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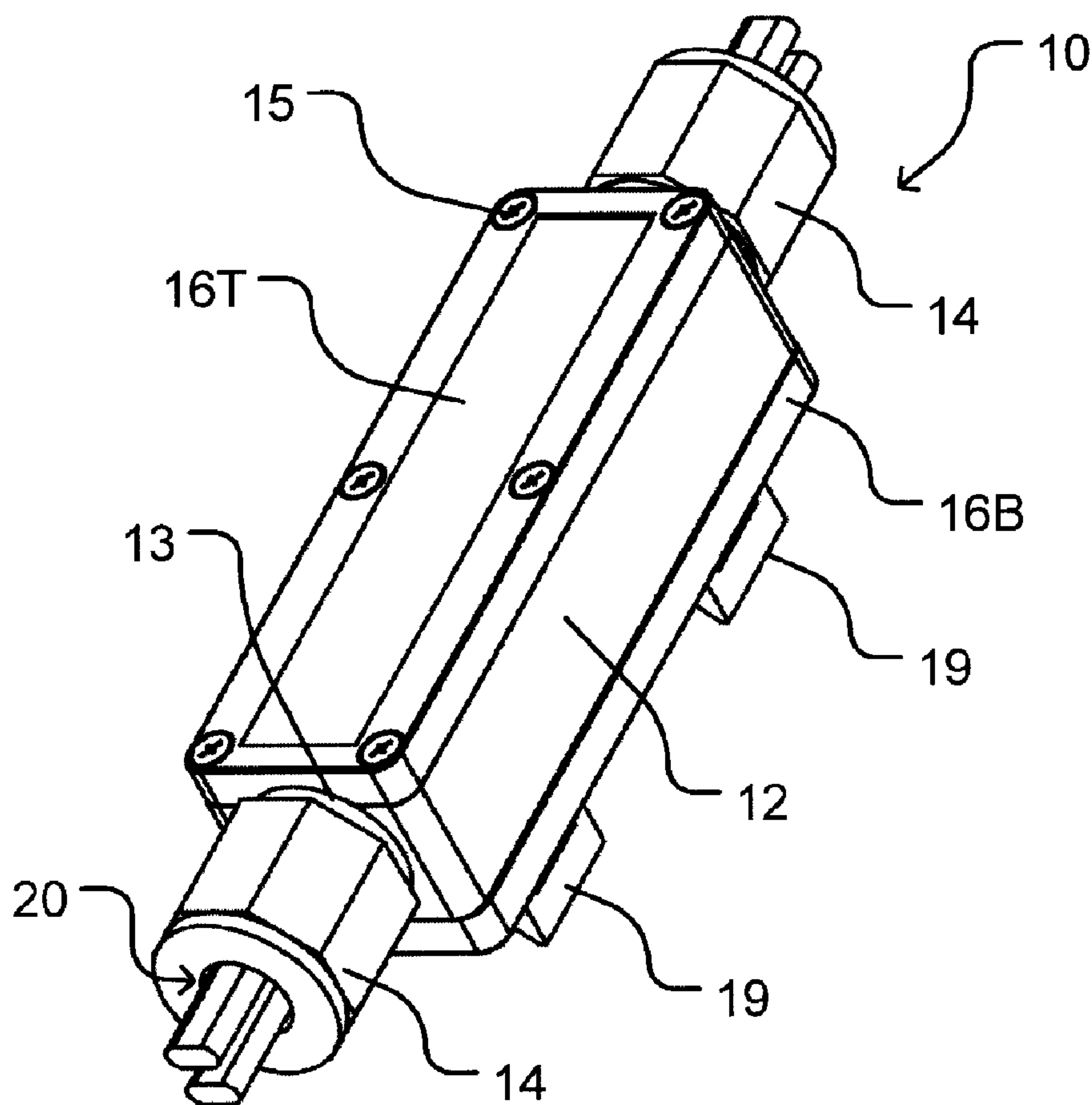
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(54) Titre : CONNECTEUR POLYVALENT POUR CABLE

(54) Title: MULTIPURPOSE CABLE CONNECTOR



(57) Abrégé/Abstract:

A cable connector assembly comprising an insulating block defining a plurality of cable receiving channels therein. Each cable receiving channel has an entrance at a periphery of the insulating block. A plurality of ground connectors are coupled to the



(57) **Abrégé(suite)/Abstract(continued):**

insulating block and positioned such that a ground connector is located proximate to the entrance of each cable receiving channel. Each ground connector comprises a U-shaped member for engaging a ground braid of a heating cable and a grounding screw for engaging a ground wire of a power cable. A ground linking structure electrically connects the plurality of ground connectors. A plurality of first and second wire connectors are adjustably coupled to the insulating block and positioned such that a first wire connector is selectively extendible into a first side of each cable receiving channel and a second wire connector is positioned to selectively extend into a second side of each cable receiving channel. First and second wire linking structures electrically connect the plurality of first wire connectors and the plurality of second wire connectors, respectively. The first and second wire linking structures may comprise leaf springs.

Abstract of the Disclosure

A cable connector assembly comprising an insulating block defining a plurality of cable receiving channels therein. Each cable receiving channel has an entrance at a periphery of the insulating block. A plurality of ground connectors are coupled to the insulating block and positioned such that a ground connector is located proximate to the entrance of each cable receiving channel. Each ground connector comprises a U-shaped member for engaging a ground braid of a heating cable and a grounding screw for engaging a ground wire of a power cable. A ground linking structure electrically connects the plurality of ground connectors. A plurality of first and second wire connectors are adjustably coupled to the insulating block and positioned such that a first wire connector is selectively extendible into a first side of each cable receiving channel and a second wire connector is positioned to selectively extend into a second side of each cable receiving channel. First and second wire linking structures electrically connect the plurality of first wire connectors and the plurality of second wire connectors, respectively. The first and second wire linking structures may comprise leaf springs.

MULTIPURPOSE CABLE CONNECTOR

Technical Field

5 [0001] The invention relates to cable connectors. Certain embodiments of the invention have particular application for use with heating cables.

Background

10 [0002] Electric heating cables, sometimes referred to as "heat tracing" or "heat tape" are used for a number of applications, including regulating the temperature of pipes and providing underfloor heating. Some such cables comprise two bus wires surrounded by a semi-conductive polymer. When an electric potential is applied across the bus wires, current flows through the polymer, which causes the polymer to heat up. The polymer is typically surrounded by an inner jacket, which is in turn surrounded by a grounding braid. The grounding braid is typically surrounded by an outer jacket. Other types of heating cables, 15 sometimes referred to as "zone heaters", have a pair of insulated bus wires with a heating element wrapped around them, which is in turn surrounded by an inner jacket, braid, and outer jacket.

20 [0003] It can be difficult and time consuming to establish safe and robust electrical connections between a heating cable a power cable, or between two heating cables. There exist a number of prior art systems which are aimed at aiding users in making such connections, including Tyco Thermal Controls LLC's RayClic™ system (aspects of which are disclosed in U.S. Patent No. 5,756,972), and Heat Trace Limited's StripFree™ system.

25 [0004] The inventors have determined a need for improved systems for establishing electrical connections between cables.

Summary

30 [0005] The following embodiments and aspects thereof are described and illustrated in conjunction with systems, tools and methods which are meant to be exemplary and illustrative, not limiting in scope.

35 [0006] One aspect of the invention provides a cable connector assembly comprising an insulating block defining a plurality of cable receiving channels therein. Each cable receiving channel has an entrance at a periphery of the insulating block. A plurality of ground connectors are coupled to the insulating block and positioned such that a ground connector is located proximate to the entrance of each cable receiving channel. Each ground

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connector comprises a U-shaped member for engaging a ground braid of a heating cable and a grounding screw for engaging a ground wire of a power cable. A ground linking structure electrically connects the plurality of ground connectors. A plurality of first and second wire connectors are adjustably coupled to the insulating block and positioned such that a first wire connector is selectively extendible into a first side of each cable receiving channel and a second wire connector is positioned to selectively extend into a second side of each cable receiving channel. First and second wire linking structures electrically connect the plurality of first wire connectors and the plurality of second wire connectors, respectively. The first and second wire linking structures may comprise leaf springs.

[0007] Further aspects of the invention and details of example embodiments are described below.

Brief Description of Drawings

[0008] In drawings which illustrate non-limiting embodiments of the invention:

Figure 1 shows a cable connector assembly according to one embodiment of the invention;

Figure 2 is an end view of the cable connector assembly of Figure 1;

Figure 3 is a side view of the cable connector assembly of Figure 1;

Figure 4 is a top view of the cable connector assembly of Figure 1;

Figure 5 is a sectional view taken along line A-A of Figure 4;

Figure 6 illustrates the relative positions of wire connectors and leaf springs with respect to cable receiving channels on an upper side of the block of the cable connector assembly of Figure 1;

Figure 7 is an exploded view of the cable connector assembly of Figure 1;

Figures 8A-E show a plurality of grommets and washers which may be used with the cable connector assembly of Figures 1-7;

Figure 9 shows a spacer which may be used with the cable connector assembly of Figures 1-7;

Figure 10 shows a cable connector assembly according to another embodiment of the invention;

Figure 11 is a side view of the cable connector assembly of Figure 10;

Figure 12 is a top view of the cable connector assembly of Figure 10;

Figure 13 is a sectional view taken along line A-A of Figure 12;

Figure 14 shows a cable connector assembly according to another embodiment of the invention;

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Figure 15 is a side view of the cable connector assembly of Figure 14;
 Figure 16 is a top view of the cable connector assembly of Figure 14;
 Figure 17 is a sectional view taken along line A-A of Figure 16; and
 Figure 18 is an exploded view of the cable connector assembly of Figure 14.

5

Description

[0009] Throughout the following description specific details are set forth in order to provide a more thorough understanding to persons skilled in the art. However, well known elements may not have been shown or described in detail to avoid unnecessarily obscuring the disclosure. Accordingly, the description and drawings are to be regarded in an illustrative, rather than a restrictive, sense.

[0010] Embodiments of the invention described herein provide users with easy and efficient mechanisms for making safe and robust electrical connections between or among two or more heating and power cables. In some embodiments, the same cable connector assembly may be used to connect:

- a power cable and a heating cable;
- two heating cables;
- two power cables;
- 20 • a power cable and two heating cables;
- a heating cable and two power cables;
- three heating cables;
- three power cables;
- a power cable and three heating cables;
- 25 • a heating cable and three power cables;
- four heating cables; or,
- four power cables.

[0011] Figures 1-7 show a cable connector assembly **10** according to one embodiment. Cable connector assembly **10** comprises a housing **12** having two end caps **14** coupled to threaded portions **13** extending from opposite ends of housing **12**. A top panel **16T** is coupled to an upper side of housing **12**, and a bottom panel **16B** is coupled to a lower side of housing **12**, by screws **15**. Sealing members **18** may be provided between top and bottom panels **16T** and **16B** and housing **12** to ensure tight seals therebetween.

35

[0012] Mounting features **19** are provided on the underside of bottom panel **16B** of cable connector assembly **10**. Mounting features **19** facilitate mounting of assembly **10** on a supporting structure (not shown), and are preferably sized such that there is sufficient room for a user to tighten and loosen end caps **14** when assembly **10** is mounted on the supporting structure. In the illustrated embodiment, mounting features **19** are configured to accommodate straps or the like (not shown) for mounting assembly **10** to a pipe (not shown), but one skilled in the art will appreciate the mounting features **19** could take different forms for mounting assembly **10** to different structures.

10 [0013] The terms "top", "up", and the like are used herein to refer to the direction indicated by arrow *U* in Figure 2, which is generally away from the structure on which assembly **10** is mounted. Likewise, the terms "bottom", "down" and the like are used to refer to the opposite direction. As one skilled in the art will appreciate, assembly **10** may be mounted in any orientation, such that the "top" of assembly **10** could be facing the ground (or in any other
15 direction).

[0014] End caps **14** are configured to retain washers **22** and grommets **24** within threaded portions **13**. Each end cap **14** defines an aperture **20** therein which is sized smaller than washer **22** and grommet **24**. Each threaded portion **13** comprises a tapered portion **21**, such
20 that when end cap **14** is threaded onto threaded portion **13**, washer **22** and grommet **24** are held between end cap **14** and tapered portion **21**. Grommets **24** may be made from a compressible material, so that when end caps **14** are tightened onto threaded portions **13**, grommets **24** form seals with threaded portions **13** and the heating and/or power cable(s).

25 [0015] Each washer **22** and grommet **24** defines at least one cable aperture therein. In the illustrated embodiment, the cable apertures may comprise power cable apertures **26**, which are generally circular to conform to the outer jacket of a power cable, and/or heating cable apertures **28**, which are generally obround to conform to the outer jacket of a heating cable. In the other embodiments, cable apertures with different shapes can be provided to
30 accommodate other types of cable having different cross sections. The number and type of cable apertures is determined by the number and type of cables to be connected by cable connector assembly **10**.

