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CA 2455530 A1 2004/08/04

(21) 2 455 530

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2004/01/22

(41) Mise à la disp. pub./Open to Public Insp.: 2004/08/04

(30) Priorité/Priority: 2003/02/04 (10/357,678) US

(51) Cl.Int.^{7}/Int.Cl.^{7} B25B 5/10

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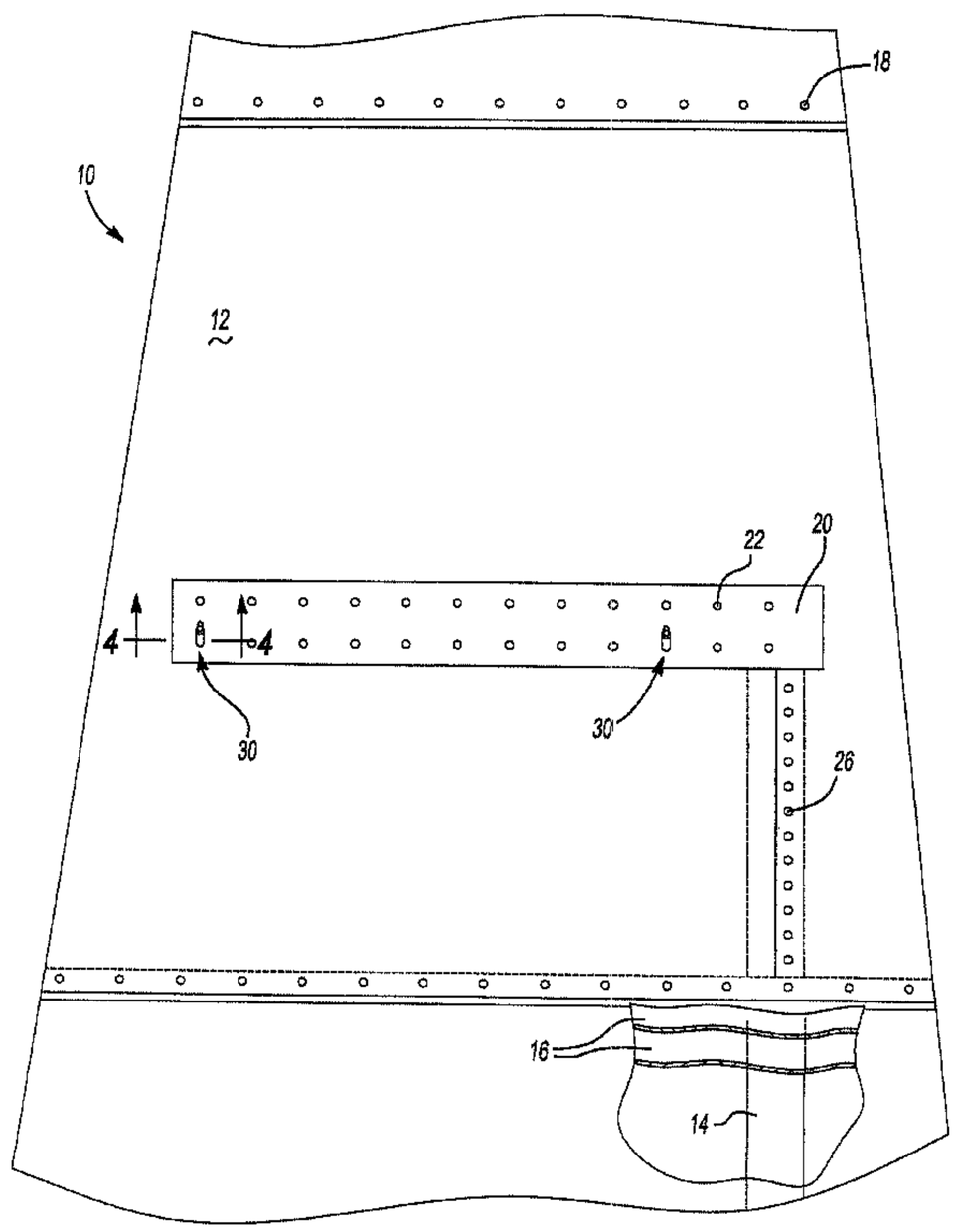
(54) Titre : PINCE A OUTIL ET METHODE DE FONCTIONNEMENT
(54) Title: TOOL CLAMP AND METHOD



(57) Abrégé/Abstract:
A clamp for securing a tool to a multi-piece panel assembly. The clamp is especially suited for applications where access to only one side of the panel assembly is available. The clamp uses a blind temporary fastener that is secured to the panel assembly to hold the independent panels of the assembly together. The clamp includes an sleeve member that is attached to the temporary fastener and a socket that attaches to the sleeve member and is axially adjustable therewith. The clamp attaches to the temporary fastener without modification of the temporary fastener and clamps the tool to the panel assembly. The clamp is adjustable for a variety of tool thicknesses and can be removed without removal of the temporary fastener.

TOOL CLAMP AND METHOD

ABSTRACT OF THE DISCLOSURE

A clamp for securing a tool to a multi-piece panel assembly. The clamp is especially suited for applications where access to only one side of the panel assembly is available. The clamp uses a blind temporary fastener that is secured to the panel assembly to hold the independent panels of the assembly together. The clamp includes an sleeve member that is attached to the temporary fastener and a socket that attaches to the sleeve member and is axially adjustable therewith. The clamp attaches to the temporary fastener without modification of the temporary fastener and clamps the tool to the panel assembly. The clamp is adjustable for a variety of tool thicknesses and can be removed without removal of the temporary fastener.

TOOL CLAMP AND METHOD

FIELD OF THE INVENTION

[0001] The present invention relates generally to a clamp used to align and secure a tool to at least one part.

BACKGROUND OF THE INVENTION

[0002] In many environments it is necessary to temporarily secure a tool, such as a jig drill template or locating jig, to one or more parts while other operations, such as drilling and/or riveting operations, are performed. For example, temporary fasteners are often used in the aircraft industry to temporarily attach jig drill templates to a multi-layer structure in order to perform a drilling operation on the multi-layer structure.

[0003] Typically, clamps or fasteners are used to align the tool to the part(s) of a multi-layer structure and to apply a clamp load to the tool and the part(s) that clamps the tool and the part(s) together. These parts can include panels and structural members. Thereafter, an operation such as drilling a plurality of holes in the part(s) or riveting the part(s) together may be performed.

[0004] Known clamps frequently require access to both sides of the part(s), which may not be practical, convenient or comfortable for the technician, as for example when the parts are components of an aircraft and located in the wings or empennage.

