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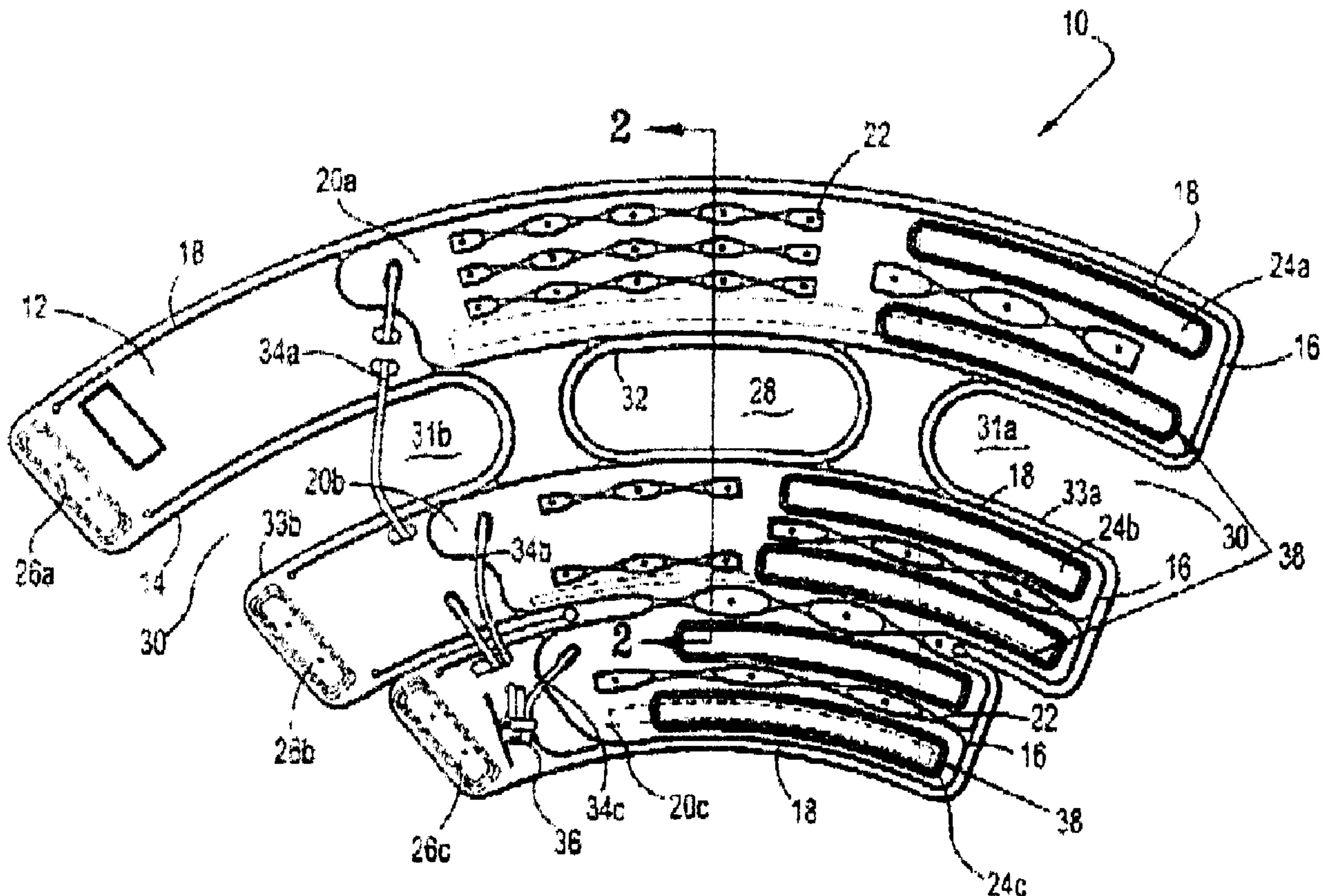
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(54) Title: COMPRESSION SLEEVE HAVING AIR CONDUIT



(57) Abrégé/Abstract:

A compression sleeve is described as having a first sheet, a second sheet attached to said first sheet and defining at least one inflatable section, and at least one conduit disposed in the at least one of said inflatable sections.



**ABSTRACT**

A compression sleeve is described as having a first sheet, a second sheet attached to said first sheet and defining at least one inflatable section, and at least one conduit disposed in the at least one of said inflatable sections.

## **COMPRESSION SLEEVE HAVING AIR CONDUIT**

### **BACKGROUND**

#### **1. Technical Field**

The present disclosure relates generally to a compression sleeve for use in a system for applying compressive forces or pressure to a patient's limb, such as the leg. In particular, the present disclosure relates to a compression sleeve that maintains air flow in the entire sleeve during compression therapy when wrapped around the limb of an individual.

#### **2. Description of Related Art**

Compression devices for applying compressive forces to a selected area of a person's anatomy are generally employed to improve blood flow in the selected area. Compression devices that provide intermittent pulses of a compressed fluid (e.g. air) to inflate at least one inflatable chamber in a sleeve are particularly useful. This cyclic application of pressure provides a non-invasive method of prophylaxis to reduce the incidence of deep vein thrombosis (DVT), and the like. These compression devices find particular use during surgery on patients with high-risk conditions such as obesity, advanced age, malignancy, or prior thromboembolism. Patients who have this condition often have swelling (i.e. edema) and tissue breakdown (i.e. venous stasis ulcer) in the lower leg.

In general, compression devices include a sleeve having at least one fluid inflatable pressure chamber progressively arranged longitudinally along the sleeve. A pressure source (e.g. a pump) is provided for intermittently forming a pressure pulse within these inflatable chambers from a source of pressurized fluid during periodic compression cycles. The compression sleeves provide a pressure gradient along the patient's limbs during these



compression cycles, which progressively decreases from the lower portion to the upper portion of the limb (i.e. from the ankle to the thigh).

Examples of compression sleeves are disclosed in U.S. Pat. Nos. 4,013,069 and 4,030,488 to Hasty, U.S. Pat. Nos. 4,029,087 and 5,795,312 to Dye, and U.S. Pat. No. 5,626,556 to Tobler et al., all of which are currently owned by Tyco Healthcare Group, LP. Other examples of compression sleeves are disclosed in U.S. Patent Nos. 4,696,289 to Gardner et al. and 5,989,204 to Lina.

When compression therapy is administered to a patient, the inflatable pressure chambers of the compression sleeves of the foregoing description may include trapped air. Trapped air changes the volume of a chamber, thus reducing the pressure gradient along the patient's limb during treatment. The shape, weight, and position of a patient's limb will contribute to the size and number of pockets of air formed. An example of compression treatment method is disclosed in U.S. Pat. No. 6,231,532 to Watson et al., which is currently owned by Tyco Healthcare Group, LP.

## **SUMMARY**

The present disclosure is directed towards a compression sleeve for applying compressive forces or pressure to a selected portion of a patient's anatomy. The compression sleeve may include a sleeve having one or more inflatable sections and at least one conduit disposed within one of the plurality of inflatable sections. A plurality of lumens may be further provided for operatively connecting the sleeve to a controller having a source of pressurized fluid (e.g. air). The compression sleeve may further include hook and loop features attached thereto for securing the compression sleeve to the selected portion of the patient's anatomy.

A compression sleeve is provided that comprises: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a base member and a plurality of ridges attached to a first surface of the base member.

In one embodiment, the compression sleeve includes a sleeve for applying compressive forces or pressure to a patient's limb (e.g. a leg). The sleeve may include first and second sheets defining a plurality of inflatable sections or chambers, and at least one air conduit disposed within the plurality of inflatable sections. The first and second sheets may be fixedly joined by radio frequency (RF) welding, or by other suitable methods, along their corresponding perimeters, thereby defining a plurality of inflatable sections therebetween. The second layer may provide the attachment surface for the hook and loop features.

The plurality of inflatable sections may be configured for receiving and retaining a pressurized fluid (e.g. air) from a pressurized fluid source for exerting compressive forces or pressure to a portion of the patient's leg during successive pressure applying cycles.

The air conduit may be configured and adapted for creating a passage for facilitating the flow of the pressurized air in the plurality of inflatable sections or chambers during compression therapy. When the pressurized air is introduced into each inflatable section, the passage created by the air conduit between the first and second sheets improves the inflation



characteristics of each inflatable section. Moreover, the air conduit, during deflation of the compression sleeve, channels the pressurized air towards the fluid source, thereby improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

According to another aspect of the invention there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a base member and a plurality of pins attached to a first surface of the base member.

According to another aspect of the invention there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a base member and a plurality of pins attached to a first surface of the base member.

According to another aspect of the invention there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a beam having a web portion and two flange portions disposed on both ends of the web portion.

According to another aspect of the invention there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a plurality of longitudinal corrugated extrusions.

According to another aspect of the invention there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along



at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a plurality of longitudinal tubes.

According to another aspect of the invention there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a base member and an upstanding member upstanding from a first surface of the base member.

In another aspect, there is provided use of a compression sleeve for applying pressure to a portion of a patient's body, the compression sleeve comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a base member and a plurality of ridges attached to a first surface of the base member.



Other features of the presently disclosed compression sleeve will become apparent from the following detailed description, taken in conjunction with the accompanying drawings that illustrate, by way of example, the presently disclosed compression sleeve.

least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit is arranged in the at least one inflatable section so that the conduit extends along the longitudinal axis of the at least one inflatable section.

In another aspect there is provided a compression sleeve, comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and wherein the compression sleeve further comprising a plurality of raised surfaces formed at an inner surface of the first or second sheet, the raised surface extend approximately from a sealing line inward and are substantially along one dimension of the first and second sheet, for improving fluid flow in and out of at least one inflatable section.

In another aspect, there is provided use of a compression sleeve for applying pressure to a portion of a patient's body, the compression sleeve comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of the dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a

compression cycle, wherein the at least one conduit includes a base member and a plurality of ridges attached to a first surface of the base member.

In another aspect of the present invention there is provided use of a compression sleeve for applying pressure to a portion of a patient's body, the compression sleeve comprising: a first sheet; a second sheet attached to the first sheet and defining at least one inflatable section, the at least one inflatable section being configured for extending circumferentially around a limb of the patient along a longitudinal axis of the at least one inflatable section; and at least one conduit disposed within the area formed by the at least one inflatable section and extending along the longitudinal axis of the at least one inflatable section, for creating a passage substantially along the entirety of at least one dimension, generally parallel to the first and second sheets, of the at least one inflatable section to facilitate the flow of a fluid therethrough.

Other features of the presently disclosed compression sleeve will become apparent from the following detailed description, taken in conjunction with the accompanying drawings that illustrate, by way of example, the presently disclosed compression sleeve.