[0016] The cable apertures may be positioned to correspond with cable receiving channels
35 **50** defined in an insulating block **30** received in housing **12**, as discussed further below. The

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cable apertures may or may not be aligned with channels **50**. Alignment of cable apertures and channels **50** is not required due to the flexibility of the cables to be received in channels **50**.

- 5 **[0017]** A plurality of washers **22** and grommets **24** with a variety of cable aperture configurations may be provided, in order to allow a user to establish a variety of cable connections with cable connector assembly **10**. Figures 8A-8E show a variety of example washers **22** and grommets **24**.
- 10 **[0018]** In some embodiments, the inner surface of threaded portions **13** may also be threaded. In such embodiments, a rigid or flexible conduit or a Teck cable could be threadedly received by the inner threads of a threaded portion **13** without the use of a washer or grommet.
- 15 **[0019]** Insulating block **30** is sized and shaped to be received within a cavity **29** defined in housing **12**. Housing **12** may comprise one or more protrusions **31** which extend into cavity **29**, and insulating block **30** may define one or more corresponding indentations **33** to ensure proper positioning of block **30** within housing **12**. In some embodiments, block **30** may be symmetrical about horizontal and vertical planes of symmetry bisecting block **30**. Such a
- 20 configuration avoids the need for a user to insert block **30** into cavity **29** in a particular orientation, since all orientations in which block **30** fits into cavity **29** are equivalent.
- 25 **[0020]** Insulating block **30** defines a plurality of cable receiving channels **50** therein. Each channel **50** has an entrance **52** which is located at a periphery of block **30**. In some embodiments, four cable receiving channels **50A-D** are defined in insulating block **30**, with channels **50A** and **50B** located in an upper portion of block **30** and channels **50C** and **50D** located in a lower portion of block **30**.
- 30 **[0021]** A ground connector **32** is positioned near the entrance **52** of each channel **50**. In the illustrated embodiment, each ground connector **32** comprises a U-shaped member **34** positioned to contact the ground braid of a heating cable, and a grounding screw **36** positioned to receive a ground wire of a power cable. Grounding screw **36** may have an enlarged head to facilitate attachment of a ground wire, and may have a length selected so as to prevent contact with a ground braid inserted under U-shaped member **34**, to avoid
- 35 damaging the braid. Each ground connector **32** may also comprise a flat spring **37** coupled

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to U-shaped member **34** for ensuring good electrical contact between the ground braid of a heating cable and ground connector **32**. In the illustrated embodiment, flat springs **37** are coupled to U-shaped members **34** by grounding screws **36**.

- 5 **[0022]** Ground connectors **32** are electrically connected to each other by a ground linking structure. In the illustrated embodiment, the ground linking structure comprises a ground bar **38** to which U-shaped members **34** are attached using screws and washers (not specifically enumerated). Ground bar **38** is inserted into a slot **39** defined in block **30**.
- 10 **[0023]** A pair of wire connectors **40** are adjustably coupled to block **30** on either side of each cable receiving channel **50**. Each wire connector **40** comprises one or more teeth positioned to be selectively extended into one side of channel **50**, such that the teeth penetrate insulation of a heating cable received in channel **50** and make electrical contact with a bus wire of the heating cable. A spacing device may also be provided, as discussed below, to position wires
- 15 of a power cable to be contacted by teeth of wire connectors **40**.

- [0024]** Wire connectors **40** are biased away from channels **50** by leaf springs **42** such that the teeth of wire connectors **40** do not extend into channels **50** until wire connector screws **44** are tightened. Wire connectors **40** may be guided by walls (not specifically enumerated)
- 20 formed by block **30** which maintain the orientations of wire connectors **40** as screws **44** are tightened or loosened. Leaf springs **42** are compressed in the view shown in Figure 5. Each leaf spring **42** also provides an electrical connection between corresponding wire connectors **40** of different cable receiving channels **50**. Figure 6 shows the positions of wire connectors **40**, leaf springs **42** and wire connector screws **44** relative to channels **50A** and **50B** on the
- 25 upper side of block **30** in an example embodiment.

- [0025]** Leaf springs **42** are preferably flexible enough that one of the two wire connectors **40** contacted by a leaf spring **42** may be forced into channel **50** by a tightened screw **44**, and the other wire connector **40** may be allowed to ride up a loosened screw **44** such that the teeth
- 30 are clear of a cable path in channel **50**, while corresponding surfaces both wire connectors **40** remain generally parallel to one another.

- [0026]** Wire connector screws **44** may be positioned to receive wires of a power cable. Alternatively, the wires of a power cable may be coupled to a spacing device which holds the
- 35 wires in predetermined positions in a cable receiving channel **50**, such that the teeth of wire

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connectors **40** make electrical contact with the wires of the power cable when wire connector screws **44** are tightened. Figure 9 shows an example spacer **60** according to one embodiment of the invention. Spacer **60** comprises a body **62** and a plurality of protrusions **64**. In the illustrated embodiment protrusions **64** are U-shaped to define wire cradles **66**. Body **62** and protrusions **64** may have thicknesses on the order of 1 millimeter in some embodiments.

[0027] As a further alternative, a user may strip two wires of a cable and establish an electrical connection between the stripped portions of the wires and flat portions of wire connectors **40**. The flat portions of wire connectors **40** may be perpendicular to the teeth of wire connectors **40** in some embodiments.

[0028] In the illustrated embodiment, each wire connector screw **44** extends through apertures defined in:

- a wire connector **40**;
- a leaf spring **42**; and,
- block **30**.

The apertures in block **30** may comprise threaded conductors which extend from the upper side to the lower side of block **30**, in order to provide an electrical connection between corresponding screws **44** on the upper side and the lower side of block **30**. As one skilled in the art will appreciate, other mechanisms for establishing electrical connections between corresponding wire connectors on the upper and lower sides of block **30** are also possible. For example, a jumper wire may be attached under screws **44** on the upper and lower sides of block **30**, and either pass through a hole through block **30** or wrap around the outside of block **30**. Alternatively, a wire bus made from flat spring metal could be connected between screws **44** on the upper and lower sides of block **30** and wrap around the outside of block **30**.

[0029] Figures 10 to 13 show a cable connector assembly **10'** according to another embodiment of the invention. Cable connector assembly **10'** of Figures 10 to 13 is similar to the embodiment of Figures 1 to 7, except that only two cable receiving channels **50** and associated hardware are provided, and there is no removable bottom panel. Reference numerals used in Figures 10 to 13 generally correspond with those described above with respect to the embodiment of Figures 1 to 7. Accordingly, cable connector assembly **10'** will not be described further to avoid repetition.

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[0030] Figures 14 to 18 show a cable connector assembly **110** according to another embodiment of the invention. Cable connector assembly **110** comprises an insulating block **130** defining a plurality of cable receiving channels **150** therein. Four channels **150** are provided in the illustrated embodiment. In the illustrated embodiment, insulating block **130** is configured to be received in an enclosure (not shown) having a puck-like shape. In other embodiments, differently shaped insulating blocks may be provided for use with enclosures having different shapes. In some embodiments, the enclosure may comprise a metallic or polymeric junction box.

10 [0031] Ground connectors comprising U-shaped members **134** are positioned at the entrances of channels **150**. A ground ring **138** received in a slot in block **130** is in electrical contact with the ground connectors. Each U-shaped member **134** may be made from a flexible material such as thin steel. A grounding screw (not shown) coupled to a middle portion of U-shaped number **134** may be provided in some embodiments, or ground wires
15 may be secured by the screws (not specifically enumerated) attaching U-shaped number **134** to block **30**.

[0032] A pair of wire connectors **140** are mounted to block **130** on opposite sides of each channel **150**. Wire connectors **140** comprise teeth positioned to be moved into and out of
20 channels **150** to make electrical contacts with wires of cables received in channels **150**. Leaf springs **142** positioned between wire connectors **140** and block **130** provide electrical connections between corresponding wire connectors **140** associated with opposing channels **150**. Leaf springs **142** also keep wire connectors **140** out of channels **150** unless wire connector screws **144** are tightened to force wire connectors **140** into channels **150**.
25 Additional connector elements **143** may be provided under leaf springs **142** to provide electrical connections between corresponding wire connectors **140** associated with adjacent channels **150**.

[0033] While a number of exemplary aspects and embodiments have been discussed above,
30 those of skill in the art will recognize certain modifications, permutations, additions and sub-combinations thereof. For example:

- A single wire connector screw extending through block **30** could be used to adjust corresponding wire connectors **40** on the top and bottom teeth of block **30**.
- Grommets **24** may be reusable. Alternatively, for permanent installations a
35 permanent seal around the cables could be provided.

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- Differently shaped insulating blocks may be provided which are configured for use with differently shaped housings or enclosures.

5 [0034] In the foregoing specification, the invention has been described with reference to specific embodiments thereof. However, the scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given in the broadest interpretation consistent with the description as a whole. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

WHAT IS CLAIMED IS:

1. A cable connector assembly comprising:
 - an insulating block defining a plurality of cable receiving channels therein,
5 each cable receiving channel having an entrance at a periphery of the insulating block;
 - a plurality of ground connectors coupled to the insulating block, the ground connectors positioned such that a ground connector is located proximate to the entrance of each cable receiving channel, each ground connector comprising a U-
10 shaped member for engaging a ground braid of a heating cable and a grounding screw for engaging a ground wire of a power cable;
 - a ground linking structure electrically connecting the plurality of ground connectors;
 - a plurality of first wire connectors adjustably coupled to the insulating block,
15 the plurality of first wire connectors positioned such that a first wire connector is positioned to selectively extend into a first side of each cable receiving channel;
 - a first wire linking structure electrically connecting the plurality of first wire connectors;
 - a plurality of second wire connectors adjustably coupled to the insulating
20 block, the plurality of second wire connectors positioned such that a second wire connector is positioned to selectively extend into a second side of each cable receiving channel; and,
 - a second wire linking structure electrically connecting the plurality of second wire connectors.
- 25 2. A cable connector assembly according to claim 1 wherein the first wire linking structure and the second wire linking structure each comprise at least one leaf spring electrically connected between a pair of corresponding wire connectors associated with different cable receiving channels.
- 30 3. A cable connector assembly according to claim 2 wherein the leaf spring biases the wire connectors out of the cable receiving channels.
- 35 4. A cable connector assembly according to claim 3 comprising a wire connector screw for coupling each wire connector to the block, whereby the wire connector is urged into the associated cable receiving channels as the wire connector screw is tightened.

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5. A cable connector assembly according to claim 4 wherein the leaf spring is held in electrical contact with the pair of wire connectors by the wire connector screws.
- 5 6. A cable connector assembly according to claim 4 wherein the leaf spring flexible to an extent such that the pair of wire connectors are maintained in a generally parallel relationship when one wire connector screw of the pair of wire connectors is tightened and the other wire connector screw is loosened.
- 10 7. A cable connector assembly according to claim 1 further comprising a housing defining a cavity therein sized to receive the insulating block.
8. A cable connector assembly according to claim 7 comprising removable top and bottom panels coupled to the housing.
- 15 9. A cable connector assembly according to claim 7 wherein the housing comprises threaded portions extending outwardly therefrom, the assembly further comprising end caps threadedly received on external threads of the threaded portions.
- 20 10. A cable connector assembly according to claim 9 wherein each threaded portion further comprises inner threads.
11. A cable connector assembly according to claim 9 wherein each end cap defines an aperture and each threaded portion comprises a tapered portion.
- 25 12. A cable connector assembly according to claim 11 further comprising a washer and a grommet associated with each end cap and having one or more cable apertures therethrough, the washer and grommet each having a cross section larger than the apertures of the end caps or the tapered portions of the threaded portions, such that the washer and grommet are securable between the end cap and the tapered portion.
- 30 13. A cable connector assembly according to claim 12 wherein the grommet is constructed of a compressible material such that tightening the end cap forms a seal between the grommet and one or more cables inserted through the one or more cable apertures.

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14. A cable connector assembly according to claim 1 further comprising a spacing device insertable into one of the cable receiving channels for maintaining a first wire of a cable on the first side of the cable receiving channel and the second wire of the cable on the second side of the cable receiving channel.
- 5
15. A cable connector assembly comprising:
- an insulating block defining a plurality of cable receiving channels therein, each cable receiving channel having an entrance at a periphery of the insulating block;
 - 10 a plurality of ground connectors coupled to the insulating block, the ground connectors positioned such that a ground connector is located proximate to the entrance of each cable receiving channel;
 - a ground linking structure electrically connecting the plurality of ground connectors;
 - 15 a plurality of first wire connectors adjustably coupled to the insulating block, the plurality of first wire connectors positioned such that a first wire connector is positioned to selectively extend into a first side of each cable receiving channel;
 - a first wire linking structure electrically connecting the plurality of first wire connectors;
 - 20 a plurality of second wire connectors adjustably coupled to the insulating block, the plurality of second wire connectors positioned such that a second wire connector is positioned to selectively extend into a second side of each cable receiving channel; and,
 - a second wire linking structure electrically connecting the plurality of second
 - 25 wire connectors,
- wherein the first wire linking structure and the second wire linking structure each comprise at least one leaf spring electrically connected between a pair of corresponding wire connectors associated with different cable receiving channels.