[0005] Thus, what is needed is a temporary tool fastener that can be attached with access to only one side of a work surface and does not

require modification of the temporary fastener. Such a tool would be especially useful in the fabrication and/or assembly of aircraft components, where access is often limited to only one side of a panel.

SUMMARY OF THE INVENTION

[0006] The present invention is directed to a temporary clamp that is useful for temporarily attaching a drill jig to an aircraft panel assembly. As will be described, the clamp utilizes an existing temporary fastener that positions the multiple layers of the panel assembly in preparation for fastening. Briefly, a drill jig or other tool can be attached to the panel assembly with the clamp. Holes are then formed in the panel assembly using the drill jig as a template. Rivets or other fasteners are inserted in the panel assembly holes before the temporary fasteners are removed. In one preferred form, the clamp comprises an elongated annular nut with external and internal threads. The internal threads attach to a draw bar of a temporary fastener and the external threads attach to a clamp socket. The clamp socket is an elongated annular portion with internal threads that are sized to mate with the external nut threads. When assembled, the clamp socket can be rotated relative to the nut to axially translate the clamp socket. This axial movement is used to impart a clamping force on a tool to secure the tool to the panel assembly that is attached to the temporary fastener. In another preferred form, the clamp attaches to the temporary fastener to allow for clearance for a thicker drill jig. In yet another preferred form, the clamp can be installed after the temporary fastener is installed on a work piece.

[0007] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0009] Figure **1** is a partially broken away perspective view illustrating a clamp constructed in accordance with the teachings of the present invention, the clamp being shown locating and clamping an exemplary tool to an exemplary part;

[0010] Figure **2** is an enlarged view of a portion of Figure **1** illustrating the clamp of the present invention and the tool in greater detail;

[0011] Figure **3** is a sectional front view similar to that of Figure **4**, but illustrating only the temporary fastener as it is being inserted through the tool and parts;

[0012] Figure **4** is a sectional front view taken along the line **4-4** of Figure **1**;

[0013] Figure **5** is a partial sectional side view of the outer shaft of the temporary fastener of Figure **3**;

[0014] Figure **6** is a sectional plan view taken along the line **6-6** of Figure **5**;

[0015] Figure **7** is a front view of a portion of the clamp of Figure **1** illustrating the sleeve member in greater detail;

[0016] Figure **8** is a plan view of the sleeve member of Figure **7**;

[0017] Figure **9** is a front view of a portion of the clamp of Figure **1** illustrating the socket in greater detail; and

[0018] Figure **10** is a plan view of the socket of Figure **9**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] With reference to Figure **1**, a portion of an aircraft wing is generally identified by reference numeral **10**. Wing **10** includes a panel assembly **12** and structural members **14** (only one of which is visible). Panel assembly **12** generally includes multiple layers of panels **16**. Panels **16** and structural members **14** are held together by a plurality of fasteners **18**. A drill jig **20** is used to ensure the correct placement of fasteners **18**. Briefly, drill jig **20** has various apertures **22** provided to align a drill (not shown) when forming a series of panel apertures **26**. Generally, drill jig **20** is constructed for each specific application or location on the outer portions of an aircraft. Drill jig **20** is essentially a plate of steel or similar material with the apertures **22** formed at locations that correspond to the desired locations for the fasteners **18** that are used to assemble the panels **16** to one another and/or to the structural members **14**. A clamp **30** in accordance with a preferred embodiment of the present invention is used to secure drill jig **20** to panel assembly **12** as discussed below.

[0020] Referring now to Figure **2**, the clamp **30** is shown in greater detail. Clamp **30** includes a temporary fastener **32** which is hidden therein

when the clamp **30** is secured to the panel assembly **12**, a sleeve member **34** and a socket **36**. Temporary fastener **32** may comprise a CLECO™ fastener available from Monogram Aerospace Fasteners of Los Angeles, California. Referring to Figure **3**, temporary fastener **32** is shown in greater detail. Temporary fastener **32** includes an outer shaft **38**, a spindle **40**, a draw bar **42**, and a wedge **44**. Outer shaft **38** is a generally annular member that includes a lower end surface **46** that is generally parallel to an upper end surface **48**, a bore **50** and an inner shoulder **52** formed as part of a recess **53**. Bore **50** extends axially through the body of outer shaft **38** opening onto both the lower end surface **46** and the shoulder **52**. Recess **53** has a diameter D_1 at upper end surface **48** that is larger than a diameter D_2 of the bore **50**. Also preferably, outer shaft **38** includes an annular recess or groove **54** near upper end surface **48** and within the recess **53**. A snap ring **56** can be inserted into annular recess **54**, as will be discussed further below.

[0021] Spindle **40** is an annular member having an external surface **58** with a groove **60** formed therein. A threaded bore **62** is formed axially through the spindle **40**. The spindle **40** has a thrust end surface **64** that is parallel a torque end portion **66**. Draw bar **42** has threads **68** formed on a first portion **70** and a pair of tine-like elements at a second portion **74** defining two prongs **76**. Draw bar **42** is threadably engaged within the threaded bore **62** of spindle **40**. The torque end portion **66** of spindle **40** protrudes from upper end **48** of the outer shaft **38**. Spindle **40** is inserted into bore **50** so that thrust end surface **64** abuts inner shoulder **52** within the recess **53**. Snap ring **56** can then be inserted into annular recess **54** and

groove **60**. Thus provided, spindle **40** and outer shaft **38** are coupled for rotation therebetween while snap ring **56** and the interference between thrust end surface **64** and inner shoulder **52** resists axial translation between spindle **40** and outer shaft **38**.

[0022] With specific reference to Figures **4**, **5**, and **6**, wedge **44** is formed to extend from outer shaft **38** so as to prevent rotation of draw bar **42**. In operation, rotation of spindle **40** causes axial translation of draw bar **42** relative to outer shaft **38**.

[0023] As best seen in Figure **3**, spindle **40** can be rotated in a first direction so as to cause the second portion **74** of draw bar **42** to move outwardly from outer shaft **38** in the direction of arrow A and beyond wedge **44**. In this position, the two prongs **76** of second portion **74** move inwardly toward one another due to their geometry and the characteristics of the material (preferably steel) from which the draw bar **42** is made (i.e., the prongs **76** are resiliently biased toward one another).