**BRIEF DESCRIPTION OF THE DRAWINGS**

The features of the presently disclosed compression sleeve will become more readily apparent by referring to the following detailed description of embodiments, which are described hereinbelow with reference to the drawings, wherein:

FIG. 1 is a plan view of a compression sleeve, in accordance with the present disclosure;

FIGS. 2A-2B are plan and cross-sectional views, respectively, of a first embodiment of an air conduit in accordance with the present disclosure;

FIG. 2C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 2A positioned within the inflatable sections of the compression sleeve;

FIGS. 3A-3B are plan and cross-sectional views, respectively, of a second embodiment of the air conduit in accordance with the preset disclosure;

FIG. 3C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 3A positioned within the inflatable sections of the compression sleeve;

FIGS. 4A-4B are plan and cross-sectional views, respectively, of yet another embodiment of the air conduit in accordance with the preset disclosure;

FIG. 4C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 4A positioned within the inflatable sections of the compression sleeve;

FIGS. 5A-5B are plan and cross-sectional views, respectively, of yet another embodiment of the air conduit in accordance with the preset disclosure;

FIG. 5C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 5A positioned within the inflatable sections of the compression sleeve;

FIGS. 6A-6B are plan and cross-sectional views, respectively, of yet another embodiment of the air conduit in accordance with the preset disclosure;

FIG. 6C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 6A positioned within the inflatable sections of the compression sleeve;

FIGS. 7A-7B are plan and cross-sectional views, respectively, of yet another embodiment of the air conduit in accordance with the preset disclosure;

FIG. 7C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 7A positioned within the inflatable sections of the compression sleeve;

FIG. 7D is a front elevational view of the compressive sleeve showing a linear void across the sleeve;

FIGS. 8A-8B are plan and cross-sectional views, respectively, of yet another embodiment of the air conduit in accordance with the preset disclosure;

FIG. 8C is a cross-sectional view taken along line 2-2 in FIG. 1, illustrating the air conduit of FIG. 8A positioned within the inflatable sections of the compression sleeve;

FIG. 9 is a plan view of the compression sleeve illustrating yet another embodiment of the air conduit in accordance with the present disclosure; and

FIGS. 10A-B are cross-sectional views of another embodiment of the compression sleeve illustrating various textures of an inner surface of first and second sheets in accordance with the present disclosure.

## **DETAILED DESCRIPTION**

Referring now to the drawing figures, in which like reference numerals identify identical or corresponding elements, various embodiments of the presently disclosed compression sleeve will now be described in detail. The compression sleeve of the present disclosure is similar to the compression sleeve disclosed in U.S. Patent Nos. 5,626,556 to Tobler et al. and 5,795,312 to Dye, both of which are currently owned by Tyco Healthcare Group, LP.



With initial reference to FIG. 1, a compression sleeve in accordance with the present disclosure is illustrated and is designated generally as compression sleeve 10. Compression sleeve 10 is adapted for use in a system for applying compressive forces or pressure to a portion of a patient's limbs such as, for example, the legs. Compression sleeve 10 includes first or outer sheet 12 and second or inner sheet 14 connected by a plurality of laterally extending sealing lines 16 and longitudinally extending sealing lines 18 connecting the ends of lateral sealing lines 16. First and second sheets 12, 14 are adapted as inner gas-impervious sheets, for placement against the person's limbs. Sealing lines 16, 18 may be formed by radio frequency (RF) welding, etc. Moreover, sealing lines 16, 18 define a plurality of longitudinally disposed inflatable sections or chambers 20a, 20b, and 20c which are capable of retaining a pressurized fluid such as, for example, air, in order to exert compressive forces to the patient's limbs during successive pressure-applying cycles.

First sheet 12 may, for example, comprise a suitable flexible polymeric material such as, for example, polyvinyl chloride (PVC) on the order of 5-10 mils thick. Second sheet 14 will preferably comprise a similar polymeric material (i.e. 5-10 mil PVC) having a non-woven material, such as polyester, laminated to the inner surface that is placed against the limb, thereby increasing the comfort of the wearer. Each inflatable section 20a, 20b, and 20c may include at least one wave-shaped border 22. When inflatable sections 20a, 20b, and 20c abut one another, wave-shaped border 22 defines a plurality of un-inflatable "eyes", as illustrated in FIG. 1.

In addition, compression sleeve 10 includes a plurality of hook and loop fasteners for attaching the sleeve about the patient's limb. Hook and loop fasteners include a set of spaced strips 24a, 24b, and 24c, such as loop material positioned on first sheet 12. Strips 24a, 24b, and 24c extend laterally at the inflatable sections 20a, 20b, and 20c, and cooperate



with a set of spaced hook materials 26a, 26b, and 26c disposed on second sheet 14 for releasably fastening sleeve 10 to the leg.

When compression sleeve 10 is attached to the patient's limbs, each inflatable section 20a, 20b, and 20c is oriented in a direction that is substantially transverse to a longitudinal axis of the patient's limb. That is, compression sleeve 10 encircles the leg.

Compression sleeve 10 includes an elongated opening 28 extending through what would be the knee region 30 when the sleeve is employed to apply compressive forces or pressure to the limb, opening 28 being defined by peripheral edges 32 extending around the opening. In addition, the knee region 30 has elongated cut-outs or openings 31a and 31b being defined by peripheral side edges 33a and 33b, respectively. Compression sleeve 10 is provided with a set of lumens 34a, 34b and 34c having a connector 36 for operably connecting lumens 34a, 34b and 34c to a controller (not shown) having a source of pressurized fluid (e.g. air).

With continued reference to FIG. 1, compression sleeve 10 further includes a plurality of air conduits 38 disposed within at least one of inflatable sections 20a, 20b, or 20c. Air conduit 38 is adapted for creating a passage for facilitating the flow of the pressurized air in the at least one inflatable section 20a, 20b, or 20c when compression therapy is being administered. Each air conduit 38 facilitates the flow of the pressurized air within inflatable sections 20a, 20b, or 20c by separating first and second sheets 12 and 14 when compression sleeve 10 is in a deflated state. Although air conduit 38 is shown as a linear structure in the various figures, air conduit 38 may be shaped to follow an arc that substantially corresponds to the arc defined by inflatable sections 20a, 20b, or 20c (see FIG.1). Air conduit 38 may be formed from extruded PVC. It is envisioned that each air conduit 38 may be constructed to fit the shape of other flexible sleeves and foot cuffs such as those available from Kendall's product catalog H-4693VT "Vascular Therapy Products."

In use, compression sleeve 10, in accordance with the present disclosure, is configured to apply compressive forces to a patient's leg. Compression sleeve 10 is positioned about the leg of a patient, wherein hook materials 26a, 26b, and 26c are configured for engaging loop materials 24a, 24b, and 24c. After placement of compression sleeve 10 about a leg of the patient and connecting compression sleeve 10 to pressurized fluid source via connector 36, the controller (not shown) may then be actuated for supplying pressurized air to compression sleeve 10 and initiating compression therapy. Thus, the controller intermittently inflates inflatable sections 20a, 20b, and 20c sequentially during periodic compression cycles and defines a pressure gradient profile.

Air conduit 38 inhibits the formation of random pockets of air in each of the inflatable sections. When the pressurized air is introduced into each inflatable section 20a, 20b, and 20c, the passage created by the at least one air conduit 38 located between first and second sheets 12, 14, improves the inflation characteristics of each inflatable section. In devices that do not include at least one air conduit 38, as inflatable sections 20a, 20b, or 20c deflate, first and second sheets 12, 14 collapse and may form random pockets of pressurized air. These pockets randomly redirect and/or restrict the flow of the pressurized fluid through the inflatable sections 20a, 20b, or 20c, thereby obstructing the removal of the pressurized fluid.

By positioning air conduit 38 within inflatable sections 20a, 20b, or 20c, a passage is created for facilitating the flow of pressurized fluid in each of the inflatable sections 20a, 20b, or 20c. Deflation between successive inflation cycles occurs by returning the air in inflatable sections 20a, 20b, and 20c to the controller or to another vent (not shown), as is known in the art. Air conduit 38 effectively channels the pressurized air towards lumen 34a, 34b, or 34c, thus minimizing the formation of random pockets of pressurized air in each inflatable section 20a, 20b, or 20c. In addition, air conduit 38 channels the pressurized



air towards lumens 34a, 34b, or 34c thereby improving the removal rate of the pressurized air and minimizing the formation of random pockets of pressurized air throughout compression sleeve 10.

With reference to FIGS. 2A-2C, one embodiment of air conduit 38 is illustrated and is designated generally as air conduit 38A. Air conduit 38A includes a plurality of ridges or ribs 40 extruding upwards from a base member 42. Base member 42 is adhesively fastened to second sheet 14 or first sheet 12 of inflatable sections 20a, 20b, or 20c, and ribs 40 are in releasable contact with the first sheet 12 or second sheet 14 of the inflatable section 20a, as illustrated in FIG. 2C. The plurality of ribs 40 includes a center rib 40a, middle ribs, 40b, and outer ribs 40c that will be discussed in detail hereinbelow.

With particular reference to FIG. 2B, the height of ribs 40 is at a minimum at the outer edges of base member 42 and progressively increases towards the center of the base member 42 such that center rib 40a has the greatest height of ribs 40. Base member has a thickness from about 19 mils to about 39 mils. In one embodiment, center rib has a height from about 65 mils to about 85 mils, middle ribs 40b have a height from about 43 mils to about 63 mils, and outer ribs have a height from about 29 mils to about 49 mils. Further still, center rib has a width from about 50 mils to about 70 mils, while middle and outer ribs 40b and 40c have a width of about 40 mils to about 60 mils. Therefore, air conduit 38 has a low profile and, in combination with first and second sheets 12, 14, defines a low profile compression sleeve 10. Moreover, adjacent middle and outer ribs 40b and 40c, respectively, are spaced apart defining troughs 44 therebetween. Troughs 44 fluidly couple the opposing ends of air conduit 38A and are configured for channeling the pressurized air within inflatable sections 20a, 20b, or 20c towards lumens 34a, 34b, or 34c. In use, when the pressurized air is introduced into inflatable sections 20a, 20b, and 20c, the passage created by ribs 40 in air conduit 38A improves the inflation characteristics of inflatable



sections 20a, 20b, or 20c. During deflation, troughs 44 channel the pressurized air towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