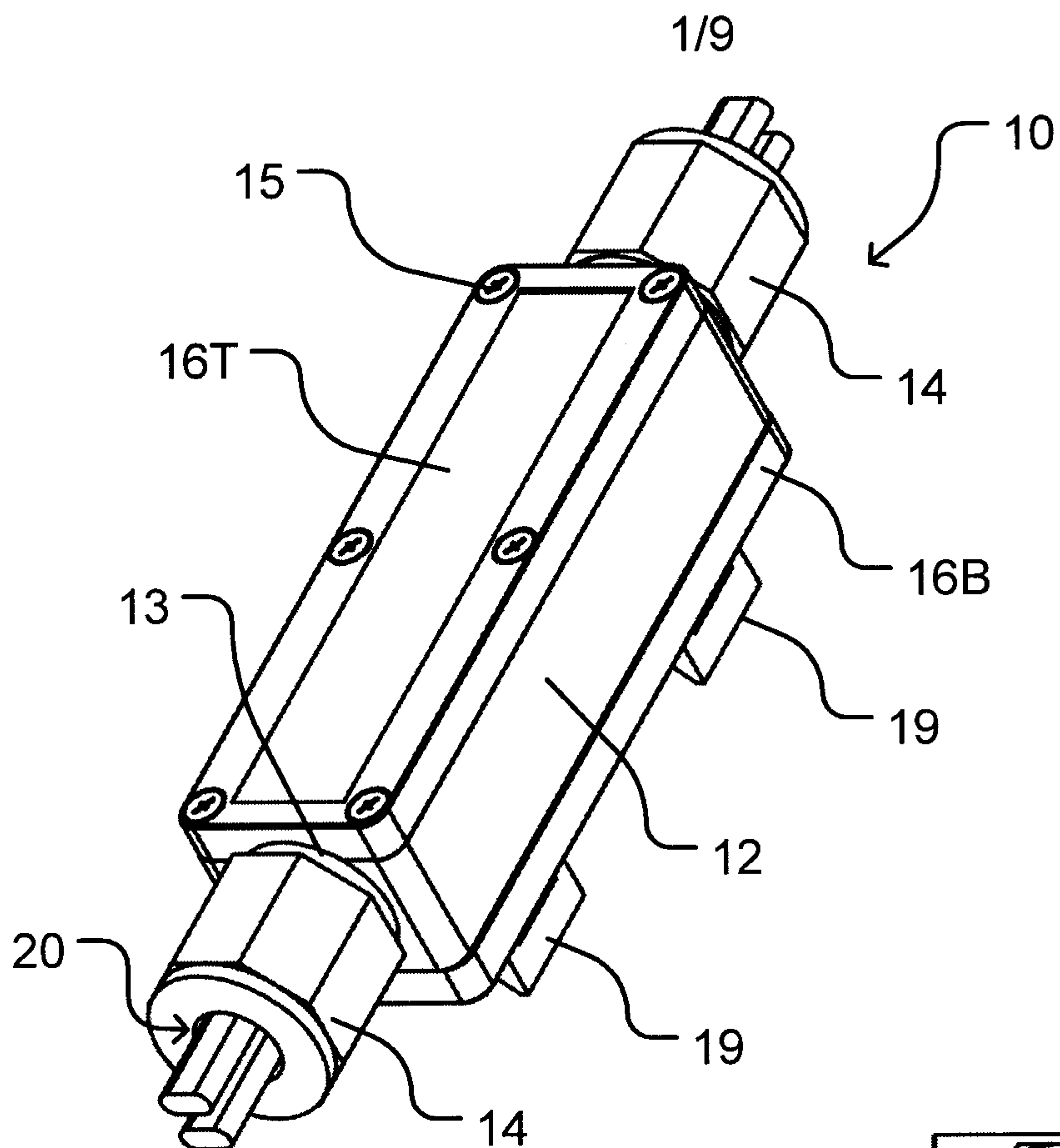


Figure 1

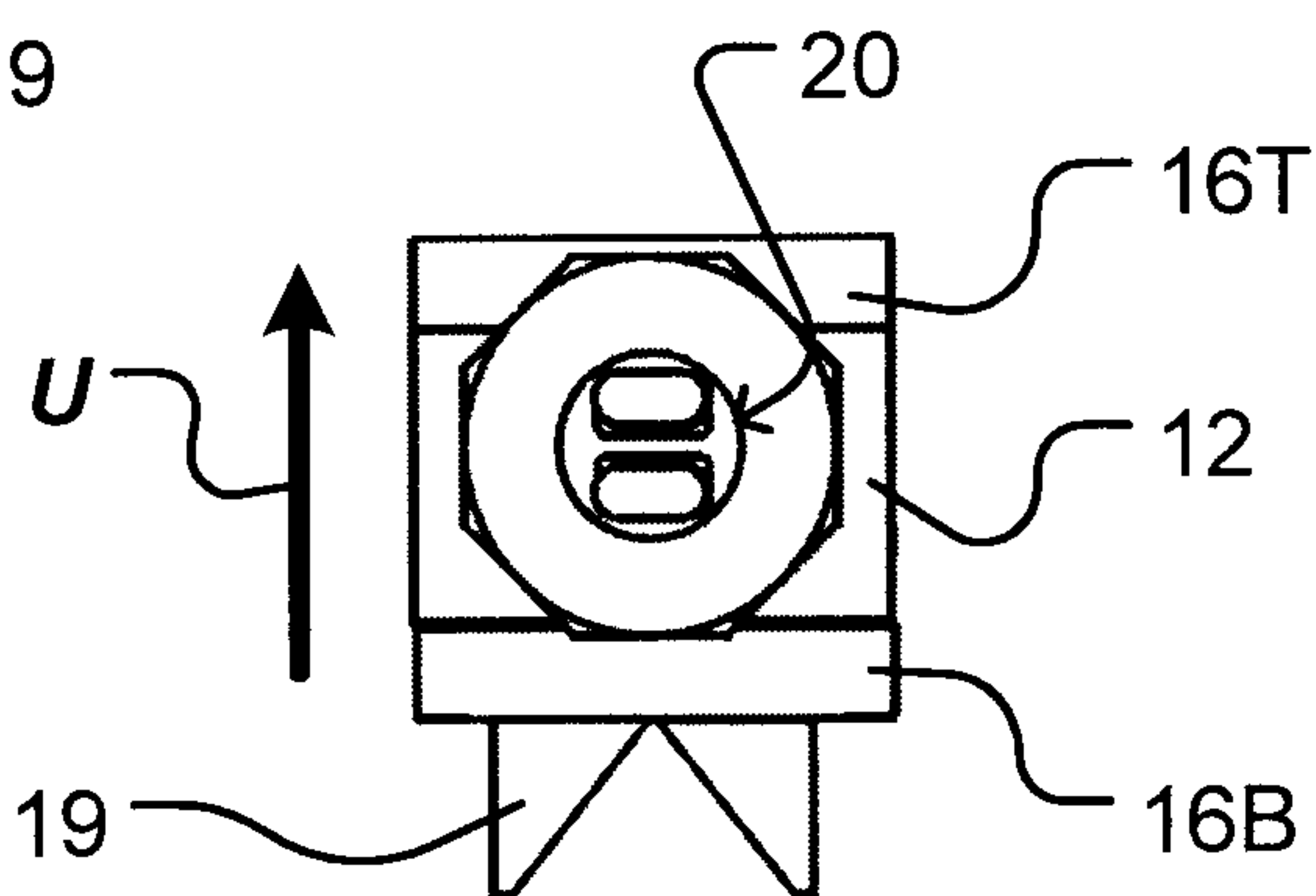


Figure 2

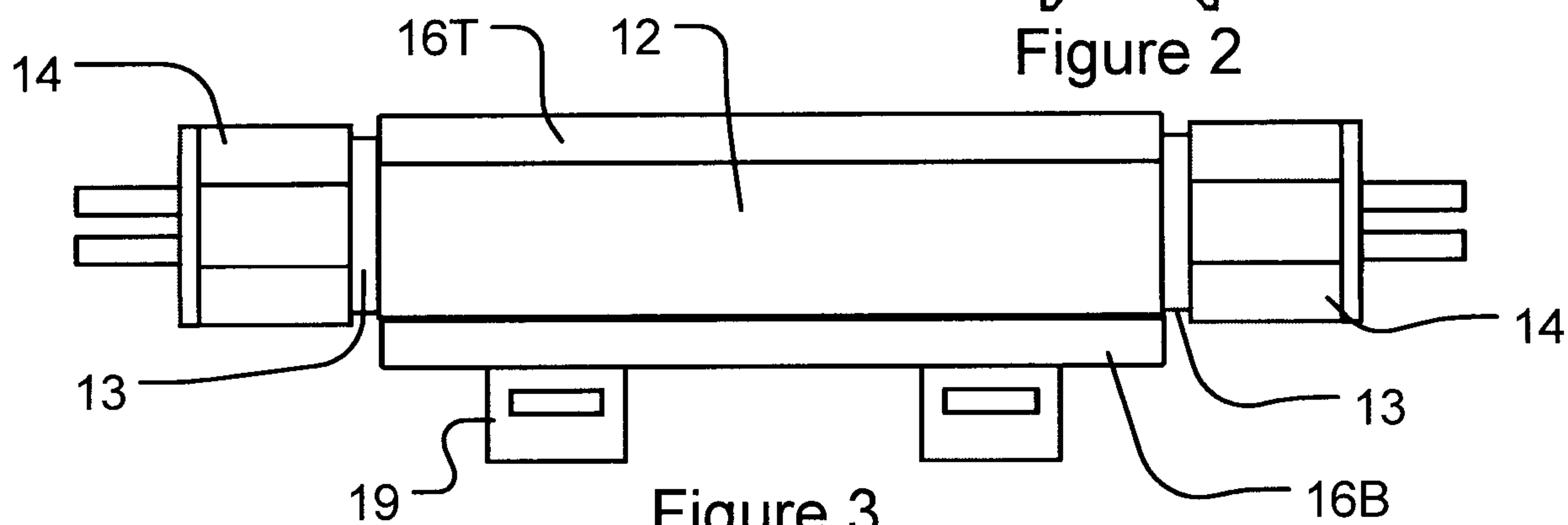


Figure 3

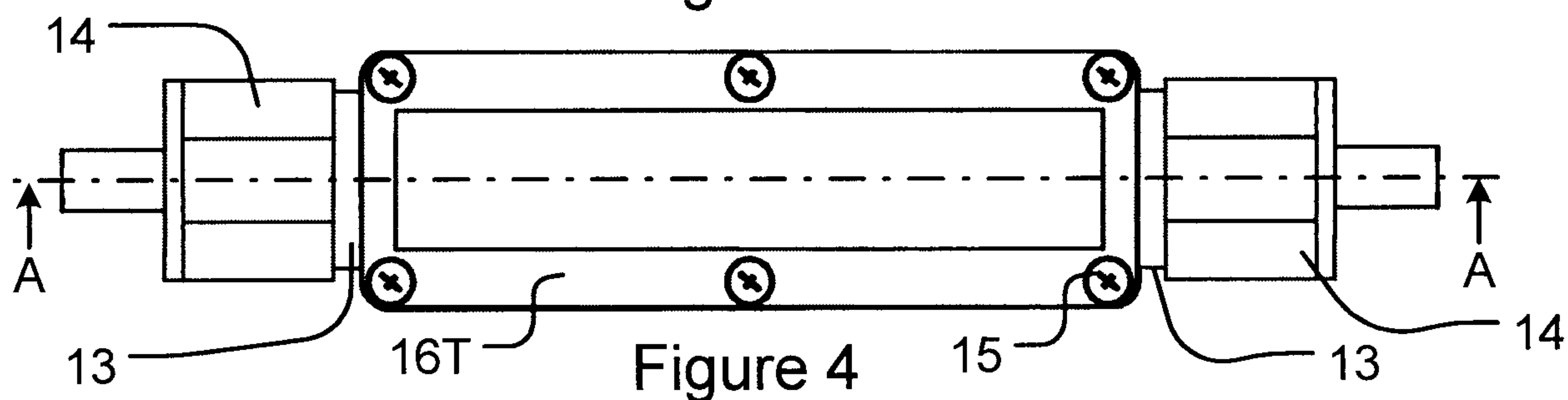


Figure 4

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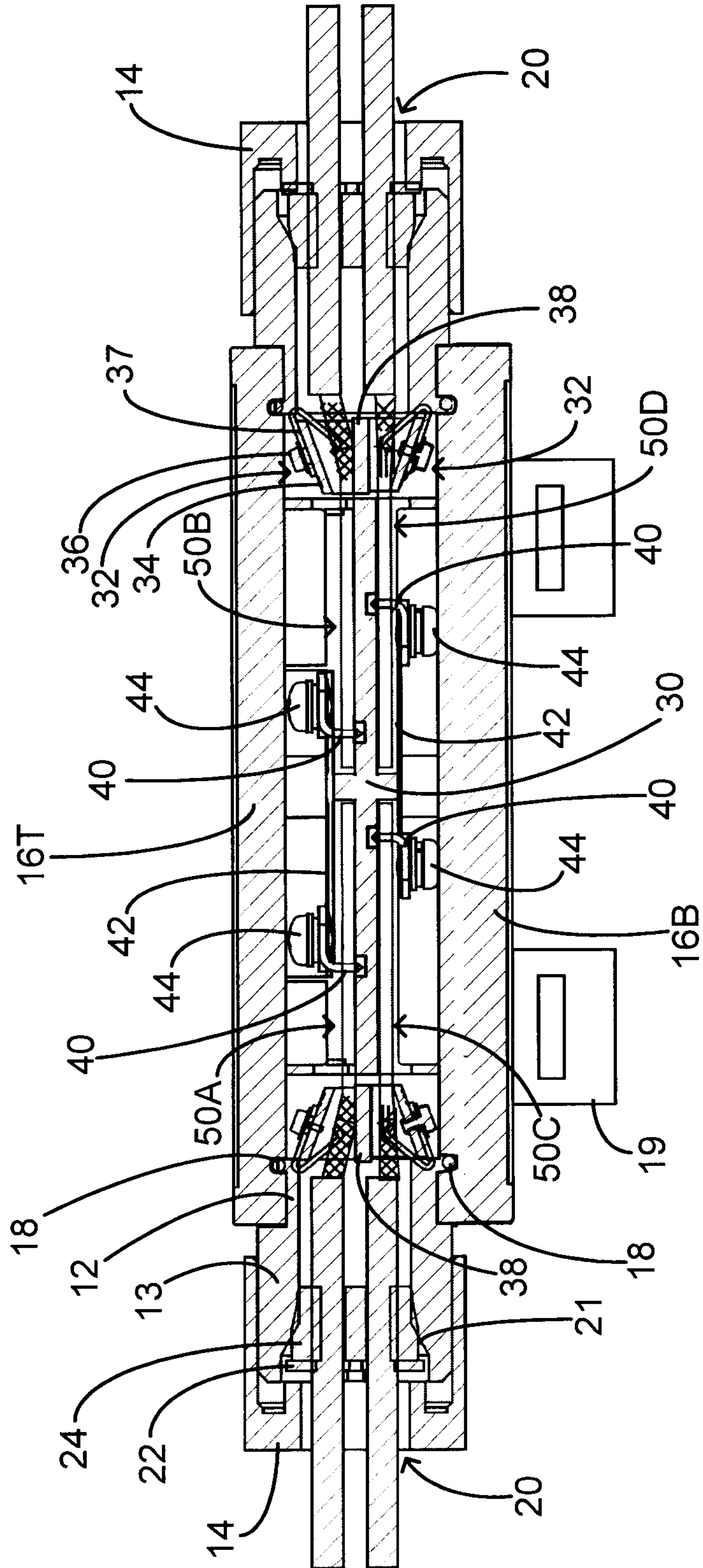