[0024] In order to attach temporary fastener **32** to panel assembly **12**, the second portion **74** of draw bar **42** is inserted in panel aperture **26**. When the second portion **74** is fully inserted in panel aperture **26**, prongs **76** extend beyond panel assembly **12**. Spindle **40** can be rotated in a second direction opposite to the first direction to cause axial translation of draw bar **42** in a direction opposite to that of arrow A, wherein prongs **76** move toward outer shaft **38** and panel assembly **12**. While moving toward outer shaft **38**, prongs **76** are forced apart due to the interference with wedge **44**. When prongs **76** contact panel **16** (Figure **4**), a gripping portion **78** of each prong **76** contacts the surface of panel **16** that surrounds panel aperture **26**, thus

binding panels **16** together with temporary fastener **32**. As spindle **40** is rotated further in the second direction, panels **16** of panel assembly **12** are tightly clamped between the prongs **76** and the outer shaft **38**, thus securing fastener **32** to the panel assembly **12**. While Figure **3** illustrates that temporary fastener **32** can be installed within panel aperture **26** after drill jig **20** is positioned adjacent panel assembly **12**, one of ordinary skill in the art will recognize that temporary fastener **32** can be installed within panel aperture **26** before drill jig **20** is positioned adjacent panel assembly **12**.

[0025] With specific reference to Figures **4**, and **7 – 10**, clamp **30** further includes the sleeve member **34** and the socket **36**. Sleeve member **34** is preferably an annular portion with a concentric internal threaded bore **80**, a top end **82**, a recess **83**, a bottom end **84**, a threaded outer surface **86** that intersects bottom end **84**, and an outer torque surface **88** that intersects the top end **82**.

[0026] With reference to Figures **4**, **9**, and **10**, socket **36** is preferably an elongated annular portion that includes an inner surface **90**, an outer surface **92**, an adjustment end **94**, and a clamping end **96**. Inner surface **90** opens into a threaded bore **100** which in turn opens onto adjustment end **94**. The threads of bore **100** couple with threaded outer surface **86** so as to allow sleeve member **34** and socket **36** of clamp **30** to releasably couple while allowing for axial adjustment therebetween. Preferably, outer surface **92** is provided with flat portions **104** to allow socket **36** to be rotated with a tool (not shown) such as an open end wrench. In operation, sleeve member **34** can be held at torque surface **88** with a hand or a tool while socket **36** is rotated. In this manner, socket **36** can be axially

adjusted relative to sleeve member **34**, temporary fastener **32**, and panel assembly **12**.

[0027] Turning now to the operation of clamp **30**, temporary fastener **32** is installed onto panel assembly **12** as described herein. Preferably, a plurality of temporary fasteners **32** are installed in an arrangement that aligns with the arrangement of apertures **22** within drill jig **20**. Drill jig **20** is then positioned adjacent panel assembly **12** with each temporary fastener **32** extending through one aperture **22**. A plurality of the clamps **30** are then installed, one at a time, onto the draw bar **42** of each temporary fastener **32** with each clamp **30**, internal threaded surface **80** of sleeve member **34** threaded onto its associated draw bar **42** preferably at least three full thread engagements. Threaded bore **100** of socket **36** is then threaded onto threaded outer surface **86** of sleeve member **34** until clamping end **96** contacts drill jig **20**. Socket **36** can then be further rotated until clamping end **96** applies a sufficient amount of pressure on drill jig **20** to prevent relative movement between drill jig **20** and panel assembly **12**. In this manner, clamp **30** is adjustable to accommodate drill jigs with different thicknesses "t" (as indicated in Figure **3**) and modification of temporary fastener **32** is not necessary. After drill jig **20** is properly oriented with respect to panel assembly **12**, additional panel apertures **26** can be drilled using apertures **22** to ensure proper orientation. Additional clamps **30**, fasteners **18** or temporary fasteners **32** can be installed in panel apertures **26** as desired. When all the required panel apertures **26** have been drilled, drill jig **20** can be removed by removing the sockets **36** of clamps **30**.

Temporary fasteners **32** can be removed and replaced with fasteners **18** to complete the assembly of panel assembly **12**.

[0028] The clamp **30** thus forms a means for quickly and easily operating in connection with a conventional fastener to enable a tool jig to be securely clamped to a panel assembly in a quick and easy manner.

[0029] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A clamp for releasably securing a plurality of members together in a subassembly, as well for securing a tool to the subassembly, the clamp comprising:

a temporary fastener having a threaded portion and a gripping portion, for clamping said plurality of members together into said subassembly; and

a sleeve device for securing the tool to the subassembly, said sleeve device including:

a sleeve member for adjustably threadably engaging said threaded portion of said temporary fastener; and

a socket member engaged with said sleeve member and axially adjustable relative to said spindle member for abutting a surface of said tool and clamping said tool to said surface of said subassembly.

2. The clamp of claim **1**, wherein said socket member includes a threaded bore in threaded engagement with an outer surface of said sleeve member.

3. The clamp of claim 1, wherein said sleeve member includes a portion adapted to be grasped with at a tool to facilitate holding said spindle member stationary while said socket member is adjusted into clamping engagement with said tool.

4. A clamp for releasably securing a plurality of layered members together to form a first structure, and to thereafter releasably secure the first structure to a second structure, the clamp comprising:

a temporary fastener having:

an outer shaft having an axially extending bore formed therethrough, the outer shaft being configured to contact a proximal side of the first structure;

a draw bar having a gripping portion and an engagement portion, the draw bar being axially movable in the bore and configured to extend from the bore in the outer shaft and through an aperture formed through the first structure such that the gripping portion is movable into and out of contact with a distal side of the first structure; and

a spindle having a first clamping end, a first coupling end and a spindle aperture formed through the first

clamping end and the first coupling end, the first clamping end abutting a portion of the outer shaft, at least a portion of the spindle aperture matingly engaging the engagement portion of the draw bar to permit the gripping portion to be adjusted relative to the distal surface of the first structure to thereby clamp the temporary fastener to the first structure; and

a sleeve device having a second clamping end, a second coupling end and a sleeve aperture formed through the second coupling end, the second clamping end being configured to abut a proximal side of the second structure, the second coupling end being matingly but releasably engaged to the engagement portion of the draw bar to permit the second clamping end to be axially adjusted relative to the gripping portion of the draw bar to thereby clamp the distal side of the second structure to the proximal side of the first structure.

5. The clamp of Claim **4**, wherein the engagement portion is threaded.

6. The clamp of Claim **4**, wherein the sleeve device includes an annular sleeve member and a socket that adjustably engages the sleeve member.