With reference to FIGS. 3A, 3B and 3C, a second embodiment of air conduit 38, in accordance with the present disclosure, is illustrated and is designated generally as air conduit 38B. As best illustrated in FIG. 3B, air conduit 38B includes a plurality of randomly placed pins or knobs 46 extending upward from a base member 48. Base member 48 is fastened to second sheet 14 or first sheet 12 of inflatable sections 20a, 20b, or 20c and pins 46 are in releasable contact with first sheet 12 or second sheet 14 of at least one of inflatable sections 20a, 20b, or 20c, as illustrated in FIG. 3C. Thus, air conduit 38B effectively separates first and second sheets 12 and 14 when compression sleeve 10 is in a deflated state. The passage created by the plurality of pins 46 improves the inflation characteristics of inflatable sections 20a, 20b, or 20c. During deflation, pins 46 channel the pressurized air towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

With reference to FIGS. 4A-4C, another embodiment of air conduit 38 is illustrated and is designated generally as air conduit 38C. Air conduit 38C includes at least one inflatable elongated sheath 49 positioned within at least one of inflatable sections 20a, 20b, or 20c. The at least one elongated sheath 49 is adhesively fastened to second sheet 14 or first sheet 12 and is in releasable contact with first sheet 12 or second sheet 14, as illustrated by FIG. 4C. In an alternative embodiment, the sheath may be RF welded to an inside surface of second sheet 14 or first sheet 12. In this particular embodiment, air conduit 38C forms a circumferential bubble passageway, as illustrated in FIG. 4C. The at least one elongated sheath 49 may be formed from a foam material wherein the foam material does not collapse under the load of the leg, thus maintaining a separation between first and

second sheets 12 and 14. In use, when the pressurized air is introduced into inflatable sections 20a, 20b, and 20c, the circumferential bubble passageway formed by air conduit 38C improves the inflation characteristics of inflatable sections 20a, 20b, or 20c. During deflation, the at least one elongated sheath 49 channels the pressurized air towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air. In addition, elongated sheath 49 may also be positioned on the outer surface of first and second sheets 12 and 14 for providing a rigid support structure of the sleeve for receiving the leg. Alternatively, a separate leg support may be provided to keep the limb raised off the bed surface.

With reference to FIGS. 5A, 5B and 5C, yet another embodiment of air conduit 38 is illustrated and is designated generally as air conduit 38D. Air conduit 38D is similar to air conduit 38A and will only be discussed in detail to the extent necessary to identify differences in construction and operation. Air conduit 38D includes a semi-rigid “I” beam having a web 50 and two flange portions 52 disposed on either end of web 50. Air conduit 38D is positioned within at least one of inflatable sections 20a, 20b, or 20c in a manner illustrated in FIG. 5C for separating first and second sheets 12 and 14, thus preventing sleeve 10 from collapsing under the weight of the patient's leg. In addition, a plurality of openings 54 is disposed on web 50 for facilitating communication throughout inflatable sections 20a, 20b, or 20c. In use, when the pressurized air is introduced into inflatable sections 20a, 20b, or 20c, the plurality of openings 54 disposed on web 50 improves the inflation characteristics of inflatable sections 20a, 20b, or 20c. During deflation, the semi-rigid “I” beam of air conduit 38D channels the pressurized air towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.



With reference to FIGS. 6A-6C, yet another embodiment of air conduit 38 is illustrated and is designated generally as air conduit 38E. Air conduit 38E is similar to air conduit 38A and will only be discussed in detail to the extent necessary to identify differences in construction and operation. Air conduit 38E includes a plurality of longitudinal corrugated extrusions 56 attached to base 58. Corrugated extrusions 56 form a passageway for air to pass therethrough. It is envisioned that corrugated extrusions 56 will permit air to infiltrate into inflatable sections 20a, 20b, or 20c. In use, when the pressurized air is introduced into inflatable sections 20a, 20b and 20c, the corrugated extrusions 56 improves the inflation characteristics of inflatable sections 20a, 20b, or 20c. During deflation, the corrugated extrusions channel the pressurized air towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

With reference to FIGS. 7A-7C, yet another embodiment of air conduit 38 is illustrated and is designated generally as air conduit 38F. Air conduit 38F is similar to air conduit 38A and will only be discussed in detail to the extent necessary to identify differences in construction and operation. Air conduit 38F includes a base portion 60 having a central longitudinal channel 62, as illustrated in FIG. 7B. In this particular embodiment, air conduit 38F is installed within inflatable sections 20a, 20b, or 20c such that channel 62 forms a passageway therethrough. Base portion 60 and channel 62 may be inflatable or, alternatively, may be RF welded onto first and second sheets 12, 14. They may also be reinforced with an additional layer of PVC sheet to form a more rigid conduit. In use, when the pressurized air is introduced into inflatable sections 20a, 20b, and 20c, central longitudinal channel 62 improves the inflation characteristics of inflatable sections 20a, 20b, or 20c. During deflation, longitudinal channel 62 directs the pressurized air



towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

Alternatively, first and second sheets 12, 14 may be RF welded, having a pre-fabricated feature, wherein a linear void 64 across the sleeve is formed, as illustrated in FIG. 7D. In this particular embodiment, linear void 64 directs the pressurized air towards lumen 34a, 34b, and 34c for improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

With reference to FIGS. 8A, 8B and 8C, yet another embodiment of air conduit 38 is illustrated and is designated generally as air conduit 38G. Air conduit 38G is similar to air conduit 38C (FIGS. 4A, 4B and 4C) and will only be discussed in detail to the extent necessary to identify differences in construction and operation. Air conduit 38G includes at least one elongated sheath 49A having an axial aperture 66 (FIG. 8B) and a plurality of transverse openings 68 (FIG. 8A). Axial aperture 66 and transverse openings 68 permit air to disperse across the full length of compression sleeve 10. The at least one elongated sheath 49A may be positioned within inflatable sections 20a, 20b, or 20c, adhesively fastened to second sheet 14 or the first sheet 12 and in releasable contact with first sheet 12 or second sheet 14, as illustrated in FIG. 8C. In use, when the pressurized air is introduced into inflatable sections 20a, 20b, and 20c, axial aperture 66 and transverse openings 68 of the at least one elongated sheath 49A improves the inflation characteristics of inflatable sections 20a, 20b, or 20c. During deflation, axial aperture 66 channels the pressurized air towards lumens 34a, 34b, or 34c, effectively improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air.

Other methods of facilitating the flow of pressurized air within inflatable sections 20a, 20b, and 20c are envisioned. For example, compression sleeve 10 may be manufactured to include a channel 70 for sliding a support member 72 therethrough, as

illustrated in FIG. 9, for providing a rigid support structure to compression sleeve 10. Thus, support member 72 will rigidly support the weight of the leg. Alternatively, sealing lines 16 (FIG. 1) may be strategically placed along first and second sheets 12, 14 for facilitating the passage of air. Moreover, inflatable sections 20a, 20b, and 20c may be filled with styrene foam pellets for adding structural rigidity and still permitting the flow of pressurized air throughout inflatable sections 20a, 20b, and 20c. In addition, a plurality of connectors 36 may be strategically installed throughout the compression sleeve for supplying inflatable sections 20a, 20b, and 20c with pressurized air from a plurality of points. Likewise, the plurality of connectors 36 can be actuated to deflate a chamber to minimize air pockets. Moreover, the strength of the sleeve material may be increased in order to allow for increased burst strength, permitting more pressure and volume to raise the large limb. For example, first and second sheets 12, 14 may be formed from a rigid material to prevent inflatable sections 20a, 20b, and 20c from collapsing under the weight of a large limb. Moreover, during manufacture of compression sleeve 10, a plurality of passageways may be embossed along the surface of first and second sheets 12, 14.

With reference to FIGS. 10A and 10B, first and second sheets 12, 14 may include a design or feature wherein the texture of the sleeve improves the flow of air. For example, particular textures may be provided on an inside surface of first and second sheets 12, 14, as shown in FIGS. 10A and 10B, such that they never collapse fully, thus facilitating the passage of the pressurized air. The texture may be laminated or may form part of first and second sheets 12 and 14. In use, when the pressurized air is introduced into inflatable sections 20a, 20b, and 20c, the texture on the inside surface of first and second sheets 12 and 14 improves the inflation characteristics of inflatable sections 20a, 20b, and 20c. During deflation, the textures on the inside surface of first and second sheets 12 and 14 assist in channeling the pressurized air towards lumens 34a, 34b, and 34c, effectively

improving the removal of the pressurized air and minimizing the formation of random pockets of pressurized air. One skilled in the art will recognize other fluids besides air can be used without departing from the scope of the invention.

It will be understood that numerous modifications and changes in form and detail may be made to the embodiments of the present disclosure. For example, it is contemplated that numerous other configurations of the conduit may be used, and the material of the sleeve and/or conduit may be selected from numerous materials, other than those specifically disclosed. Therefore, the above description should not be construed as limiting, but merely as exemplifications of the various embodiments.



**WHAT IS CLAIMED IS:**

1. A compression sleeve, comprising:
  - a first sheet;
  - a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets;
  - and
  - at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle,
  - wherein the at least one conduit includes a base member and a plurality of ridges attached to a first surface of the base member.
2. The compression sleeve as claimed in claim 1, further comprising:
  - a connector for connecting a lumen to a source of pressurized fluid; and
  - a plurality of fasteners comprising hook and loop fastener components adapted for securing the sleeve about a portion of a patient's body.
3. The compression sleeve as claimed in claim 1 or claim 2, wherein the at least one conduit is fastened to one of the first or second sheets.

4. The compression sleeve as claimed in claim 1, wherein the height of the plurality of ridges is at a minimum at an outer edge of the base member and at a maximum at a central portion of the base member.
5. The compression sleeve as claimed in claim 4, wherein a central rib at the central portion of the base member has a height between 70 mils and 80 mils, thereby defining a low profile compression sleeve.
6. The compression sleeve as claimed in any one of claims 1, 4 or 5, wherein adjacent ridges are spaced apart defining a trough therebetween.
7. The compression sleeve as claimed in any one of claims 1 to 6, wherein the at least one conduit is formed from a polyvinyl chloride.
8. A compression sleeve as claimed in claim 1, wherein the first and second sheet is sealed along a sealing line for providing a chamber capable of withstanding a pressure from a fluid without leaking.
9. A compression sleeve as claimed in claim 8, wherein the sealing line formation is selected from a group comprising: heat, RF welding, stitching, sewing, solvent bonding, stapling and stamping.

10. A compression sleeve as claimed in claim 1, wherein at least one air tube is connected to the at least one inflatable section for inflating and deflating the at least one inflatable section thereby providing compression therapy.
11. A compression sleeve as claimed in claim 1, wherein the at least one conduit is formed at the perimeter of the at least one inflatable section.
12. A compression sleeve as claimed in claim 1, wherein the conduit minimizes the formation of trapped fluid in the at least one inflatable section.
13. A compression sleeve as claimed in any one of claims 1 to 12 wherein said at least one dimension is in a longitudinal direction of said at least one inflatable section.
14. A compression sleeve, comprising:
  - a first sheet;
  - a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets;
  - and
  - at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least



one conduit includes a base member and a plurality of pins attached to a first surface of the base member.