Figure 5

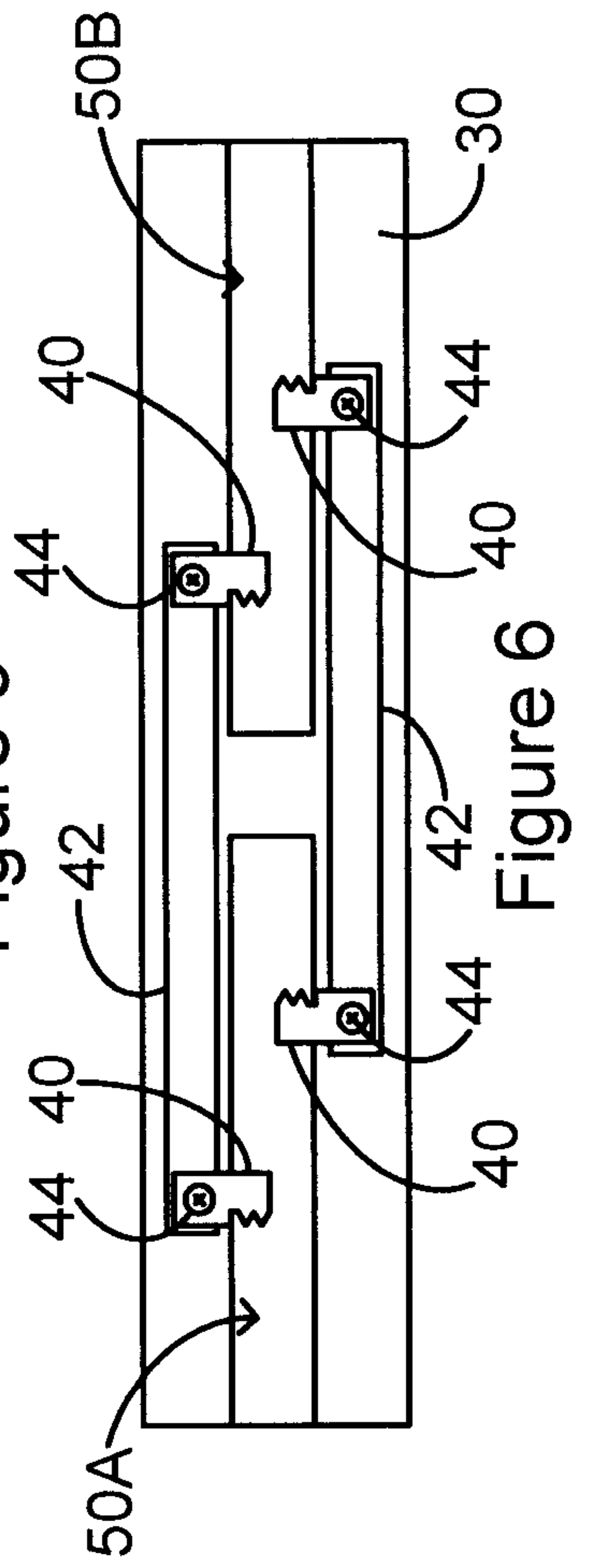


Figure 6

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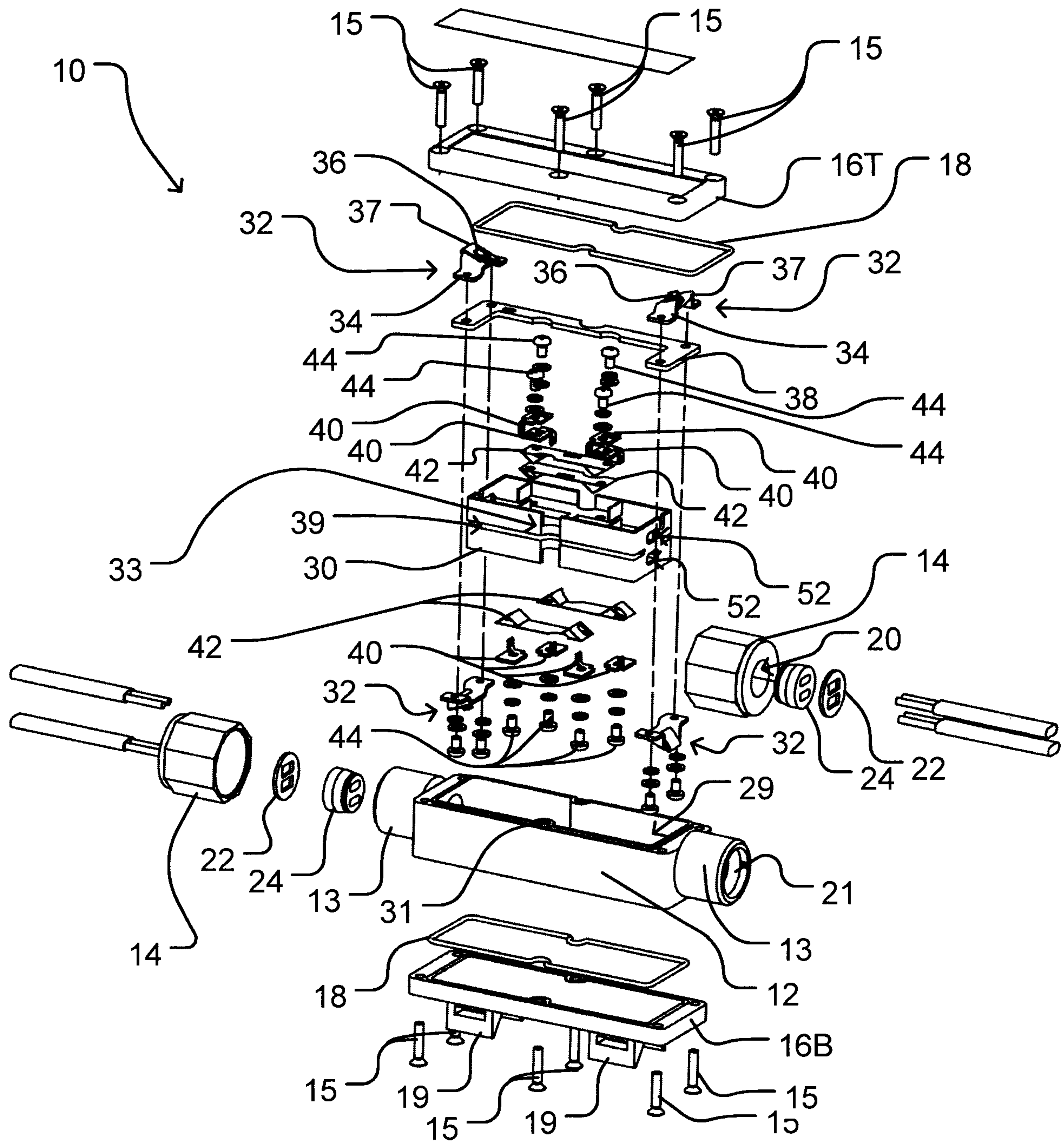


Figure 7

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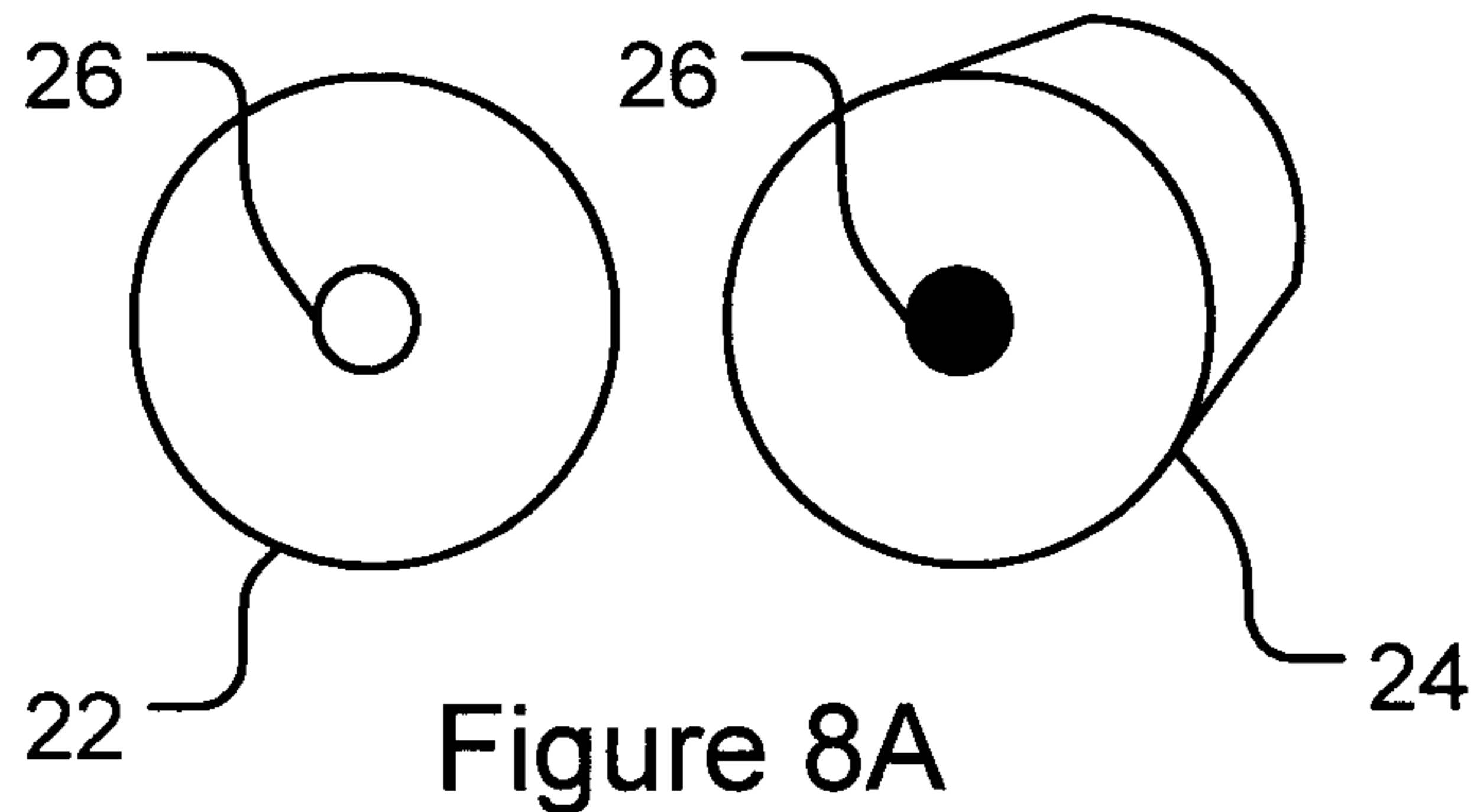