7. The clamp of Claim **6**, wherein the socket includes a threaded surface that threadably engages the sleeve member.

8. The clamp of Claim **7**, wherein each of the socket and the sleeve member include a plurality of wrench flats.

9. The clamp of Claim **4**, wherein the draw bar includes a plurality of flexible prongs that are movable between a first condition, which permits the gripping portion of the draw bar to be inserted through the aperture in the first structure, and a second condition, which permits the gripping portion to engage the distal side of the first structure.

10. The clamp of Claim **9**, further comprising a wedge formed to the outer shaft and interposed between the prongs, wherein the wedge cooperates with the prongs to radially translate the prongs as the prongs move between the first condition and the second condition.

11. The clamp of Claim **4**, further comprising coupling means for coupling the spindle and the outer shaft to one another in a manner that permits relative rotation therebetween but which substantially inhibits relative axial movement therebetween.

12. The clamp of Claim **11**, wherein the coupling means includes a snap ring.

13. The clamp of Claim **4**, wherein the engagement portion of the draw bar terminates at a tool engaging end.

14. A clamp for releasably securing a tool with an aperture to a workpiece comprising:

a temporary fastener including:

an outer shaft having an axial bore formed therethrough, the outer shaft being configured to contact a proximal side of the workpiece; and

a draw bar having a gripping portion and an engagement portion, the draw bar being axially movable in the bore and configured to extend from the bore in the outer shaft and through an aperture formed through the workpiece such that the gripping portion is movable into and out of contact with a distal side of the workpiece; and

a sleeve device including:

an annular sleeve member having a top end surface, a bottom end surface, an external threaded surface, a torque surface, and an internal threaded surface,

wherein the internal threaded surface intersects the top end surface and is adapted to couple with the engagement portion, the torque surface intersects the top end surface, and the bottom end surface intersects both the internal threaded surface and the external threaded surface; and

a generally annular socket having internal threads, an adjustment end, and a clamping end, wherein the internal threads are configured to mate with the external threaded surface to allow the clamping end to clamp the tool to the workpiece, the outer diameter of the socket being greater than the diameter of the tool aperture, the clamping end configured to engage the tool, and the socket configured to be superposed about the outer shaft.

15. A method for attaching a tool to a workpiece having at least two components, the method comprising:

securing a temporary fastener to the workpiece wherein the temporary fastener includes an axially moveable draw bar disposed therethrough;

locating a tool adjacent the temporary fastener;

coupling a sleeve device to the draw bar of the temporary fastener, wherein the sleeve device secures the tool to the workpiece, and the step of coupling the sleeve device to the draw bar is performed after the step of securing the temporary fastener to the workpiece.

16. The method of Claim **15**, wherein the sleeve device is threadably engaged with the drawbar.

17. The method of Claim **15**, wherein the step of attaching the sleeve device further comprises:

attaching a sleeve member to the draw bar of the temporary fastener; and

attaching a socket to the sleeve member, wherein the socket clamps the tool to the workpiece.

18. The method of Claim **15**, wherein the step of coupling the sleeve device further comprises locating the sleeve device directly over the temporary fastener.

