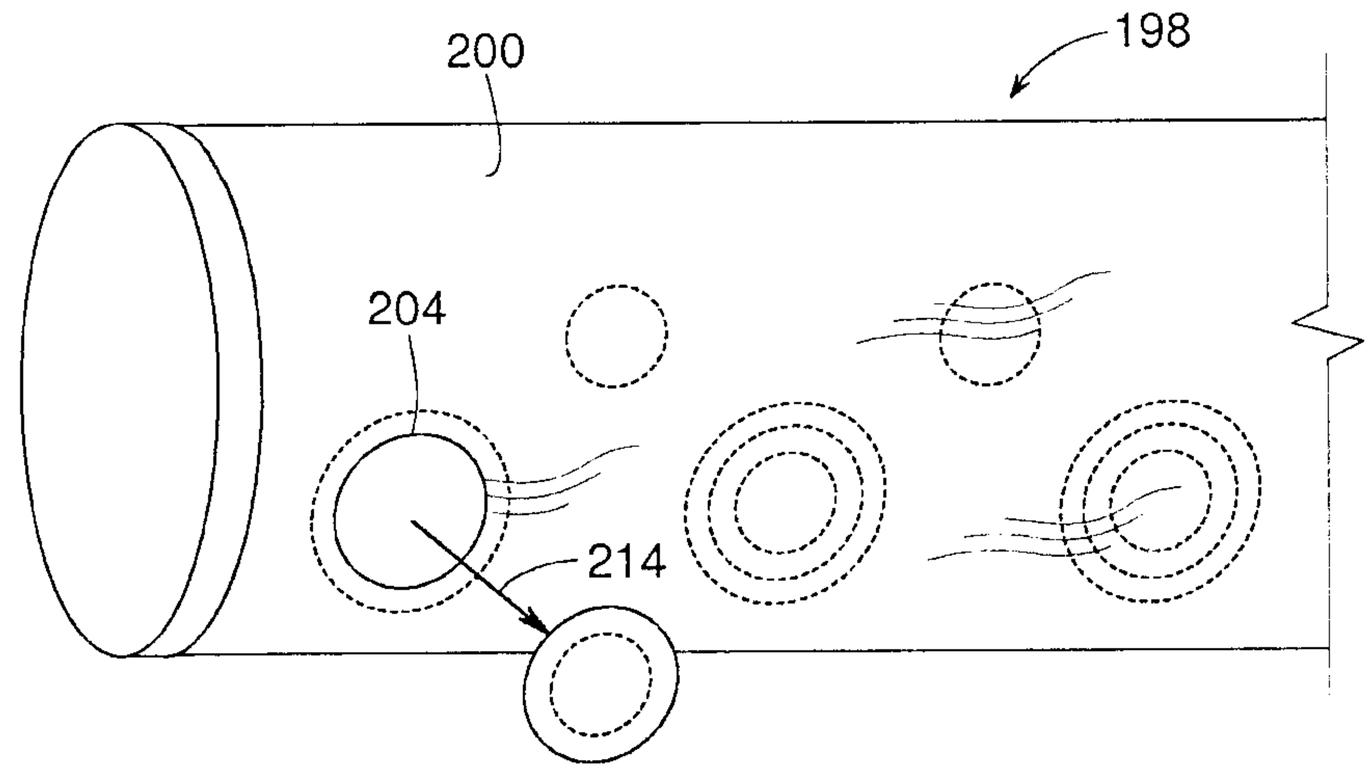


FIG. 28



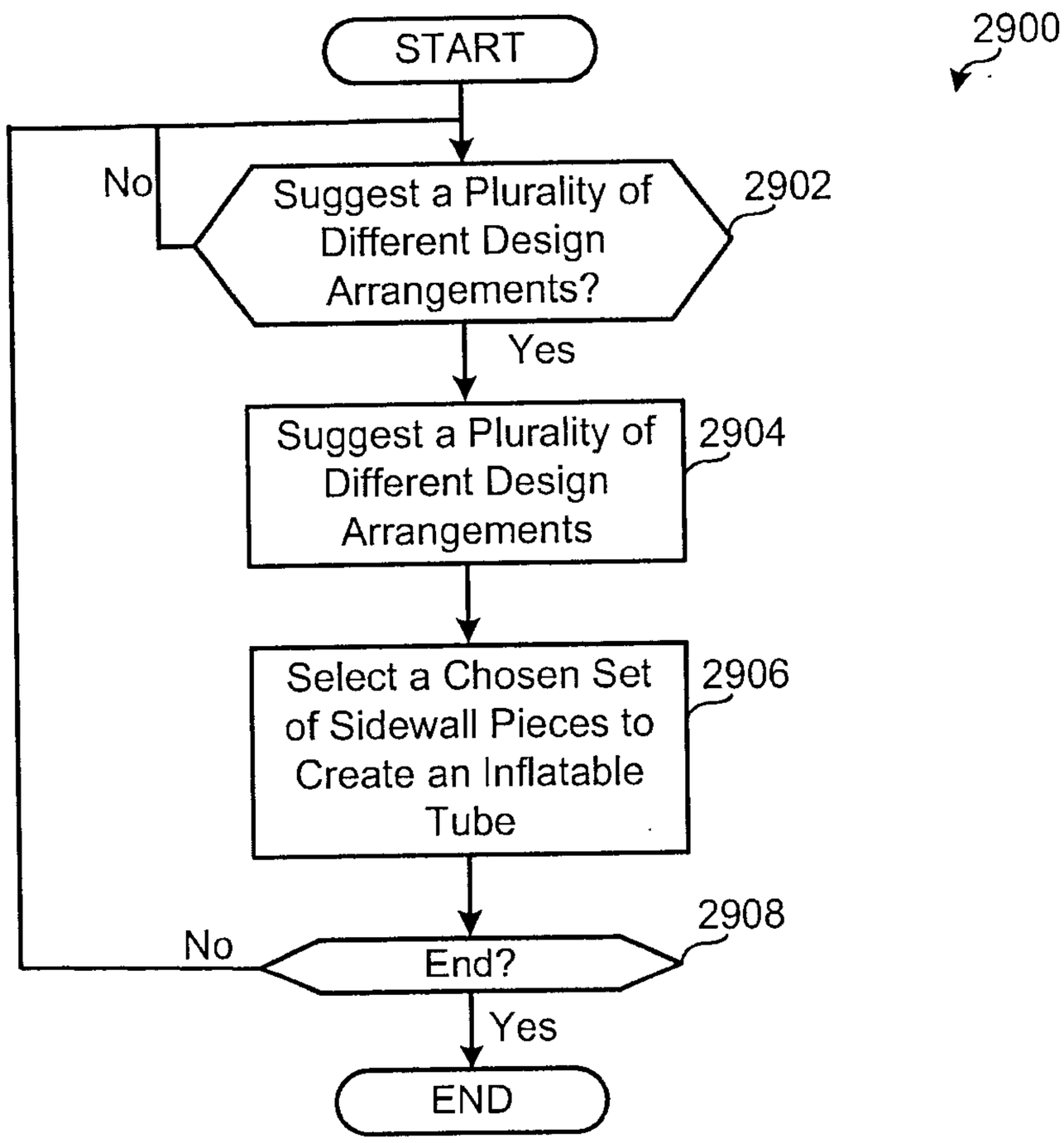

2900
START
No
Suggest a Plurality of Different Design Arrangements?
2902
Yes
Suggest a Plurality of Different Design Arrangements
2904
Select a Chosen Set of Sidewall Pieces to Create an Inflatable Tube
2906
2908
No
End?
Yes
END