Figure 8A

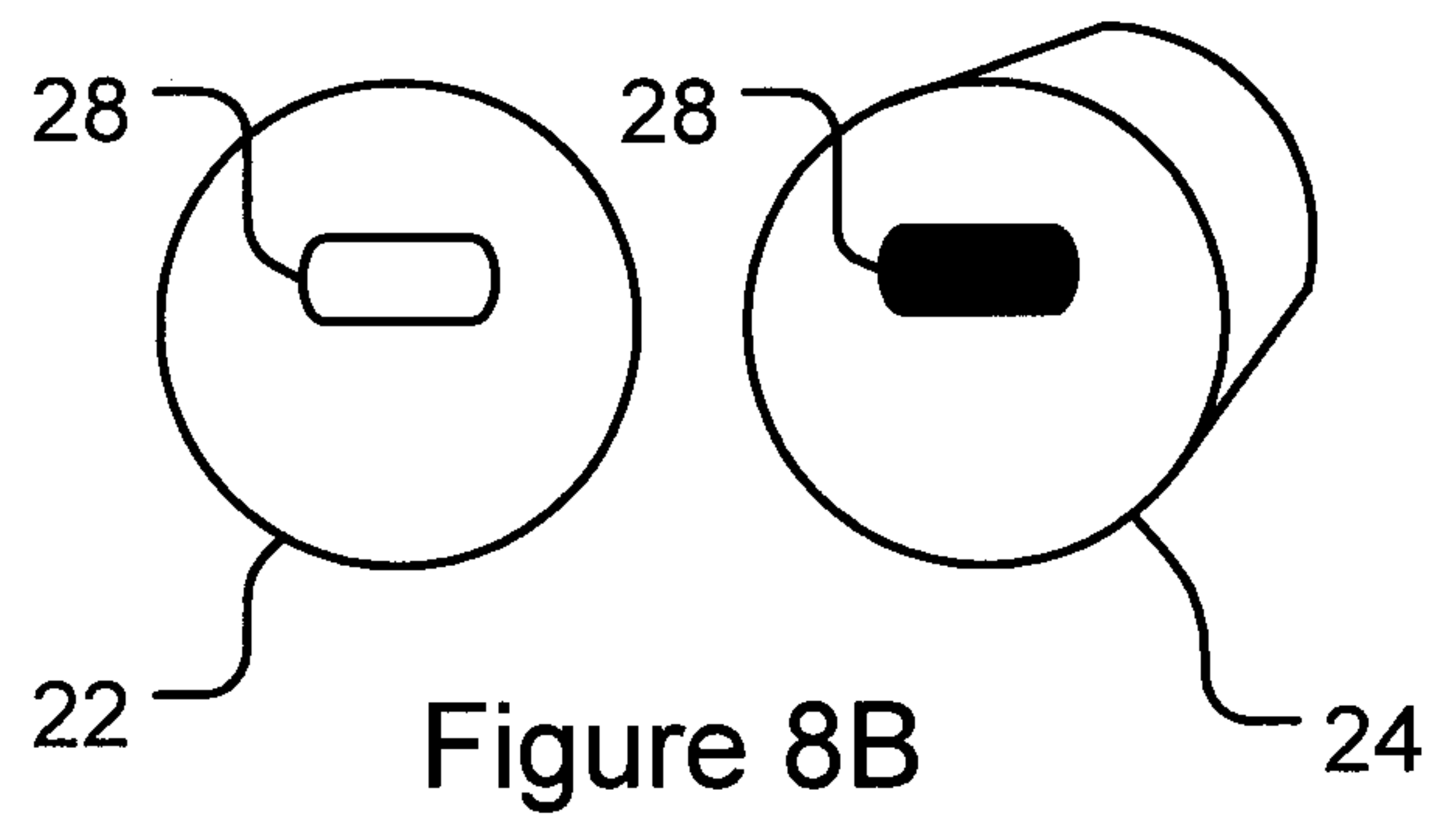


Figure 8B

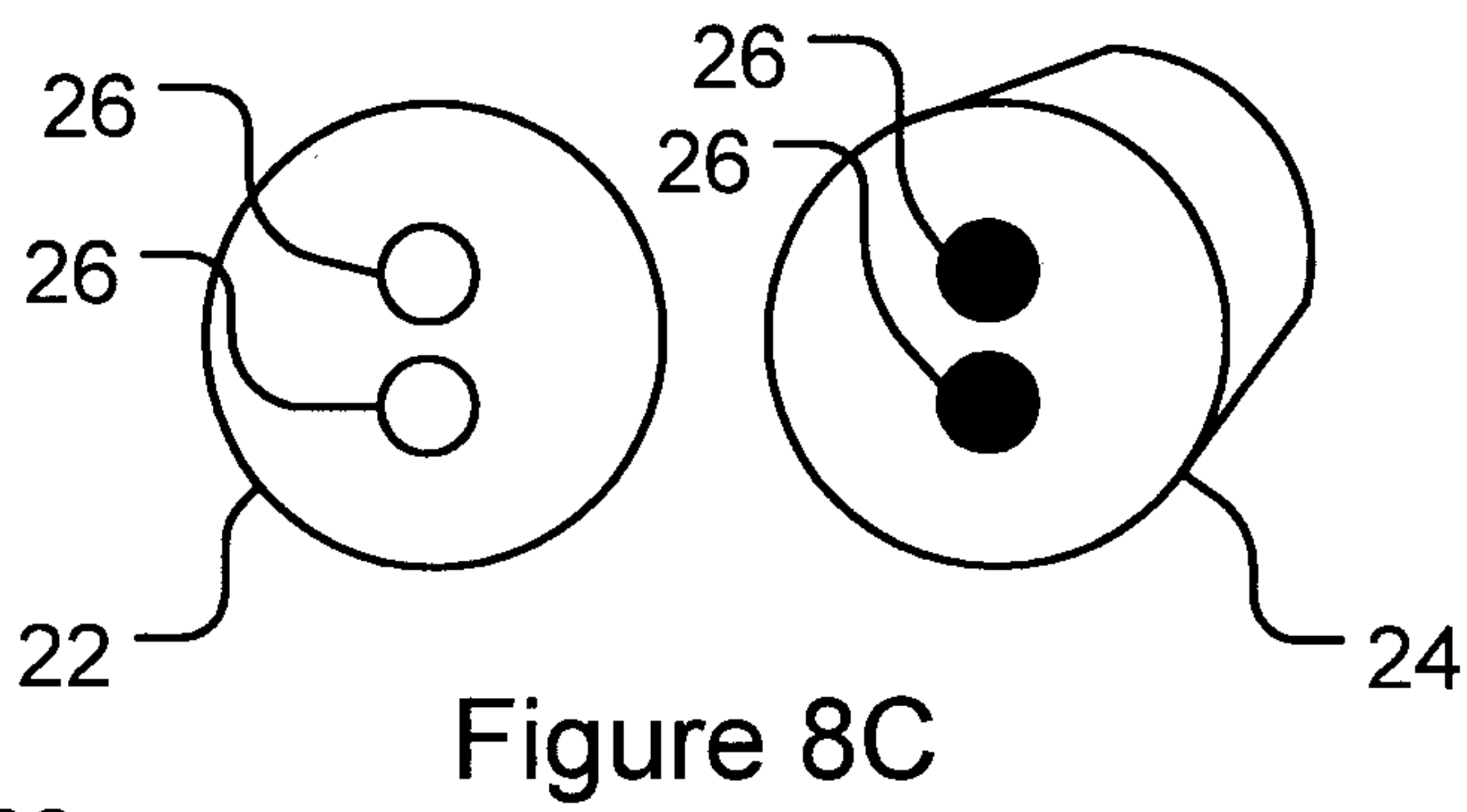


Figure 8C

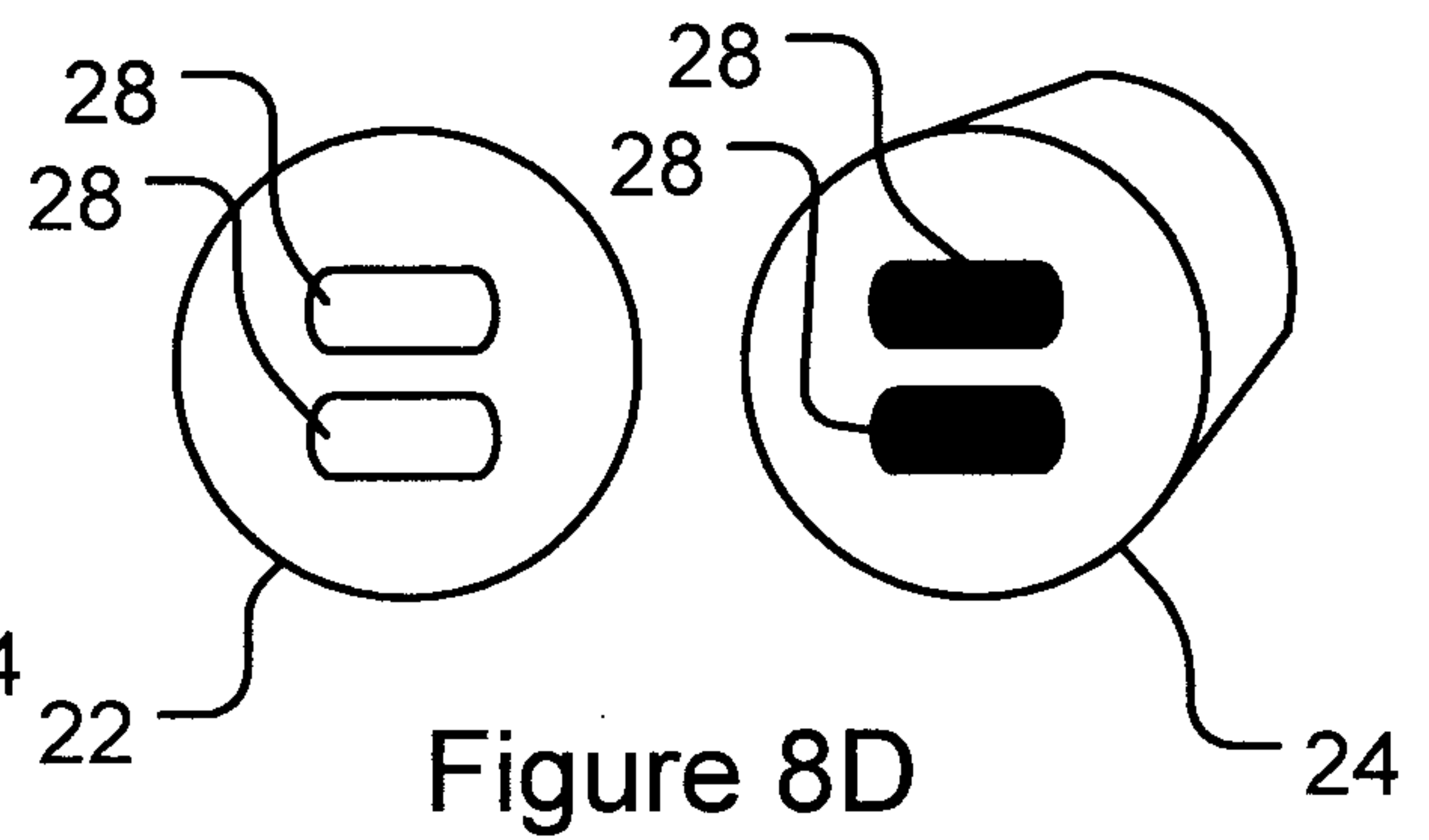


Figure 8D