15. A compression sleeve, comprising:

a first sheet;

a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and

at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a beam having a web portion and two flange portions disposed on both ends of the web portion.

16. The compression sleeve as claimed in claim 15, wherein the web portion includes a plurality of openings.

17. A compression sleeve, comprising:

a first sheet;

a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and

at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a plurality of longitudinal corrugated extrusions.

18. A compression sleeve, comprising:

a first sheet;

a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and

at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a plurality of longitudinal tubes.

19. Use of a compression sleeve for applying pressure to a portion of a patient's body, the compression sleeve comprising:

a first sheet;

a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and

at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle, wherein the at least one conduit includes a base member and a plurality of ridges attached to a first surface of the base member.

20. A compression sleeve, comprising:

a first sheet;

a second sheet attached to said first sheet and defining at least one inflatable section having dimensions in directions generally parallel to the first and second sheets; and

at least one conduit arranged within the at least one inflatable section to maintain separation of the first and second sheets and the at least one conduit defines a flow path along at least one dimension of said dimensions of the at least one inflatable section for



improving fluid flow in and out of the at least one inflatable section and inhibiting the formation of one or more fluid pockets during a compression cycle,

wherein the at least one conduit includes a base member and an upstanding member upstanding from a first surface of the base member.

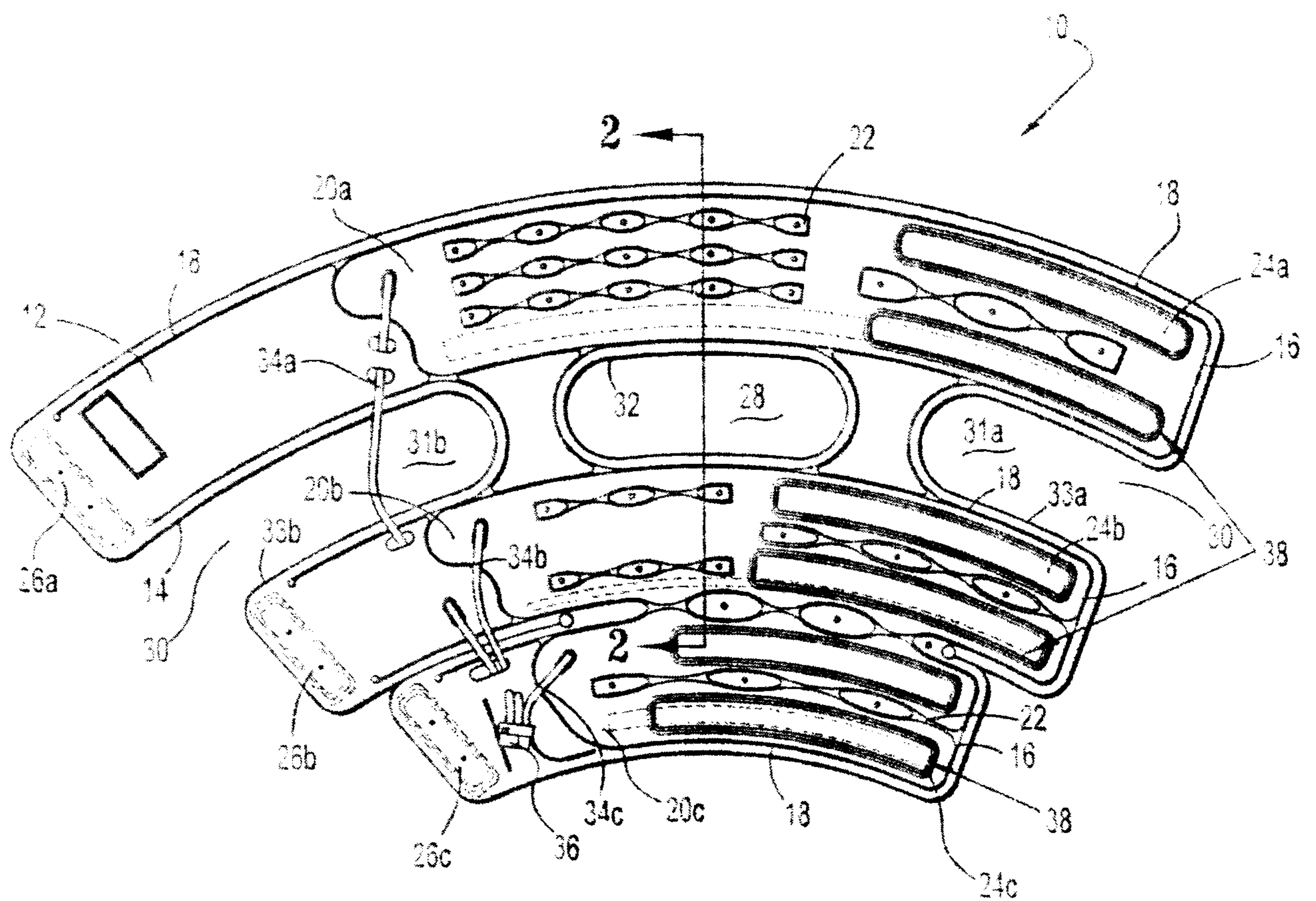
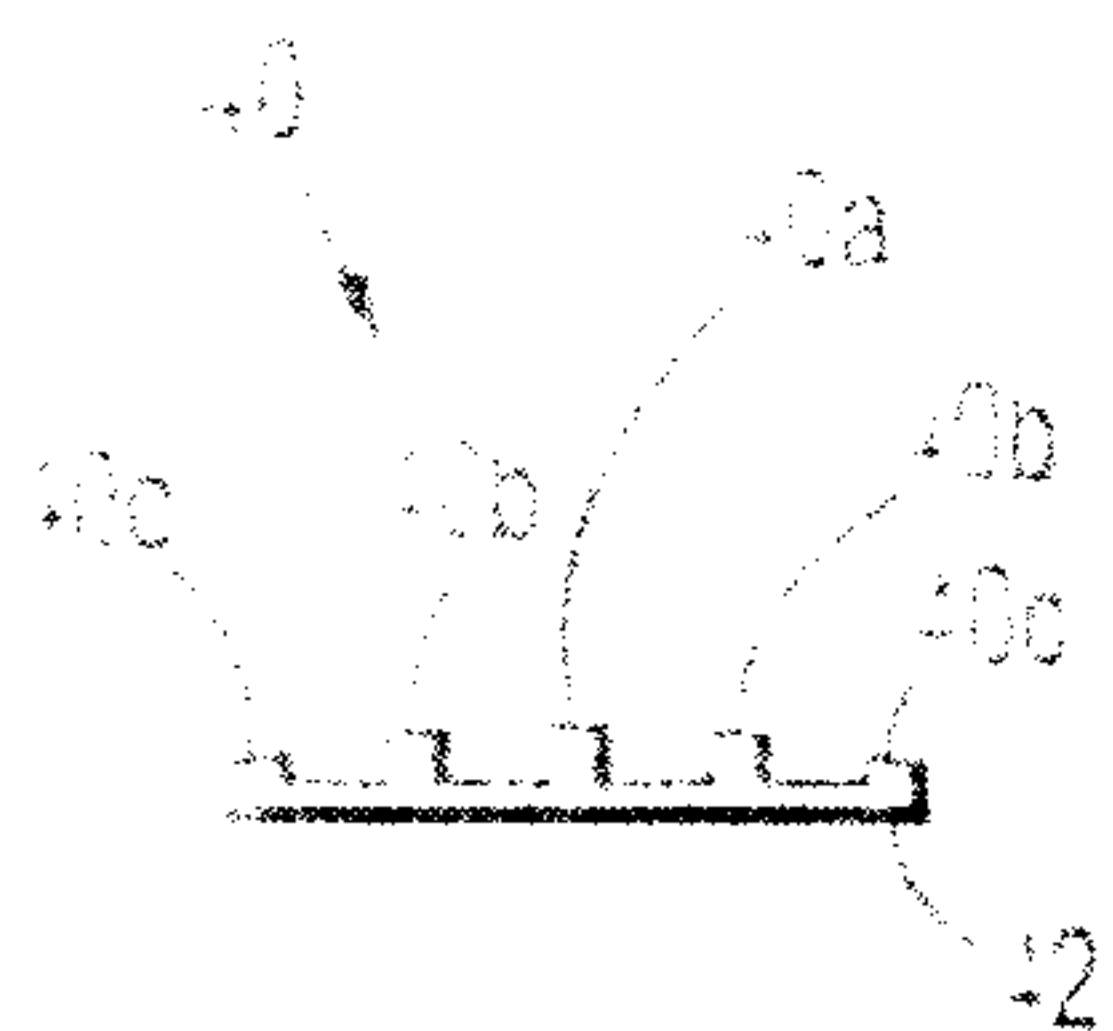
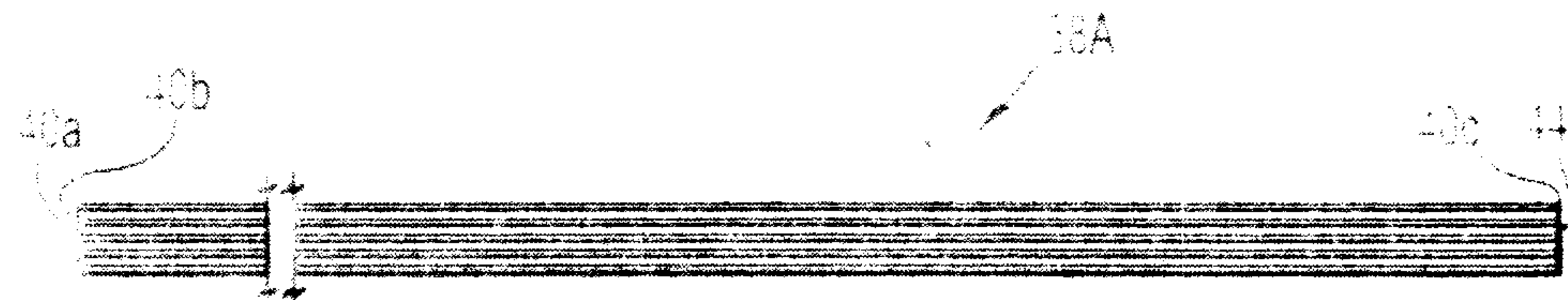