FIG. 29

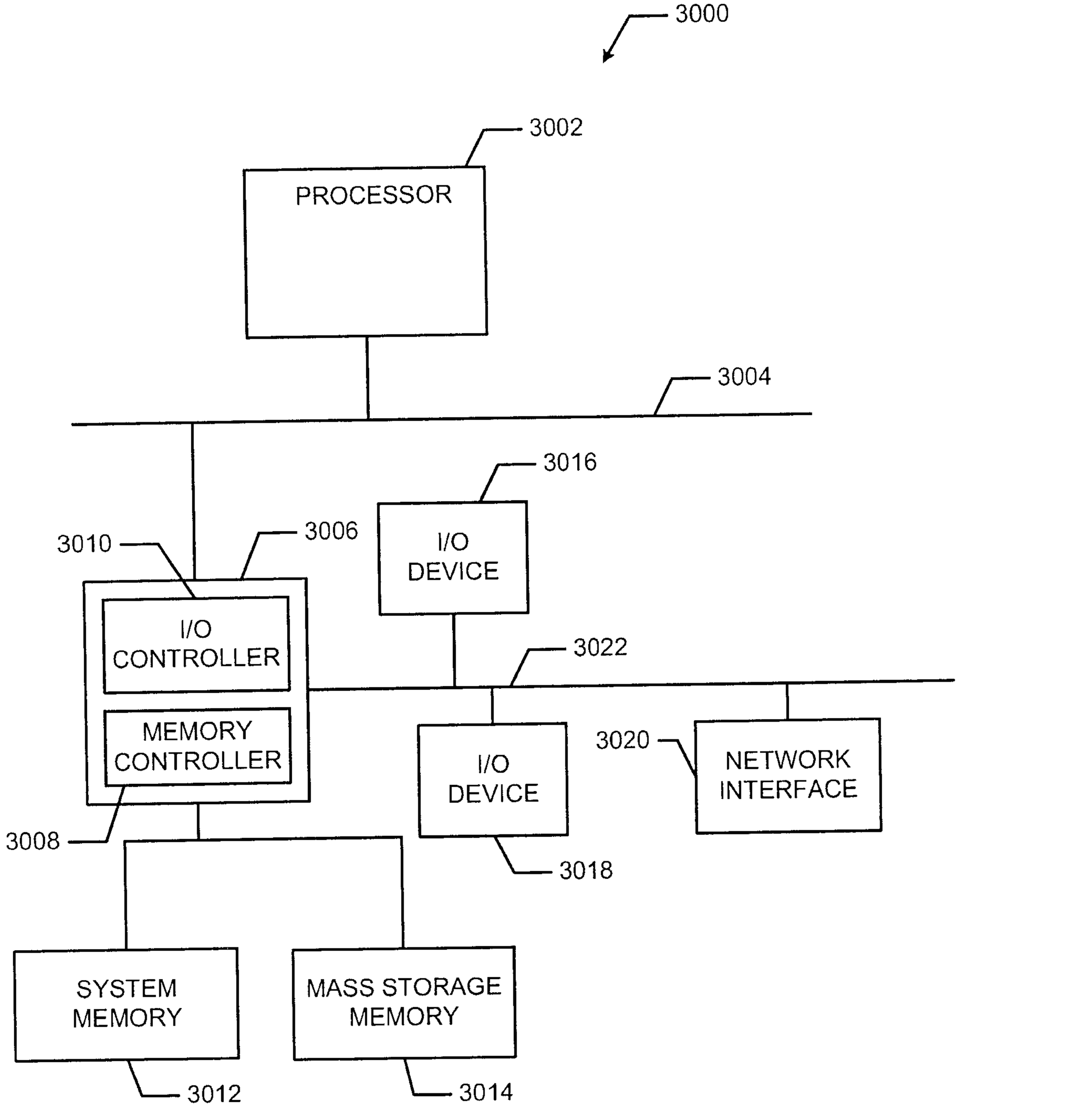
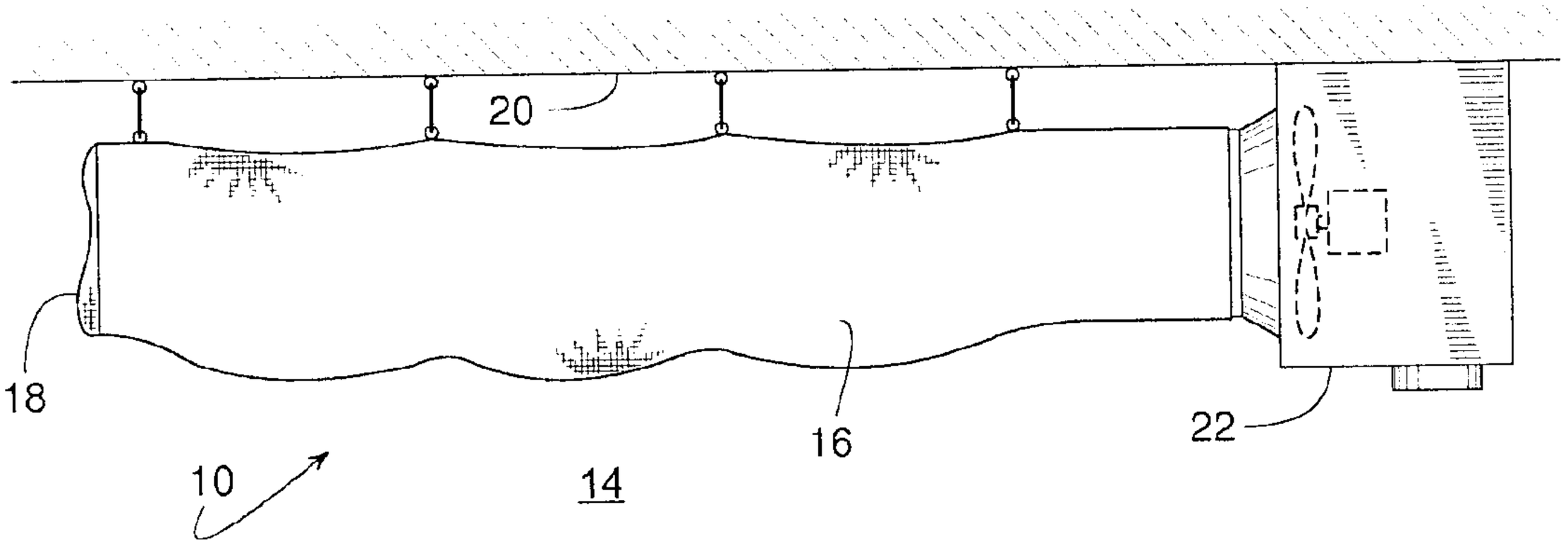

3000
3002
PROCESSOR
3004
3016
I/O DEVICE
3010
3006
I/O CONTROLLER
MEMORY CONTROLLER
3008
3022
I/O DEVICE
3018
3020
NETWORK INTERFACE
SYSTEM MEMORY
3012
MASS STORAGE MEMORY
3014

FIG. 30


20
18
16
22
10
14