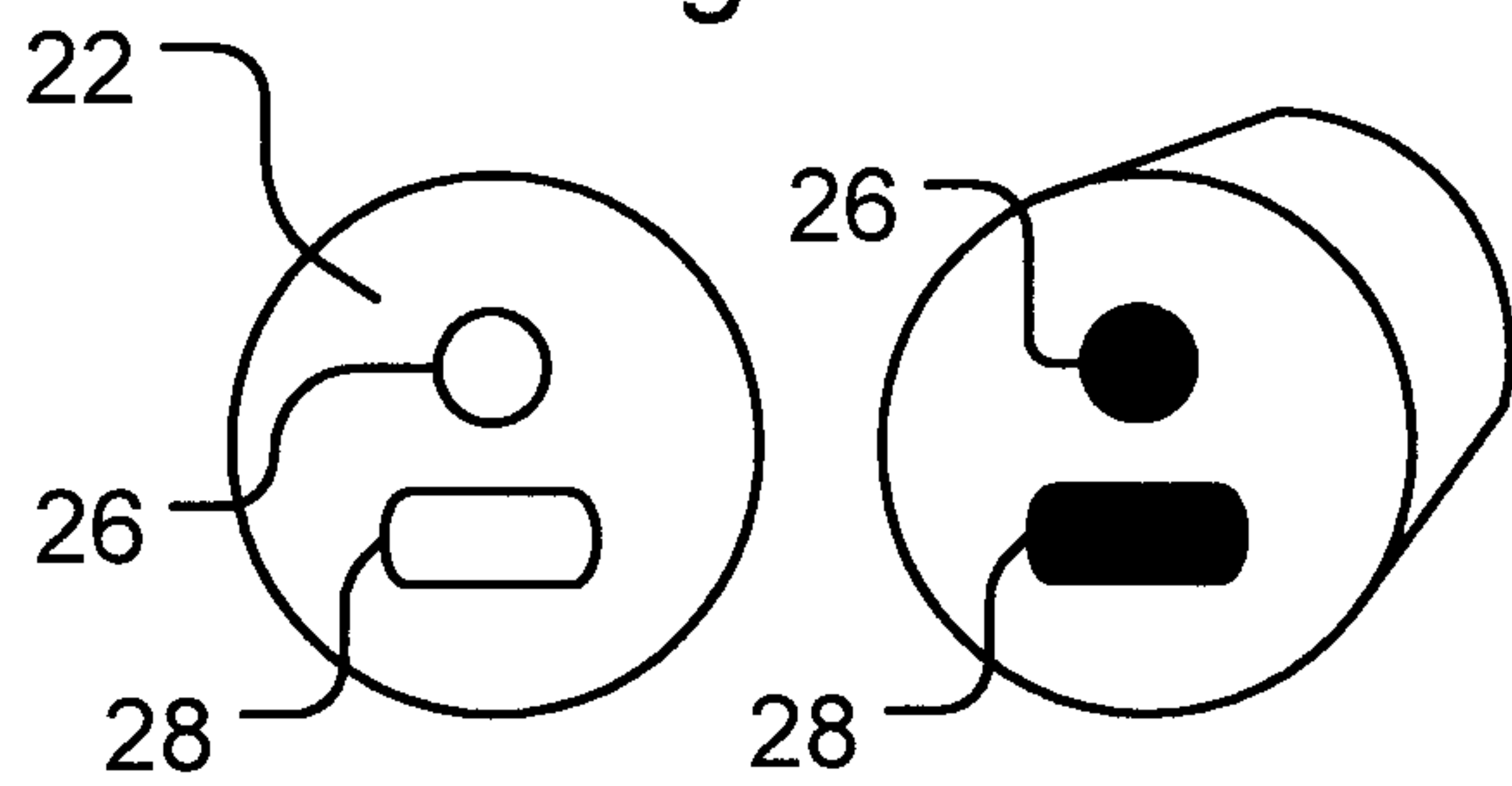


Figure 8E

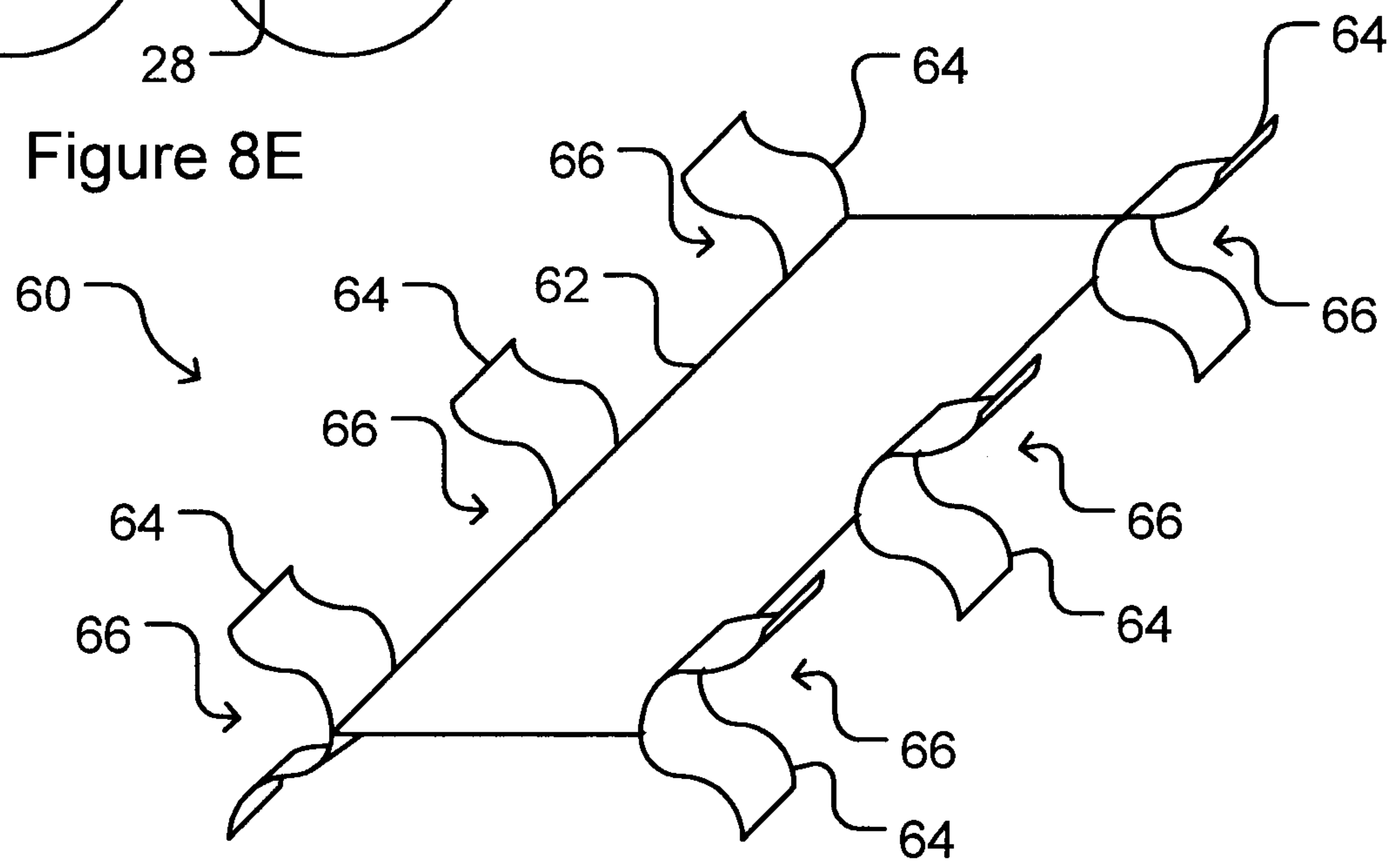
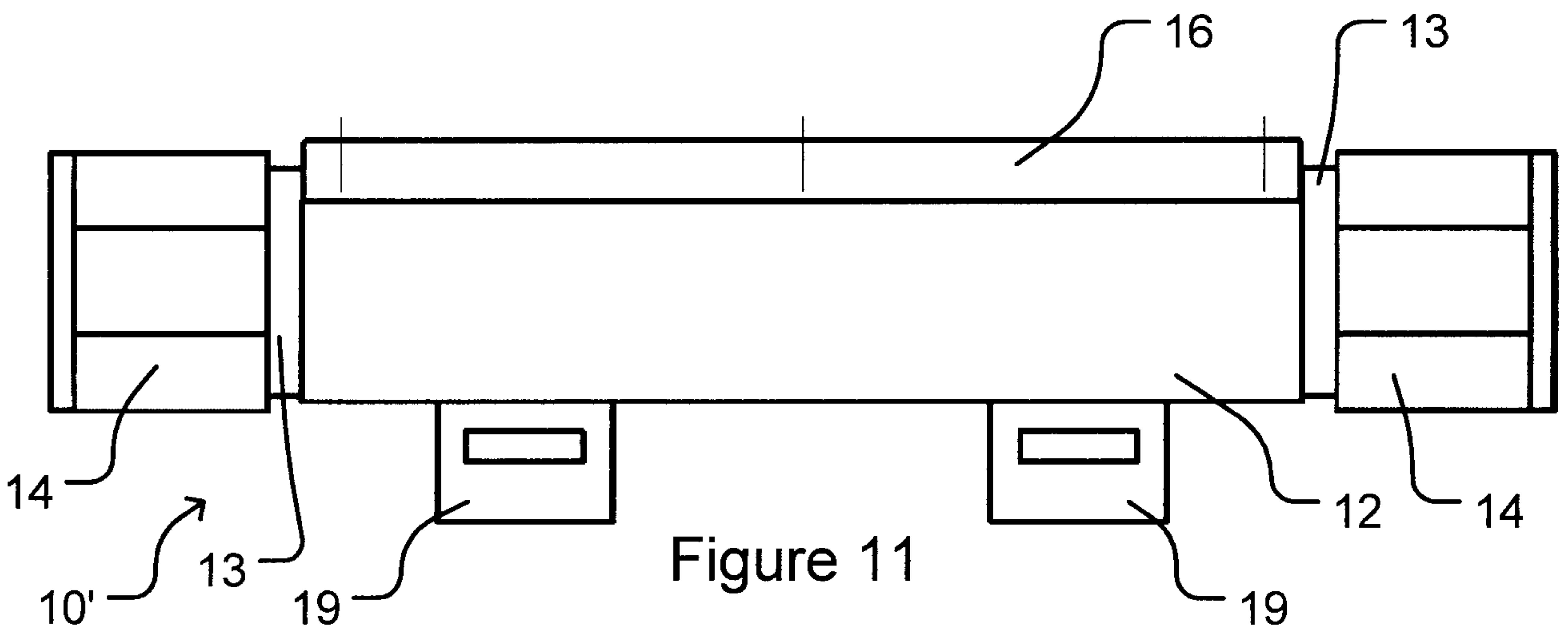
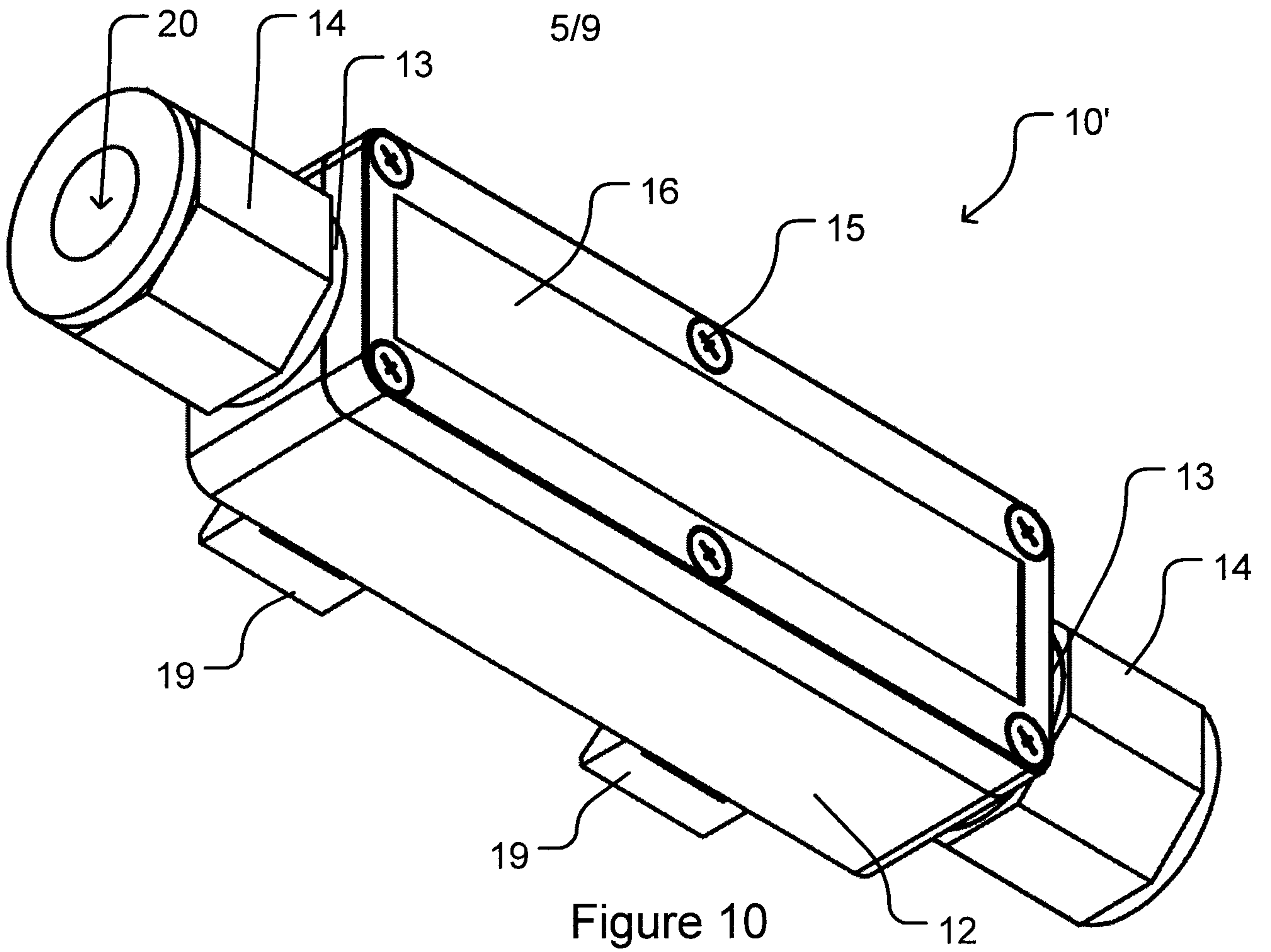