FIG. 1

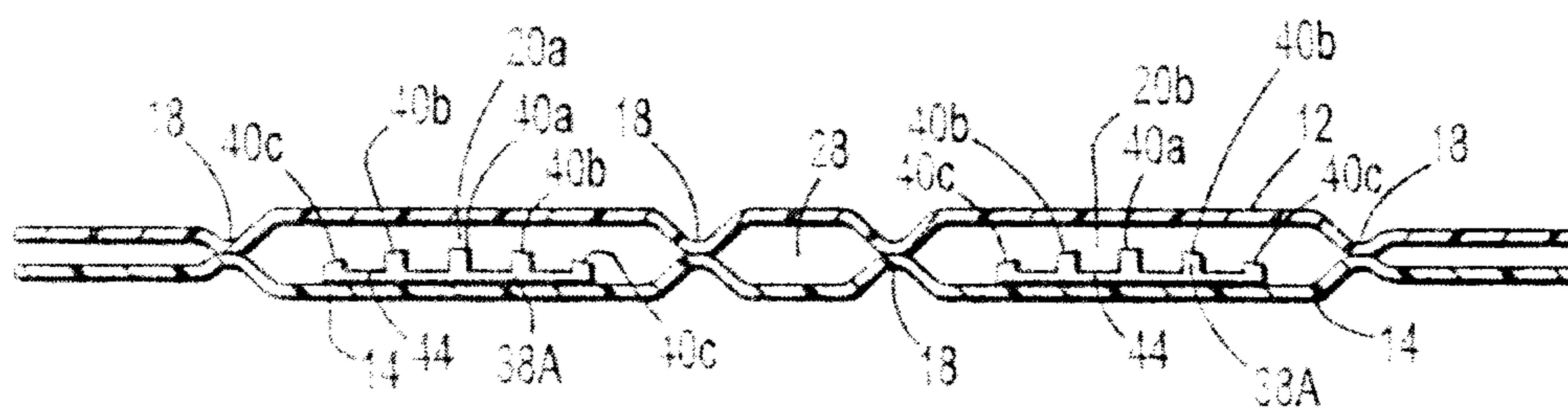




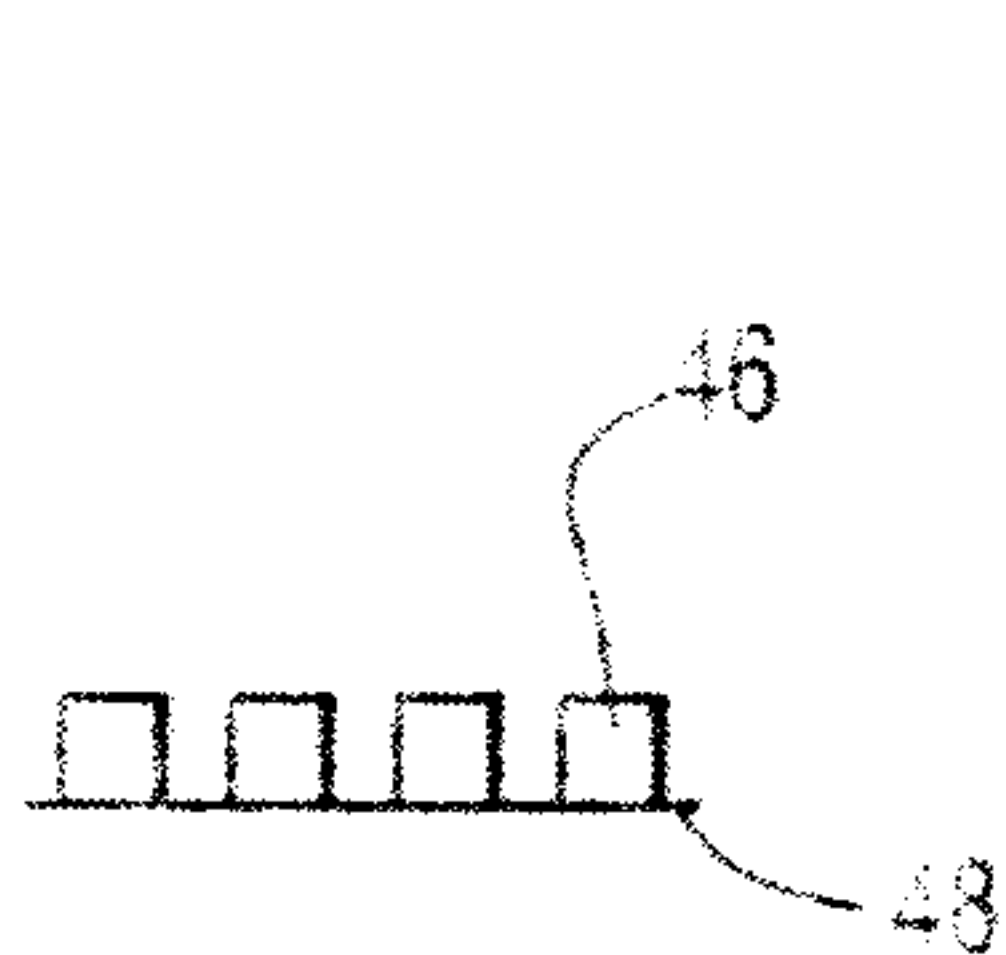
**FIG. 2B**



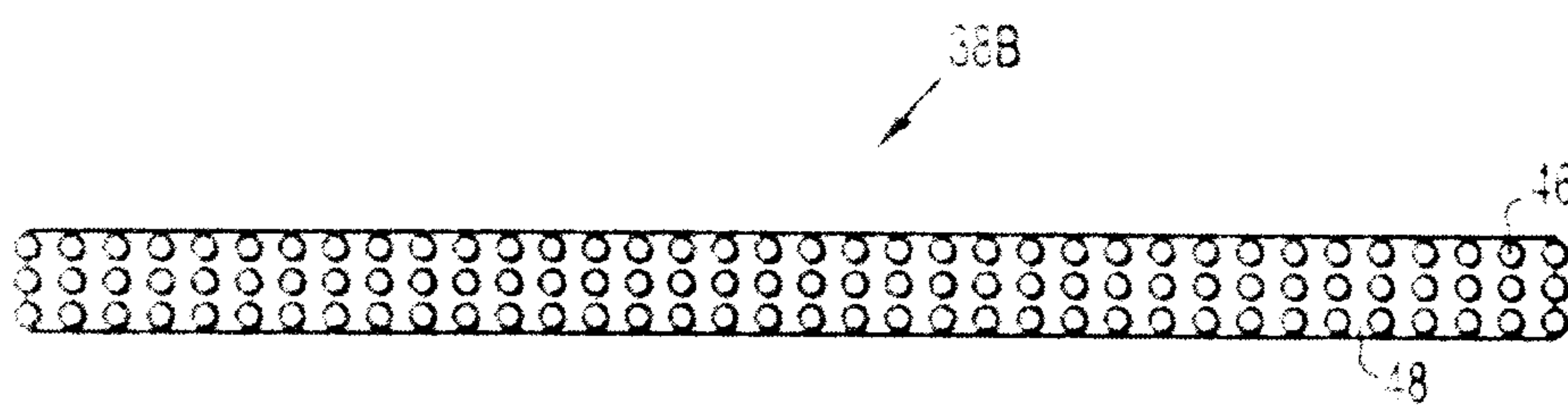
**FIG. 2A**



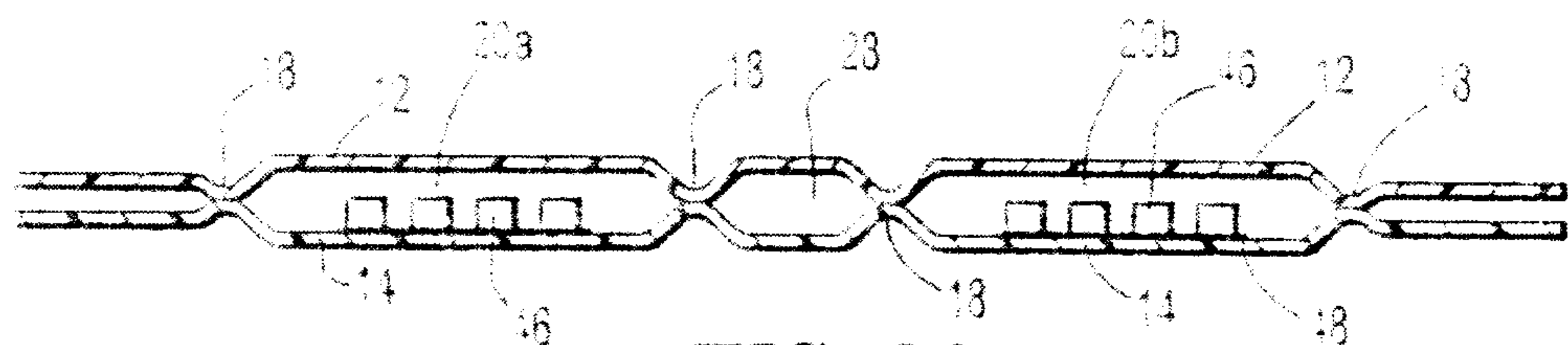
**FIG. 2C**



**FIG. 3B**



**FIG. 3A**



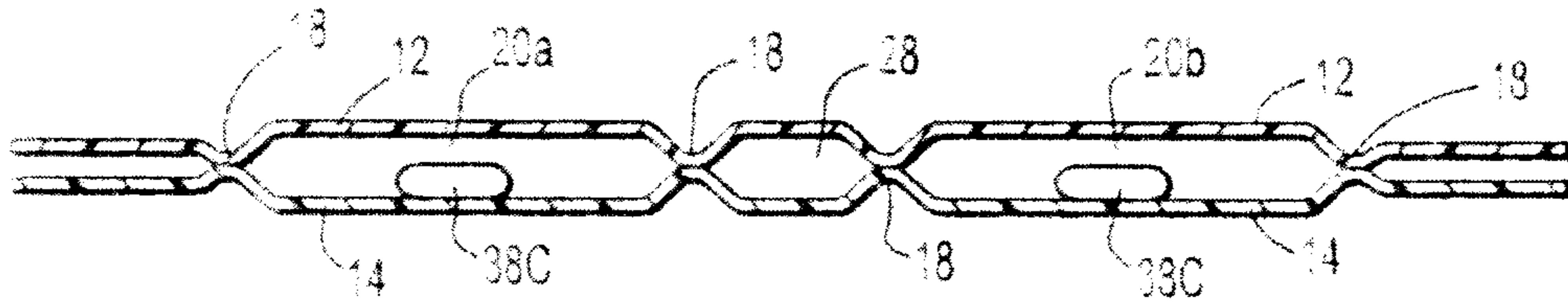