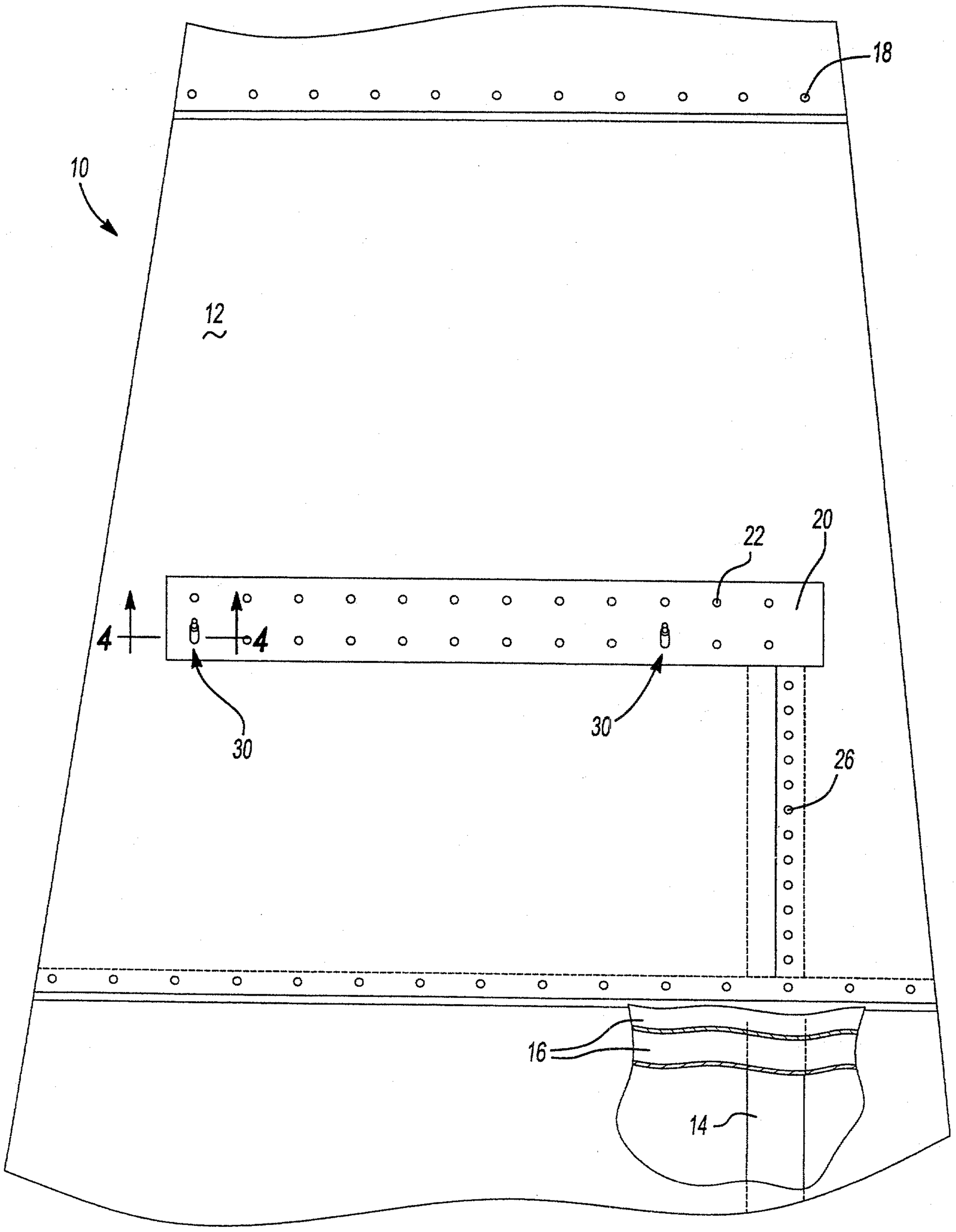


Fig-1

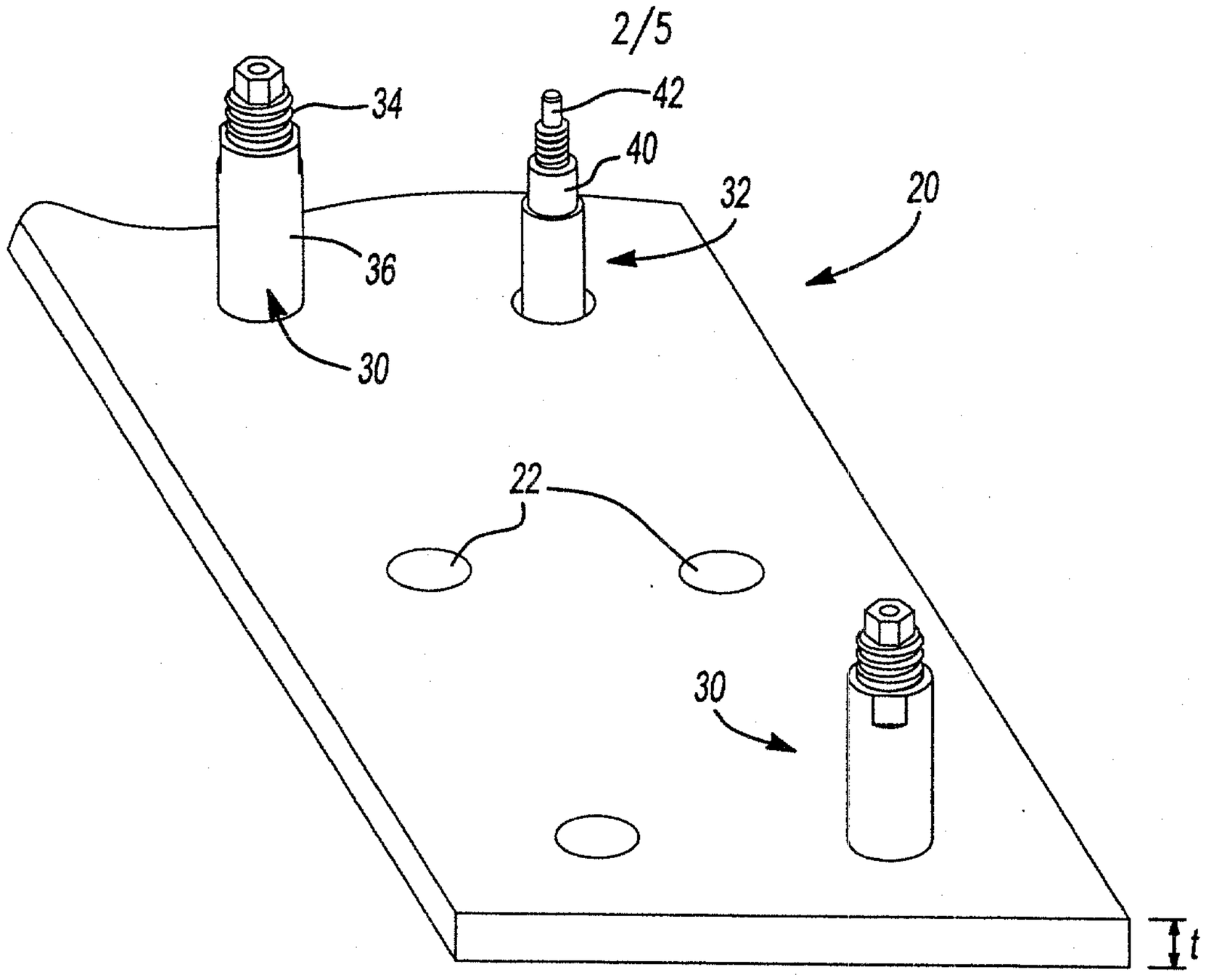


Fig-2

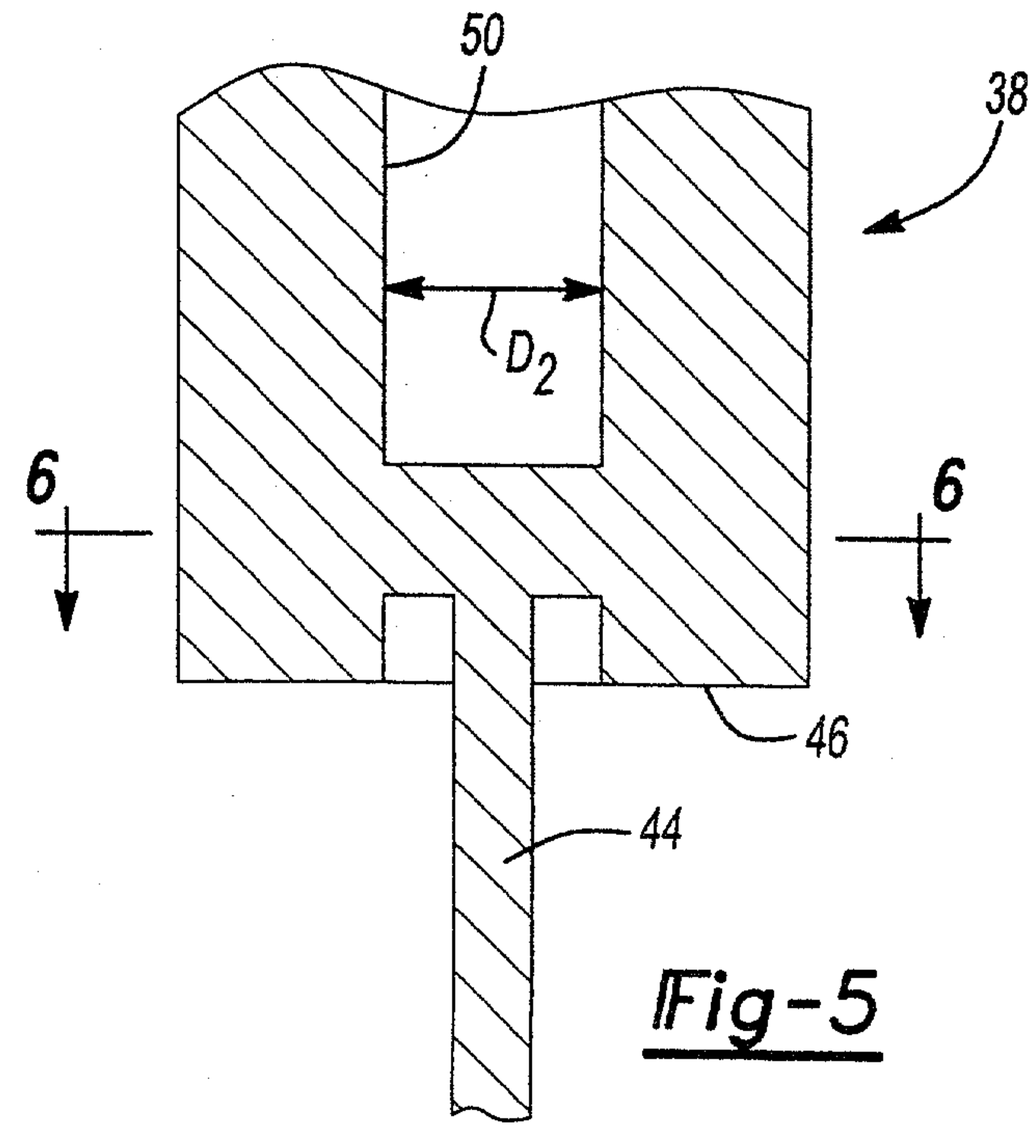