Figure 9



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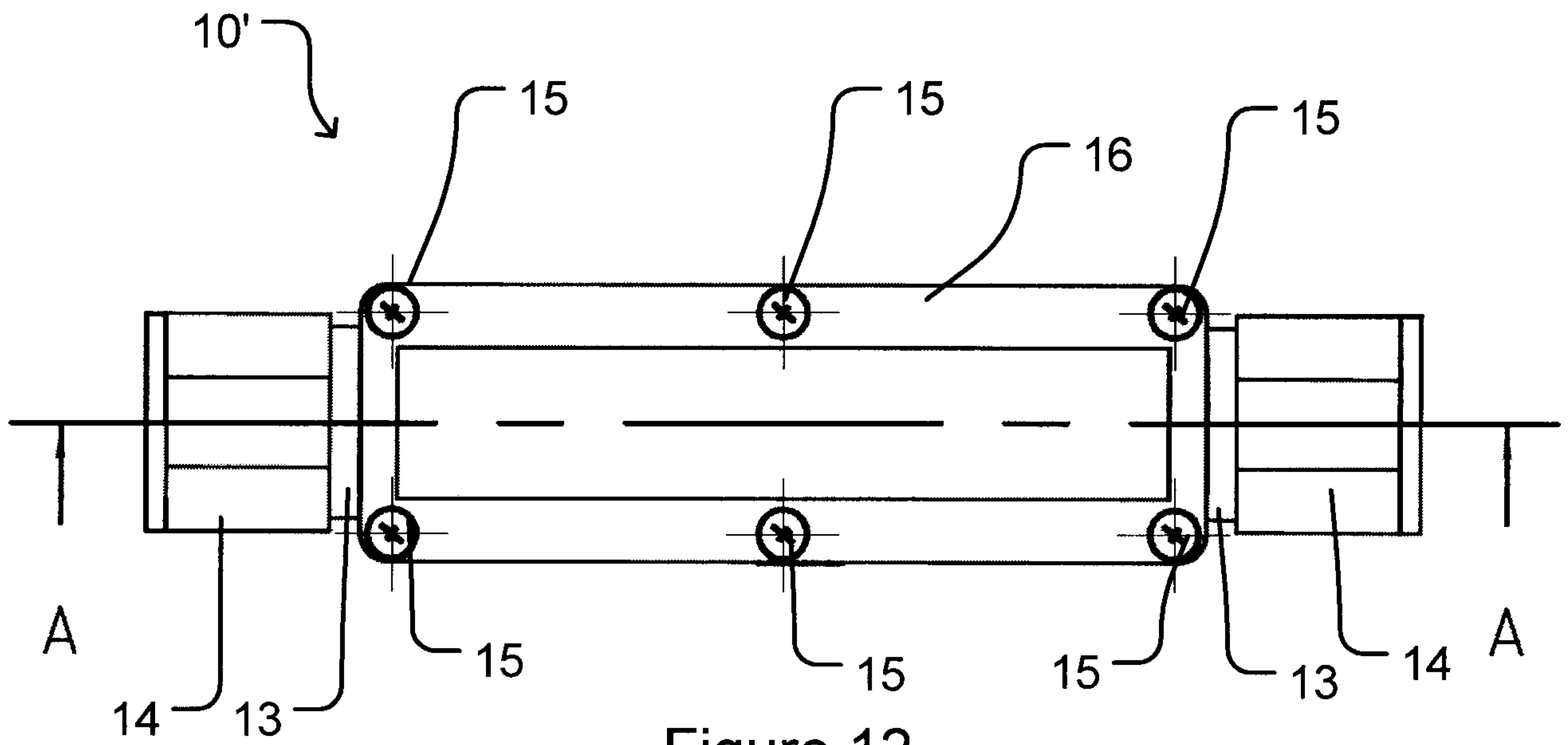