**FIG. 3C**



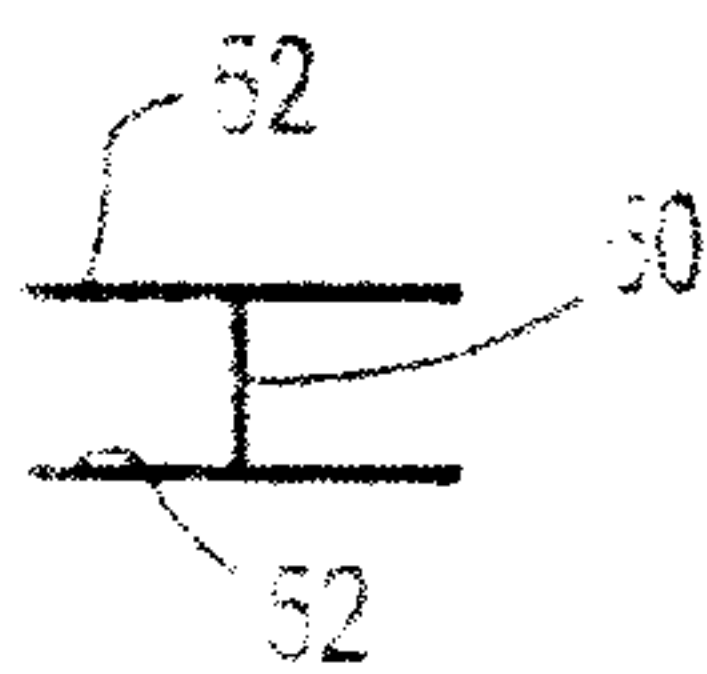
**FIG. 4B**



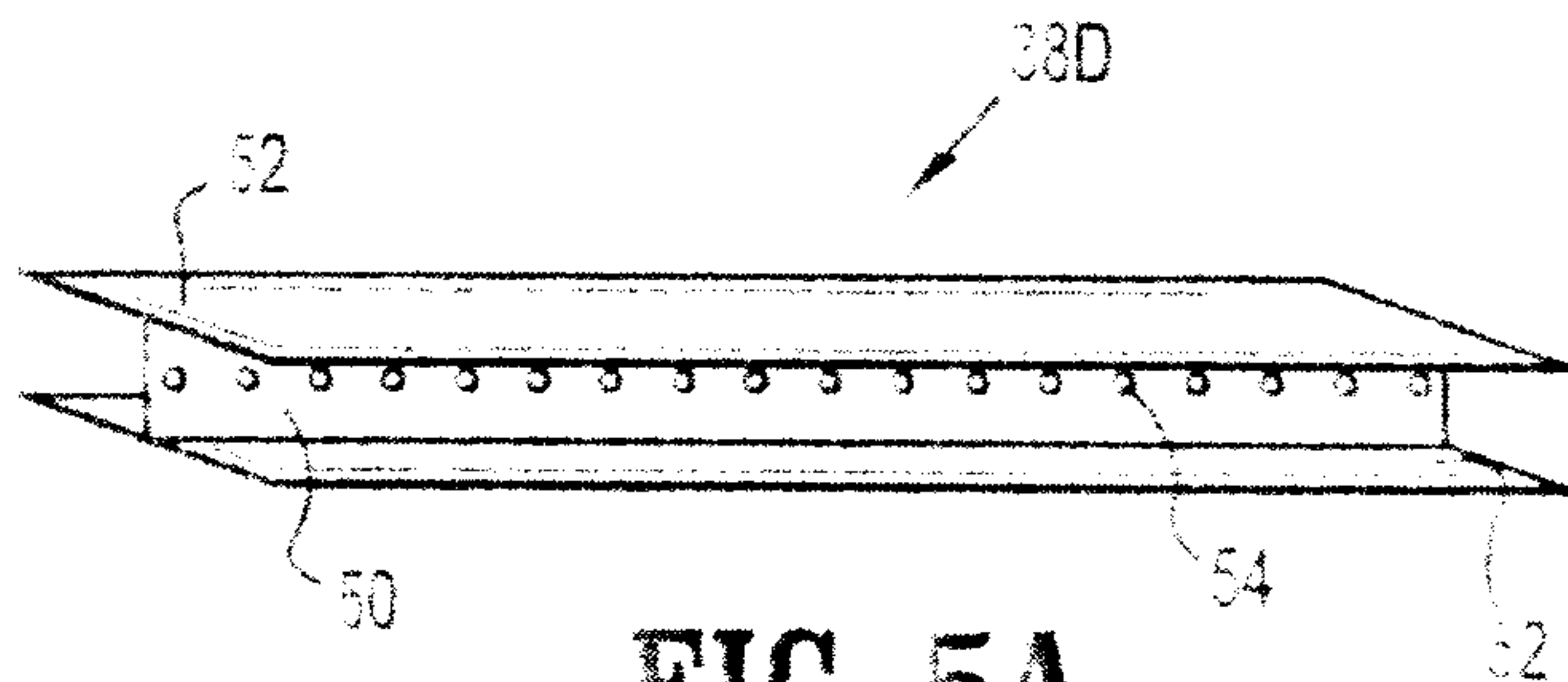
**FIG. 4A**



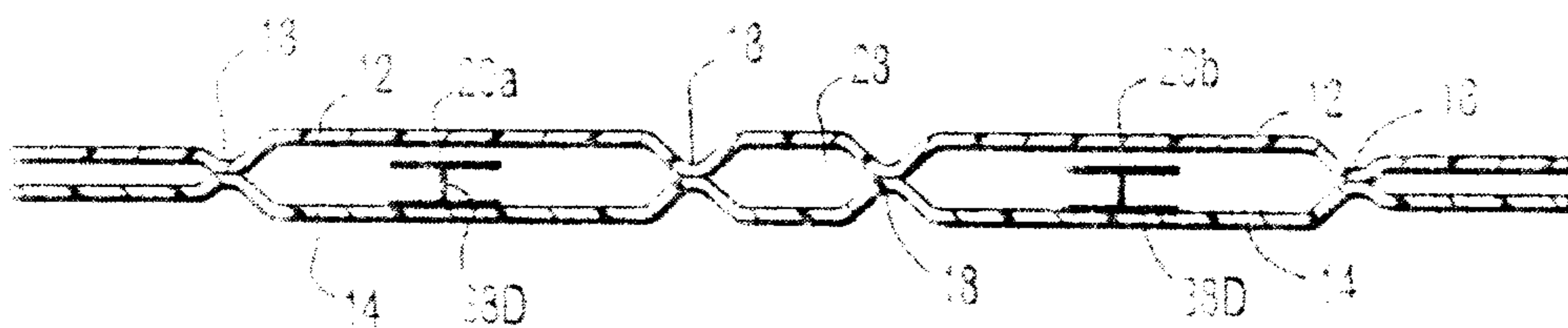
**FIG. 4C**



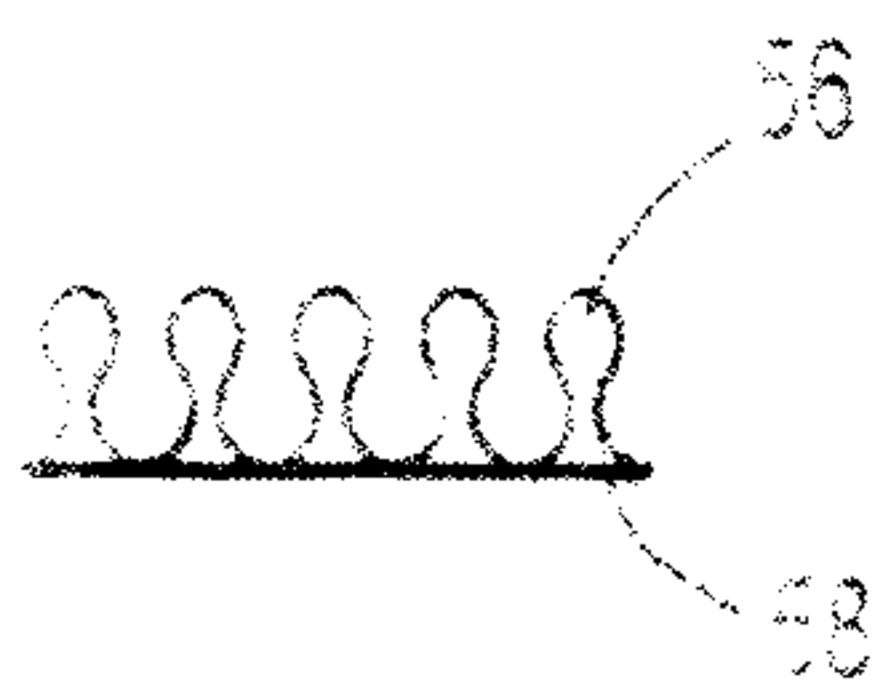
**FIG. 5B**



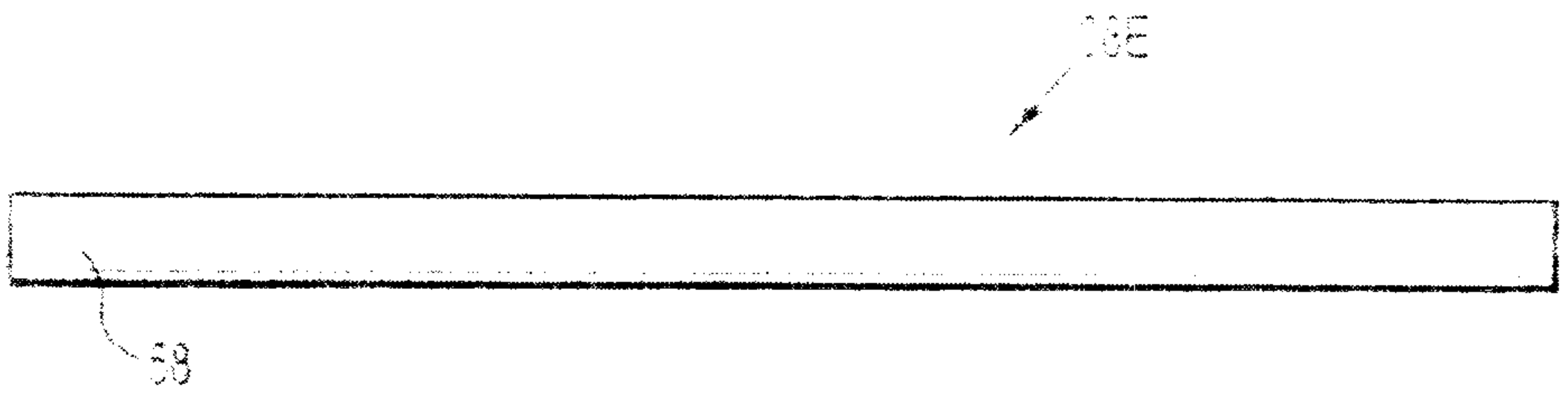
**FIG. 5A**



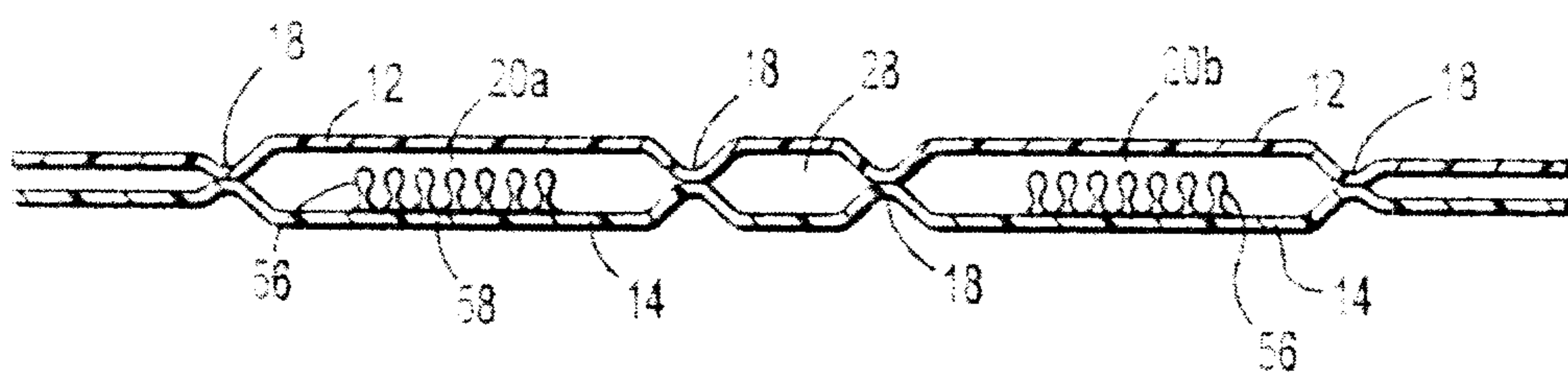