Fig-5

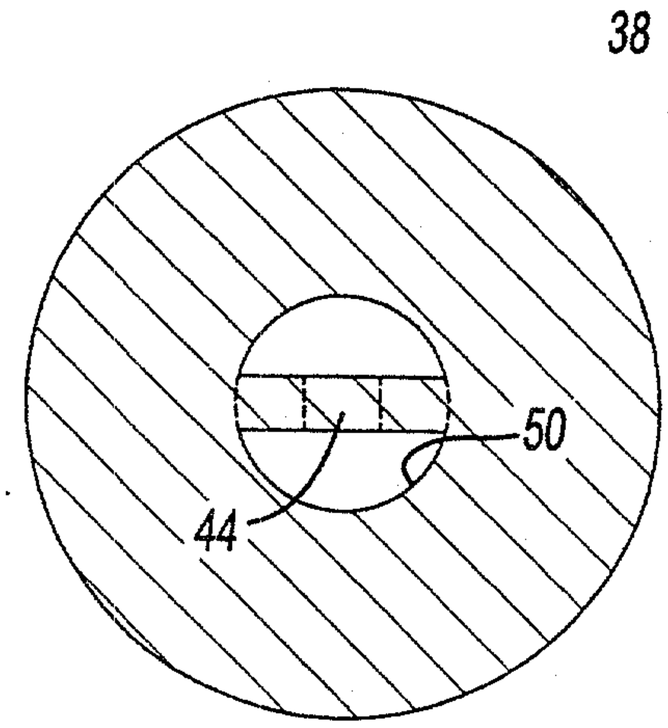


Fig-6

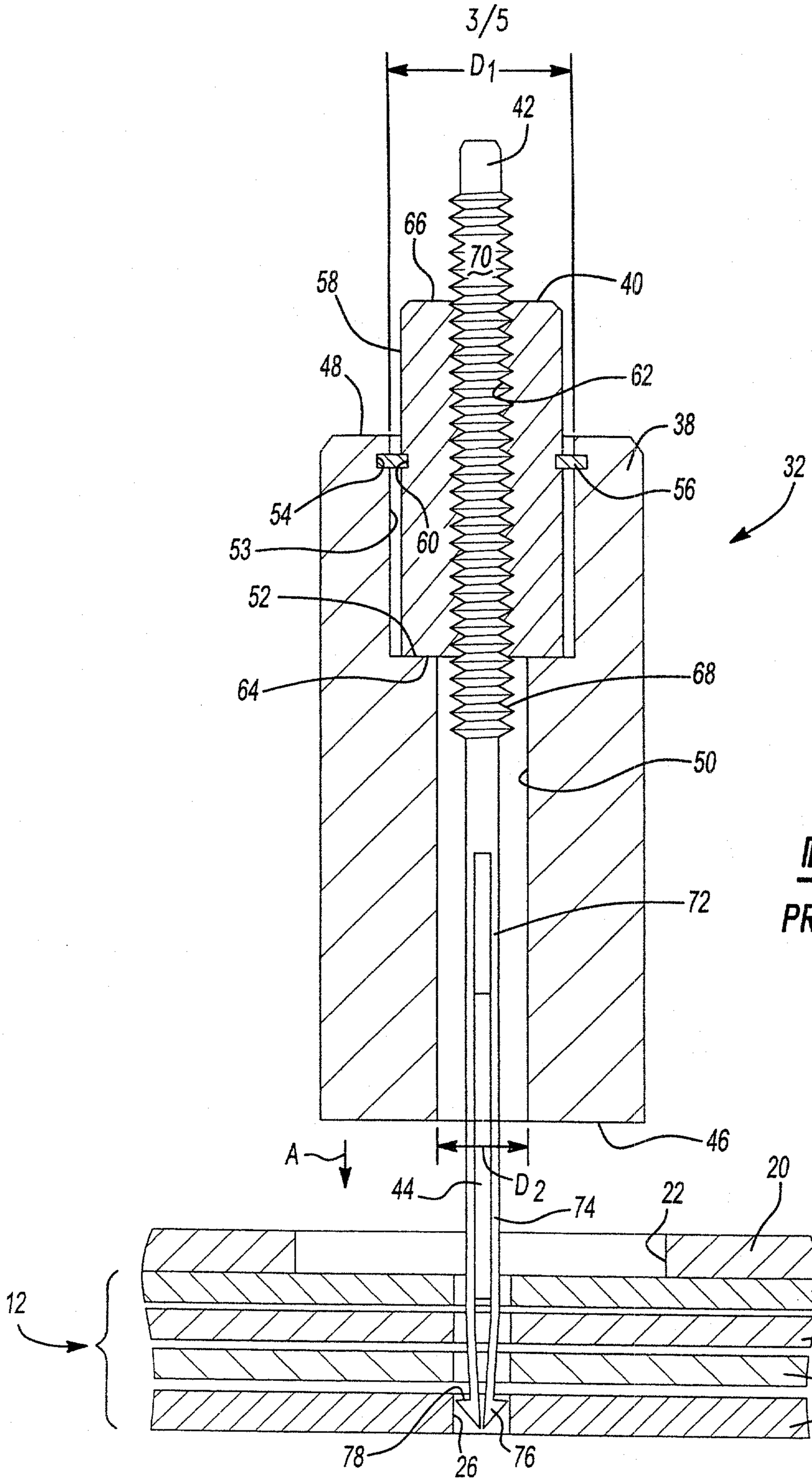


Fig-3
PRIOR ART