Figure 12

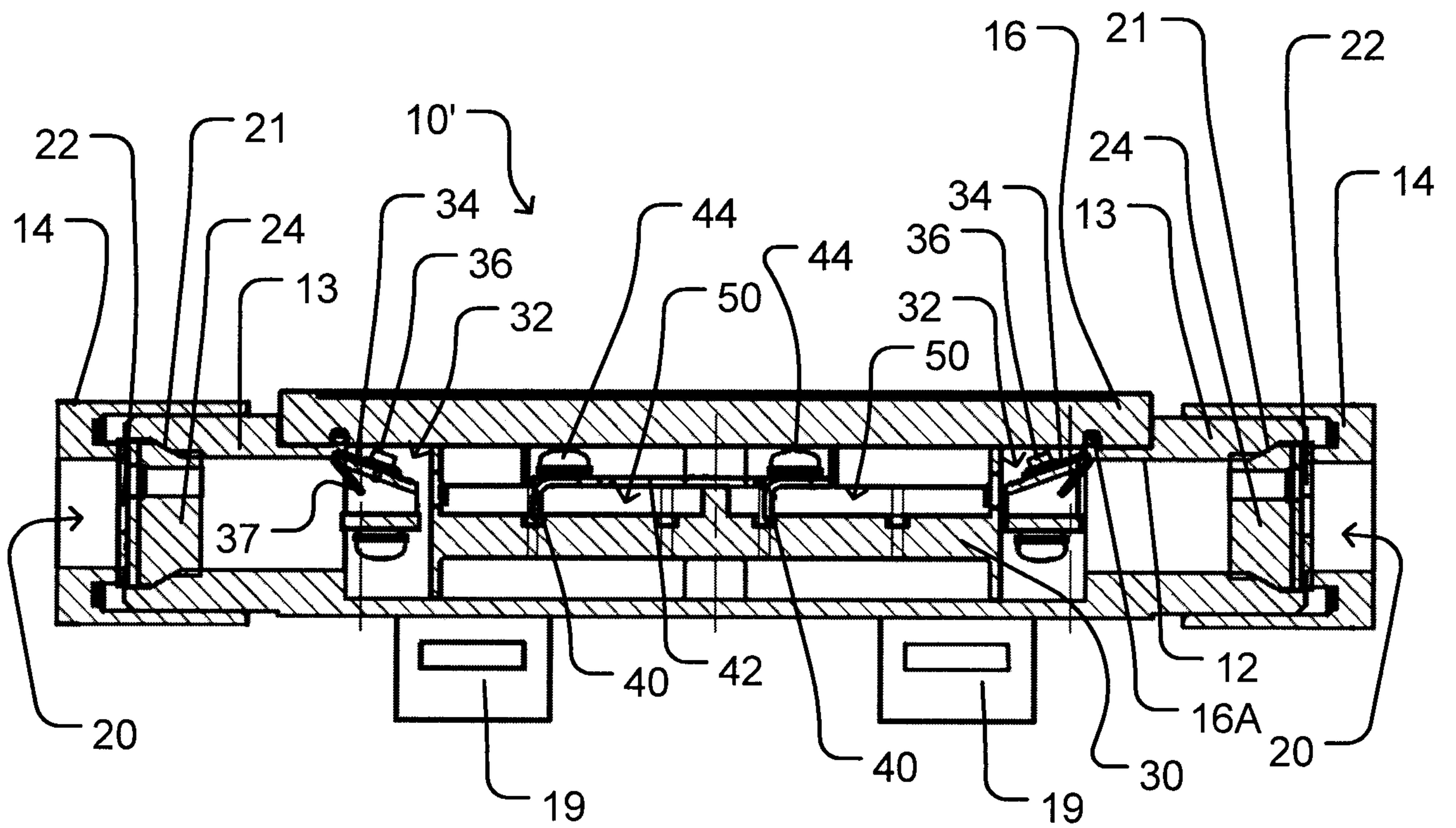


Figure 13

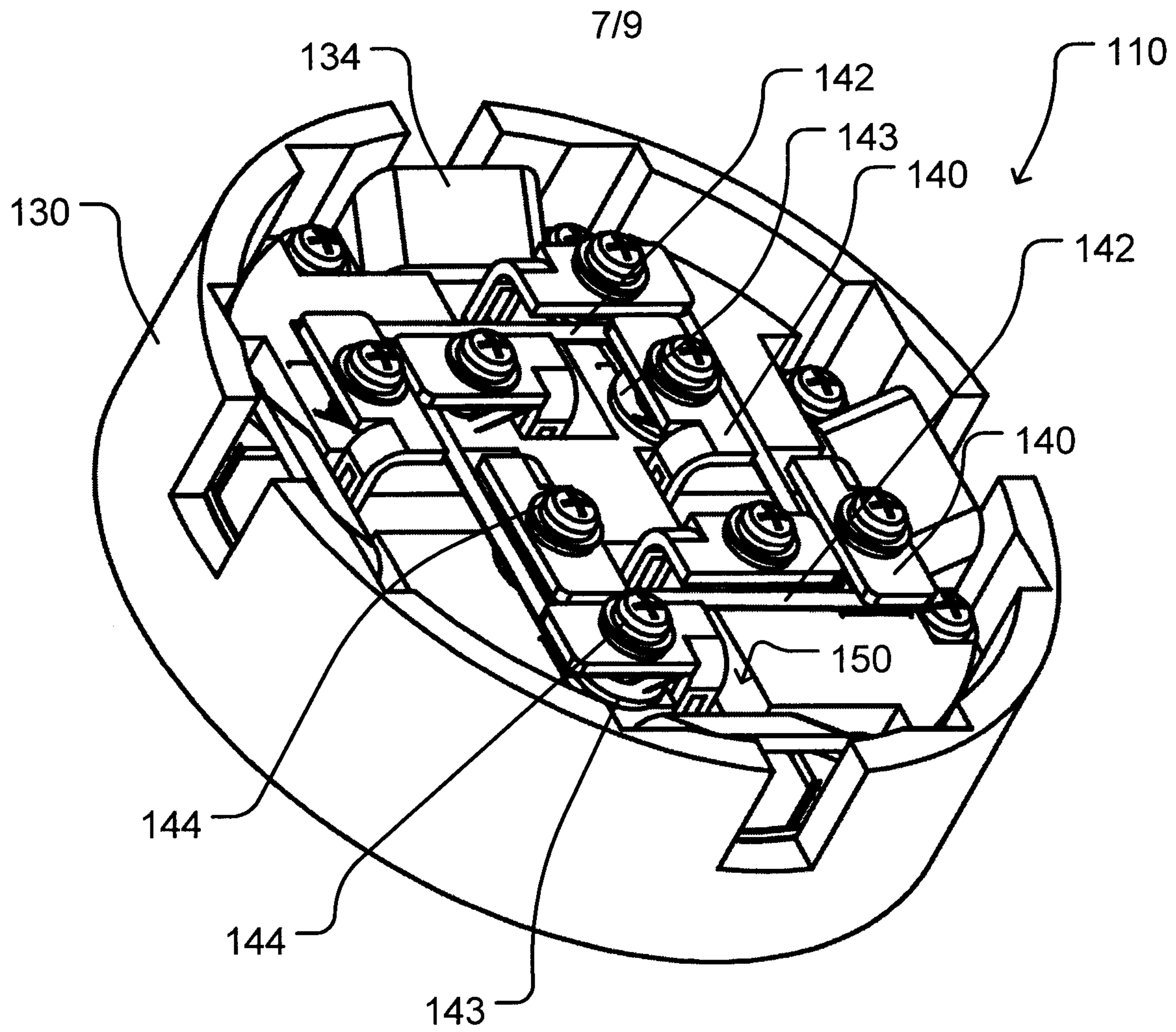


Figure 14

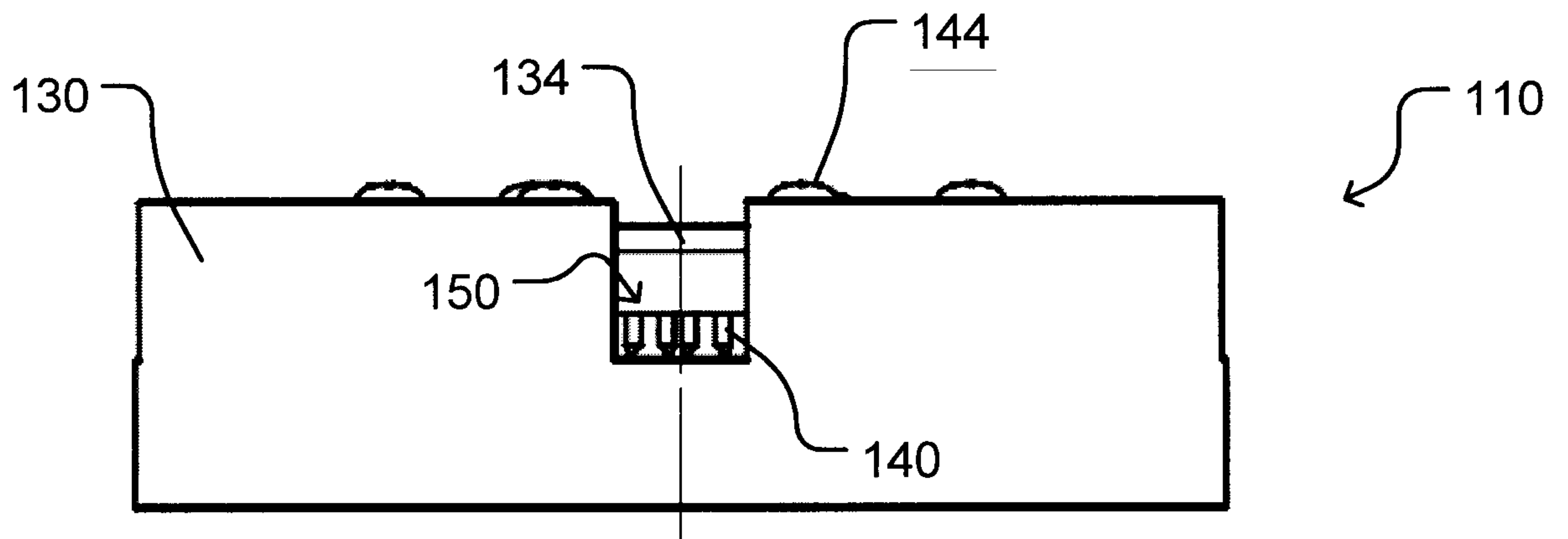


Figure 15

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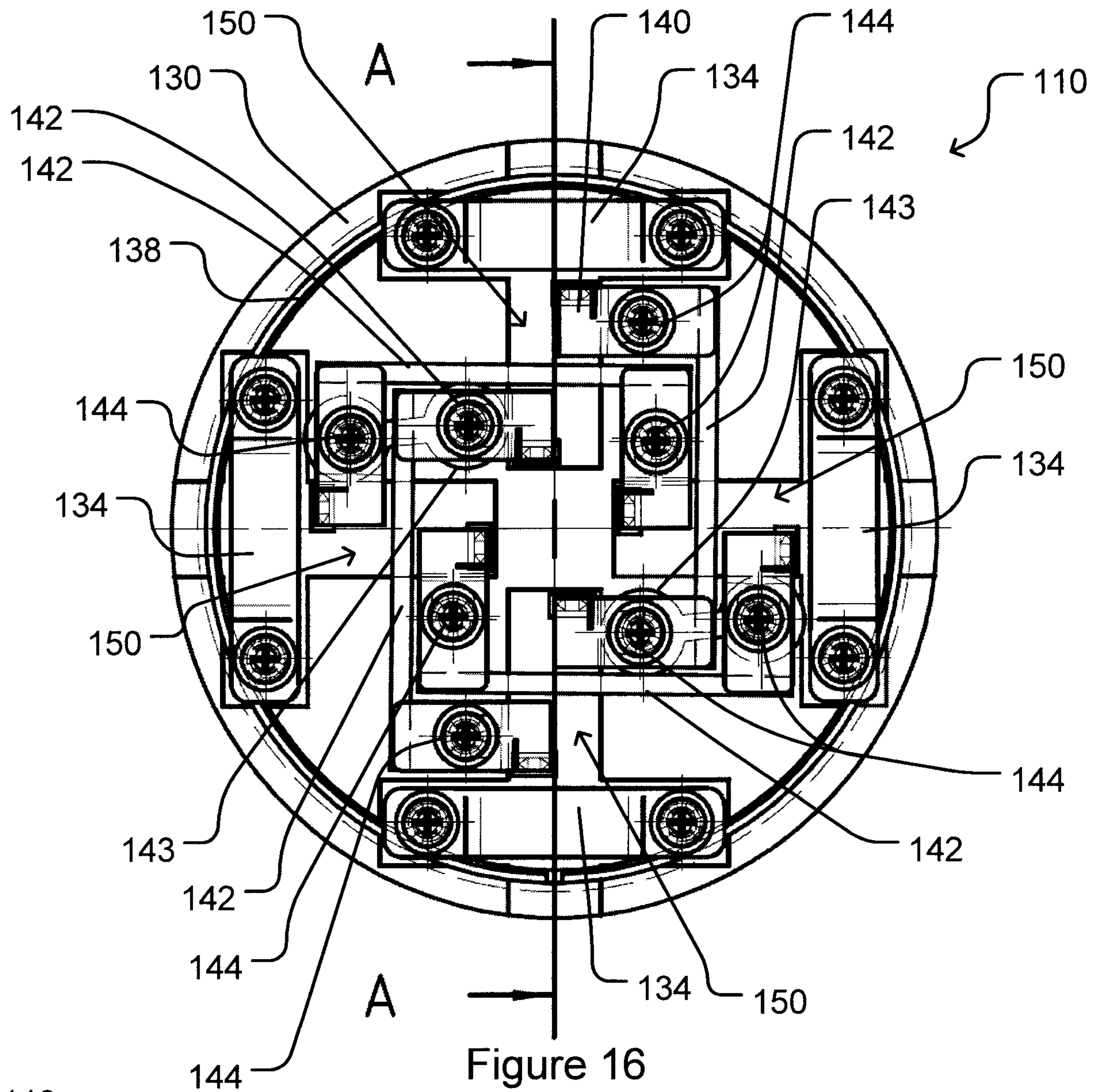


Figure 16

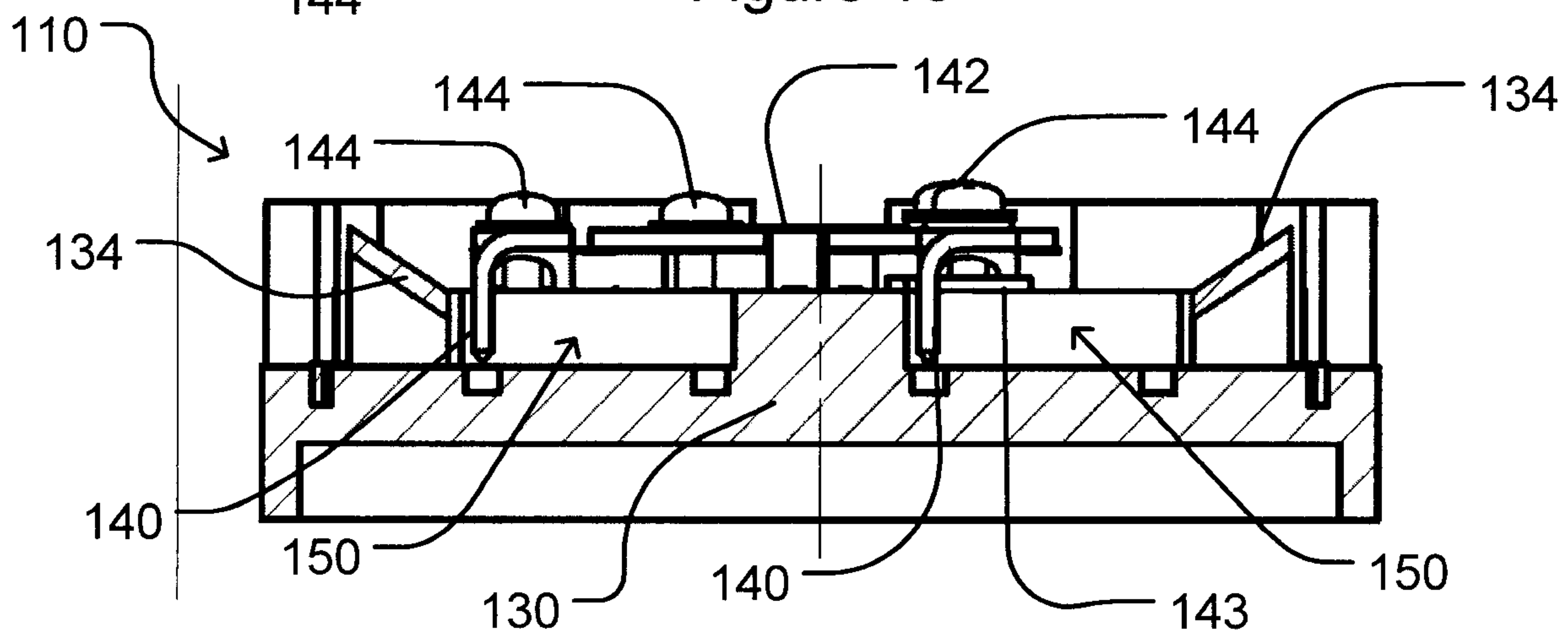


Figure 17

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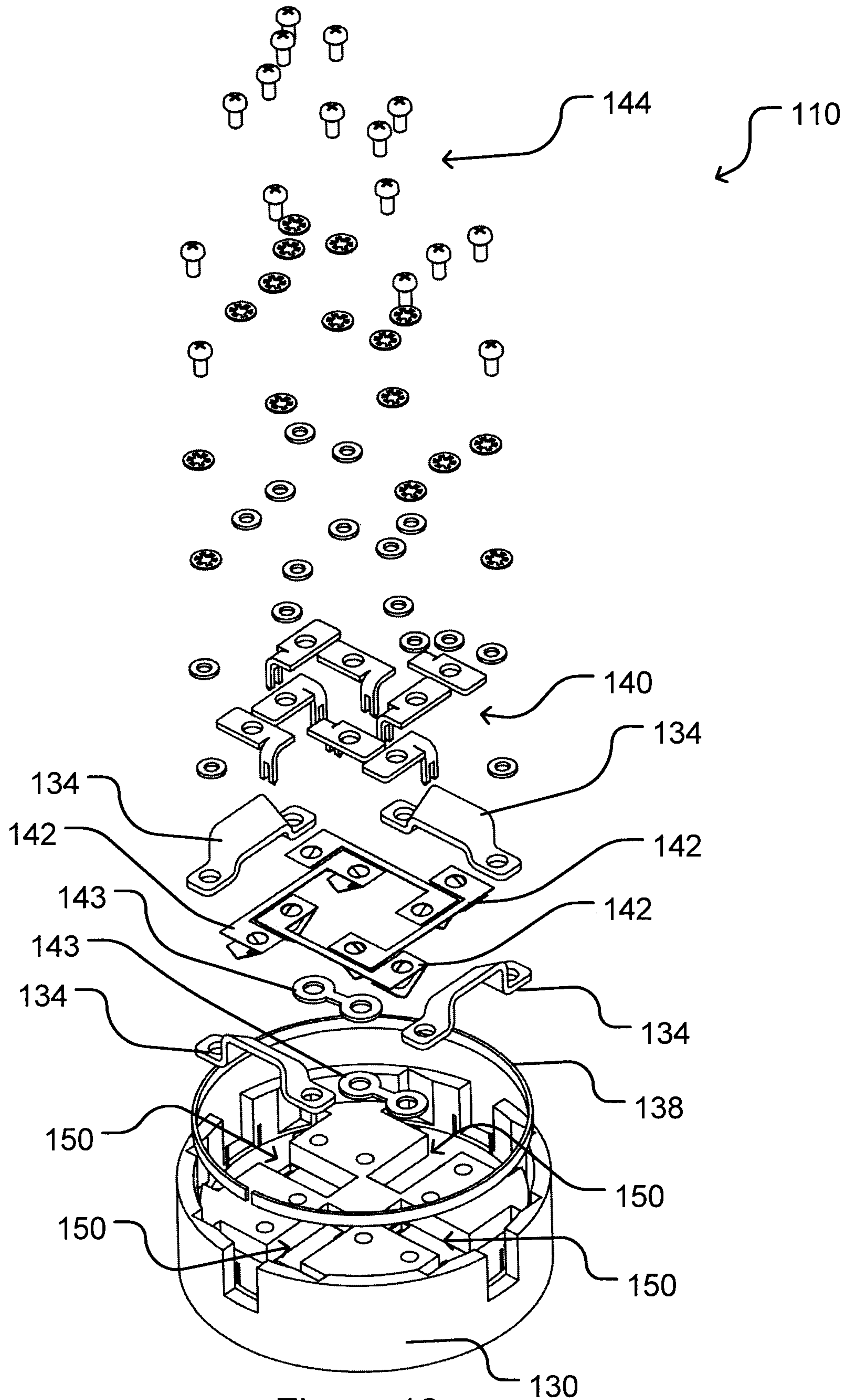


Figure 18