**FIG. 5C**



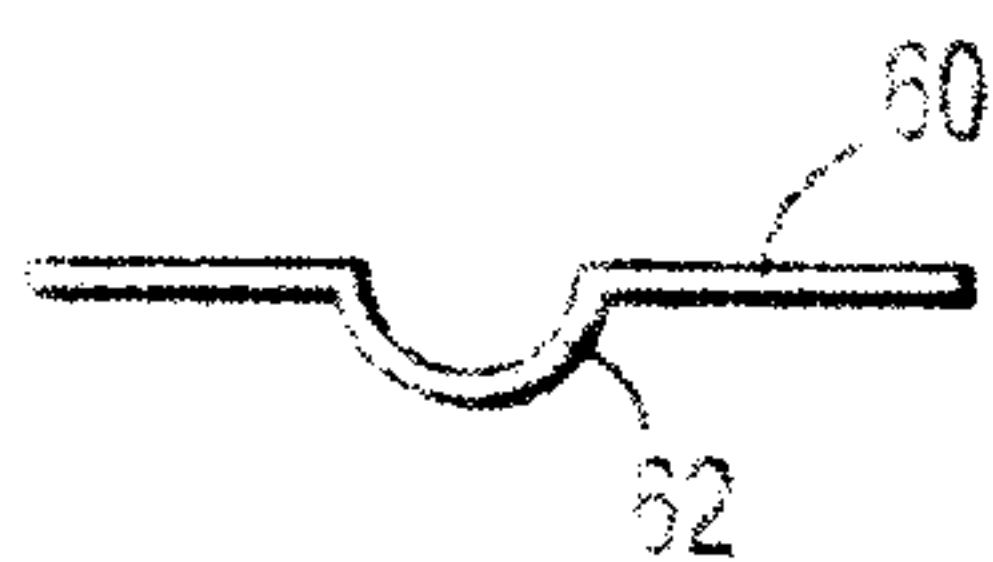
**FIG. 6B**



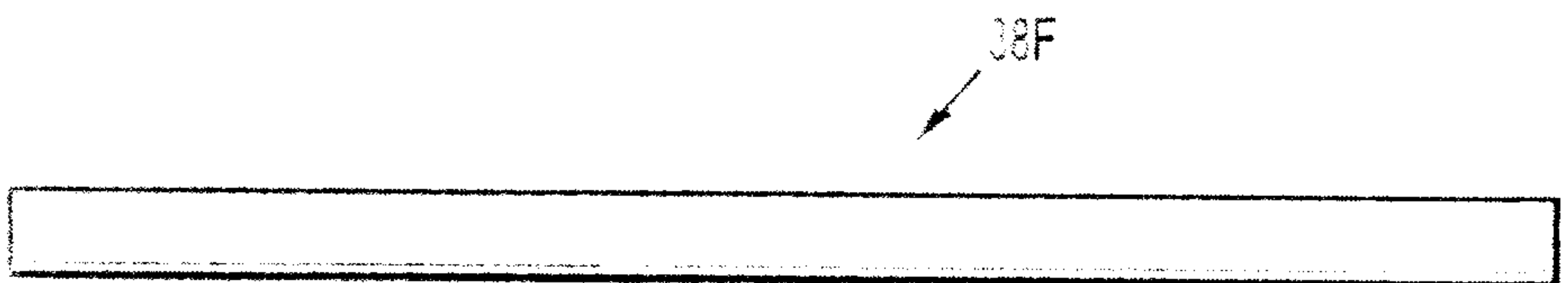
**FIG. 6A**



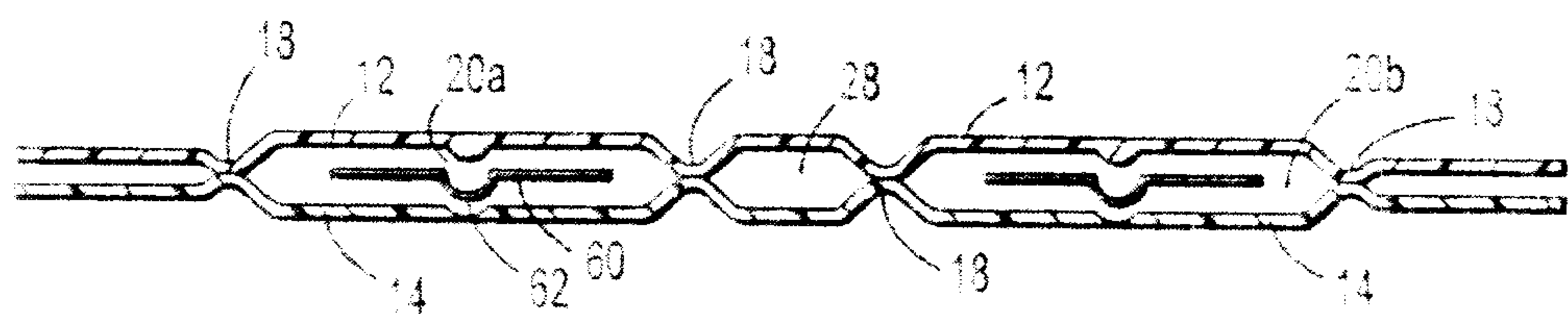
**FIG. 6C**



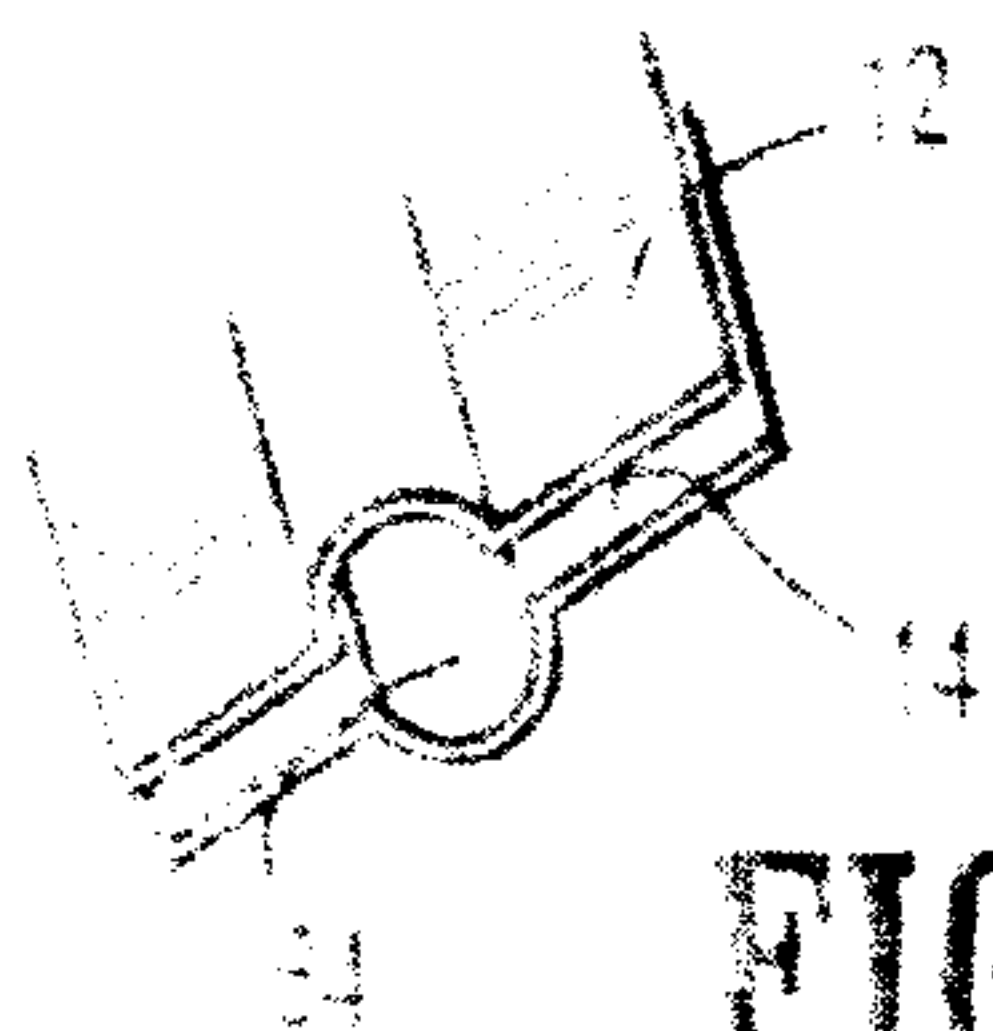
**FIG. 7B**



**FIG. 7A**



**FIG. 7C**

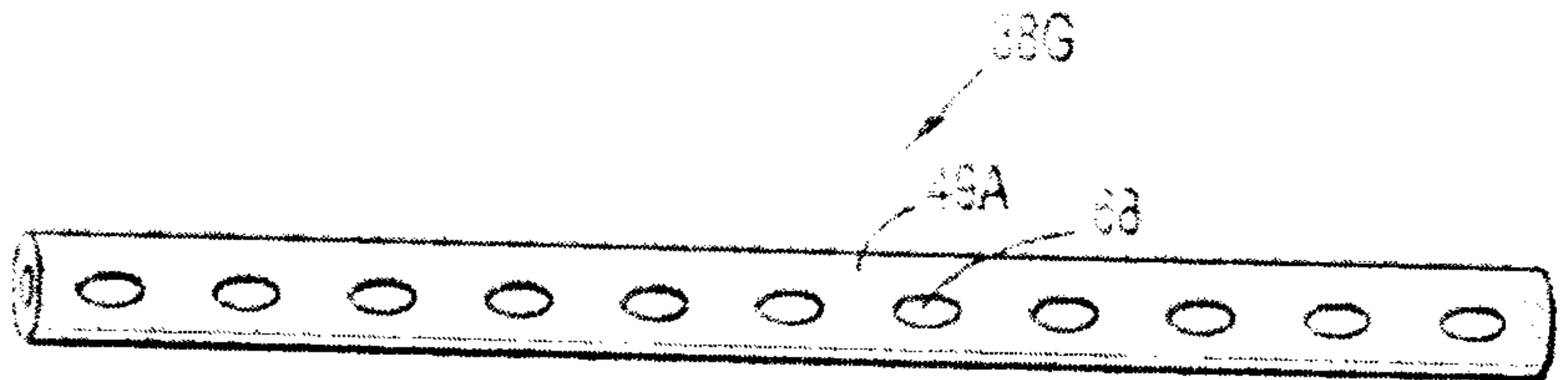