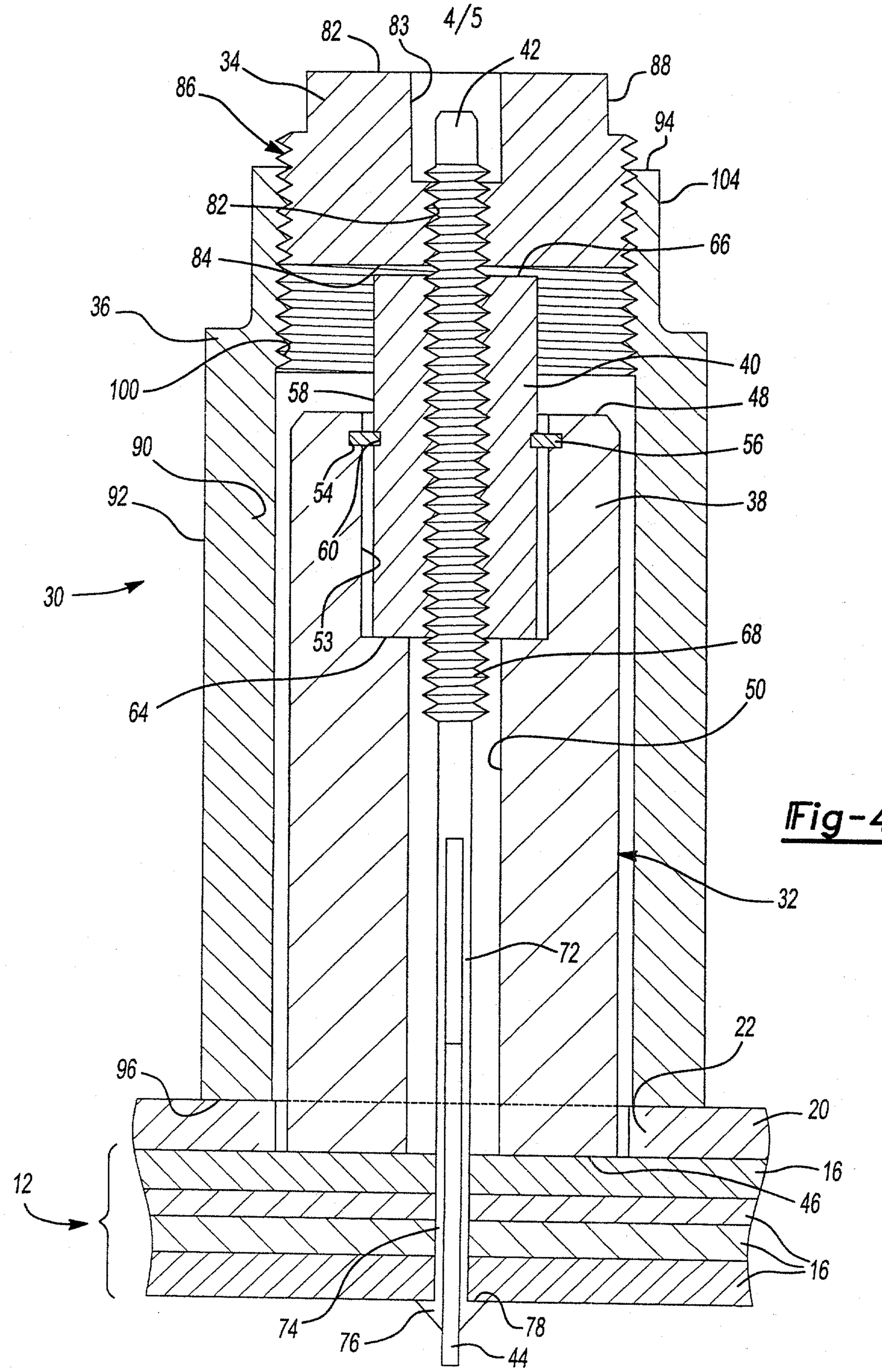

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Fig-4

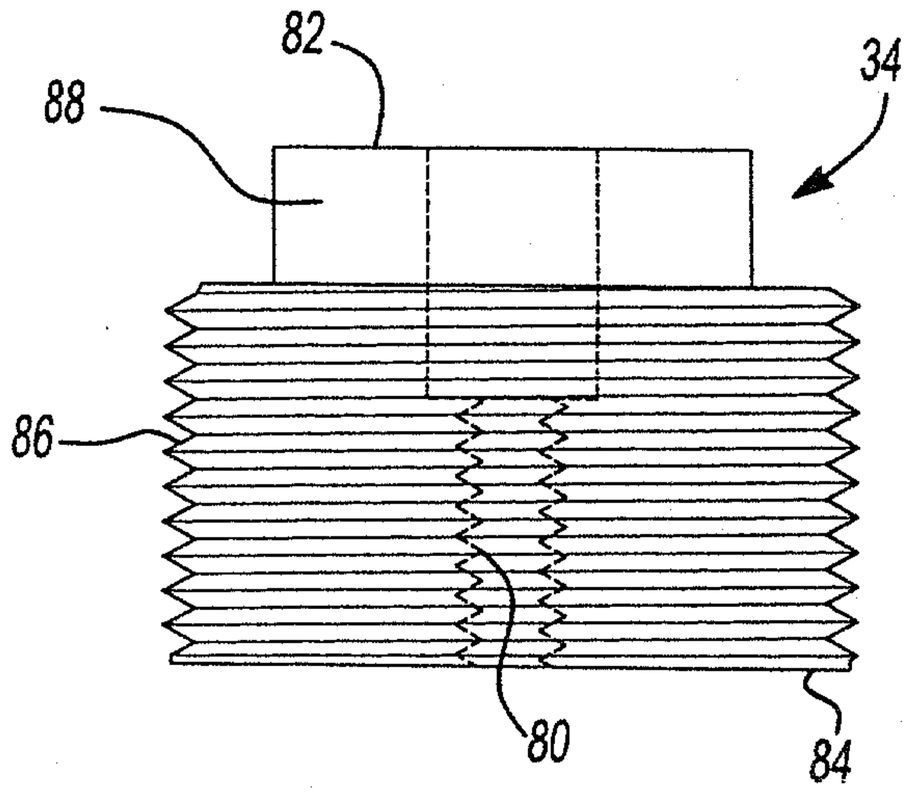