**FIG. 7D**

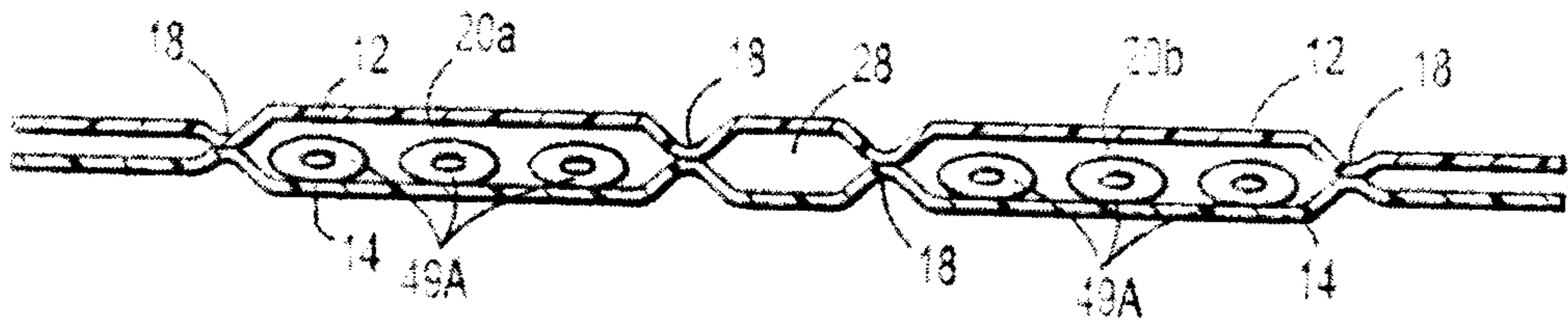




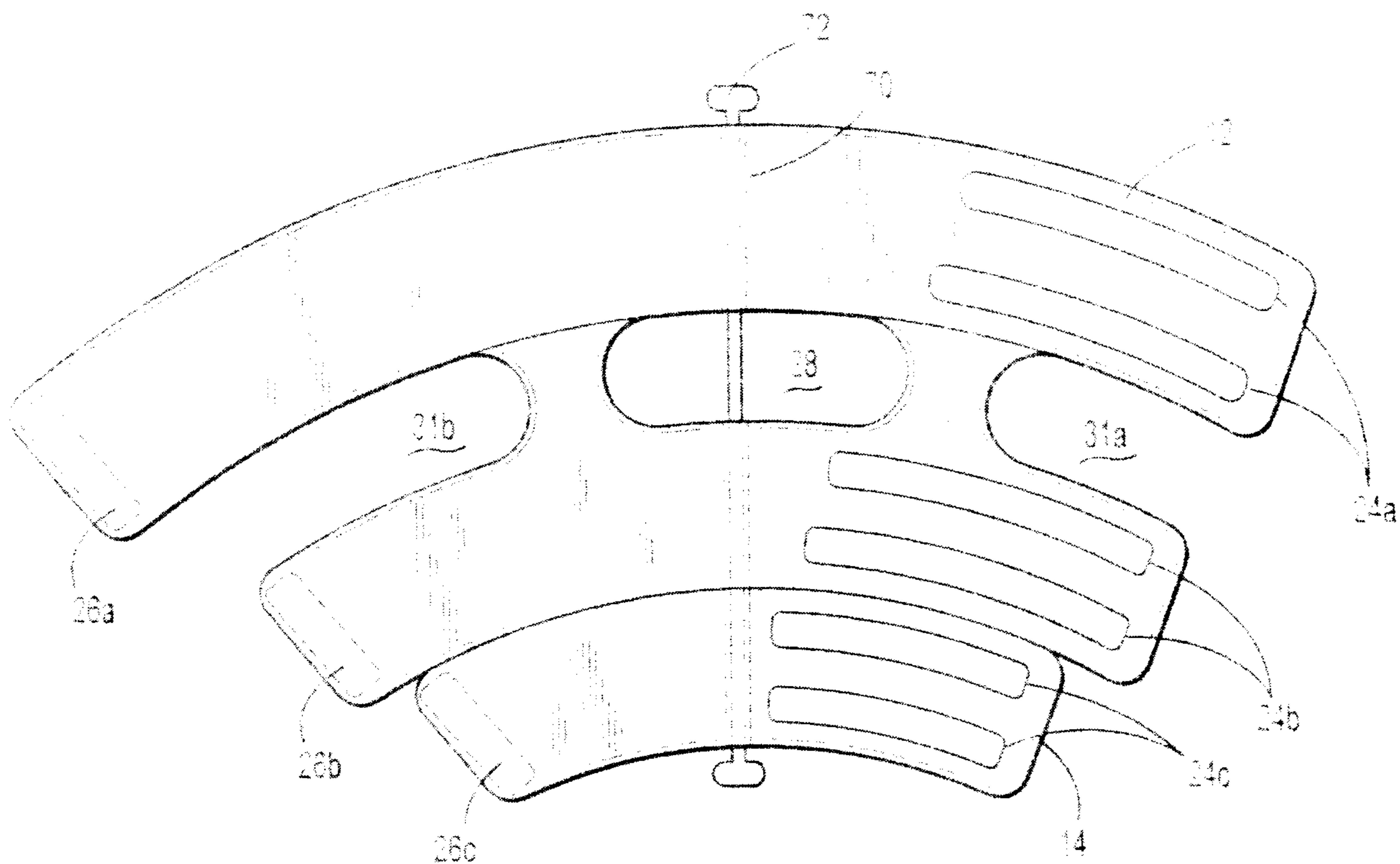
**FIG. 8B**



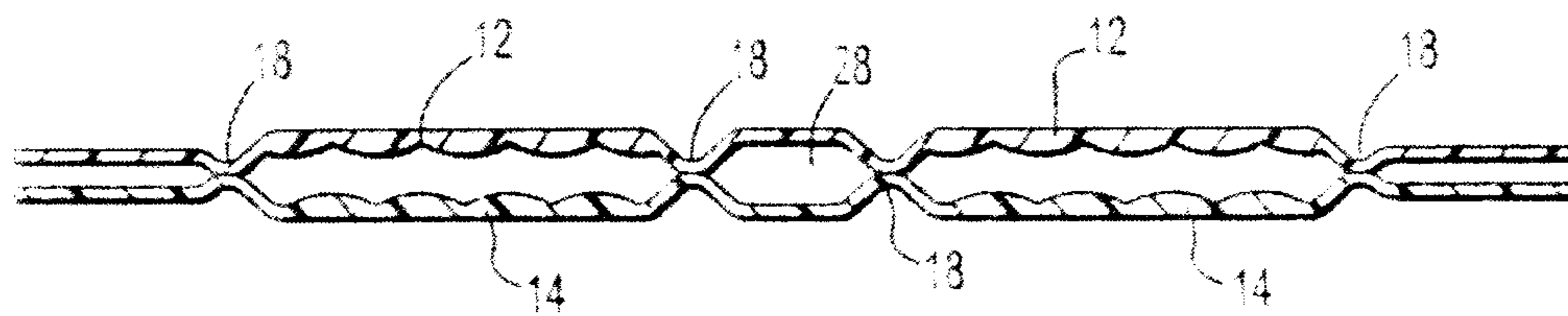
**FIG. 8A**



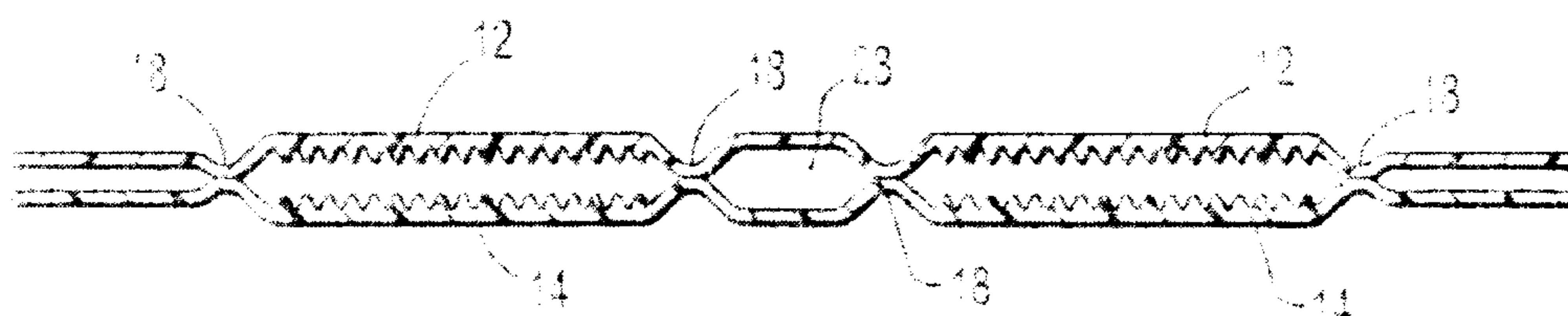
**FIG. 8C**



**FIG. 9**



**FIG. 10A**



**FIG. 10B**