Fig-7

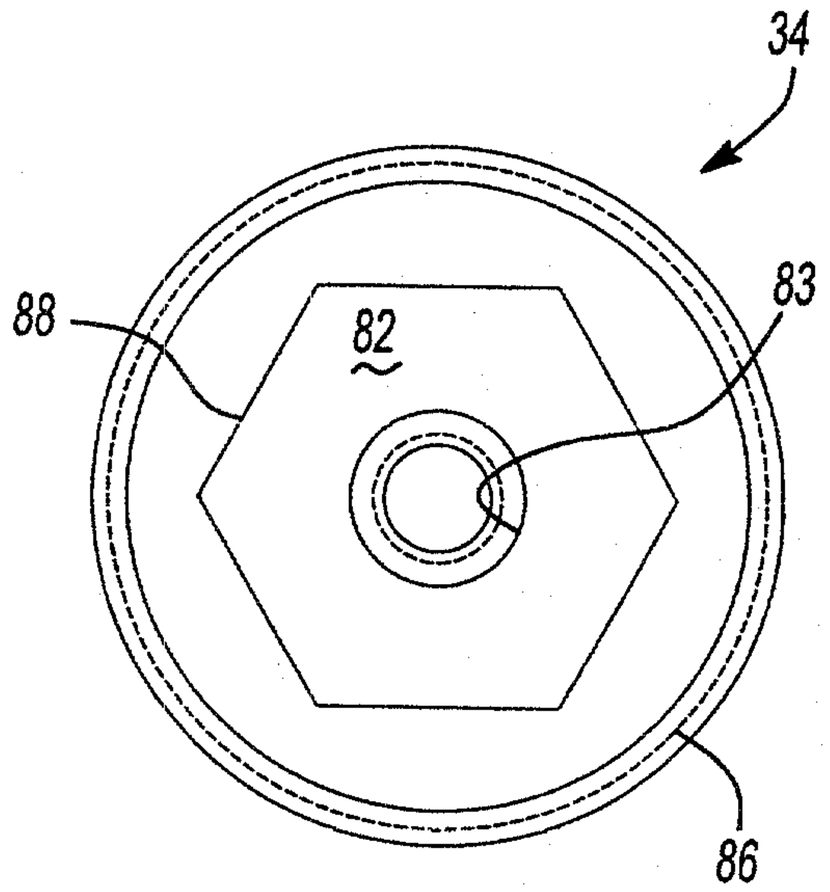


Fig-8

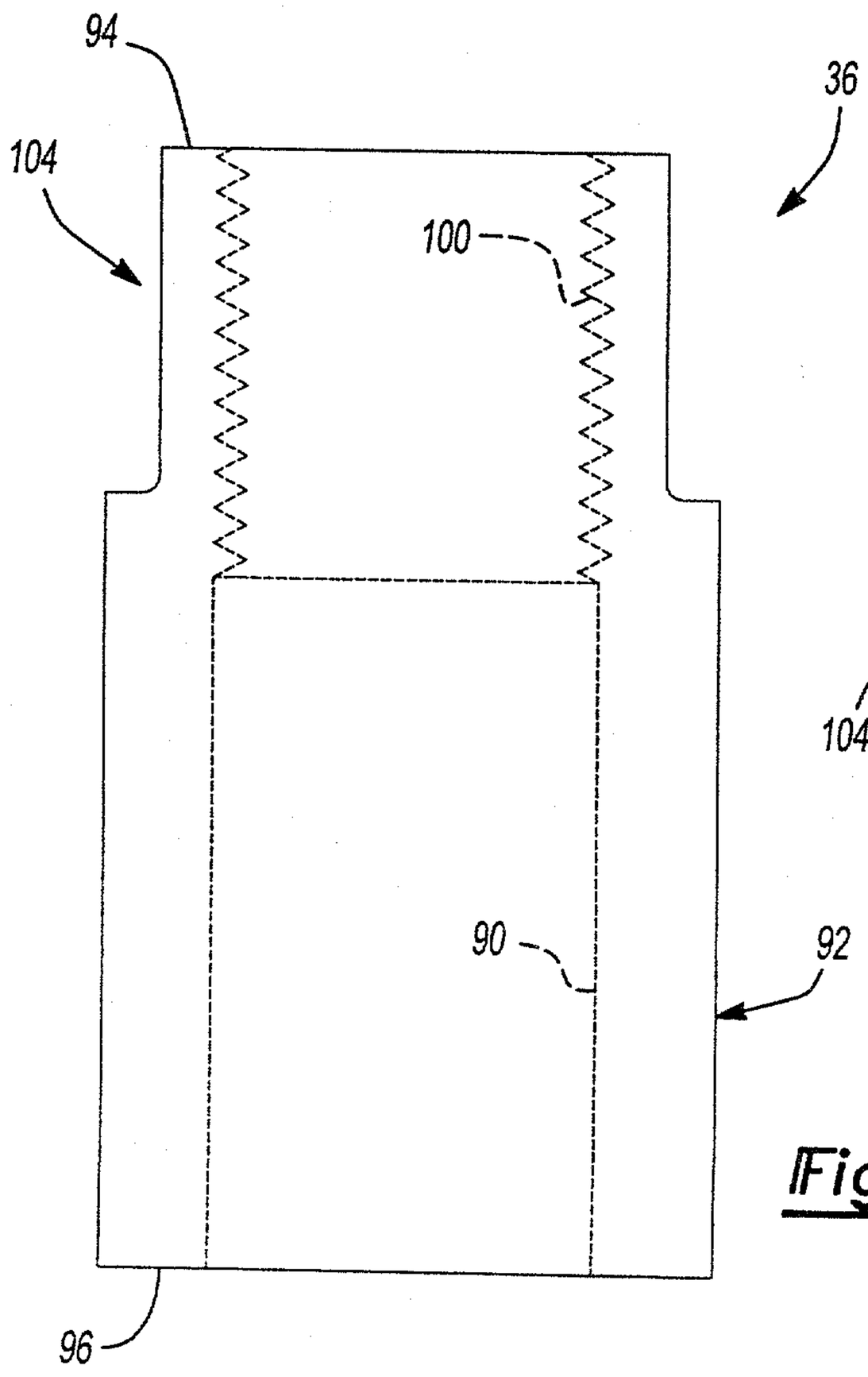


Fig-9

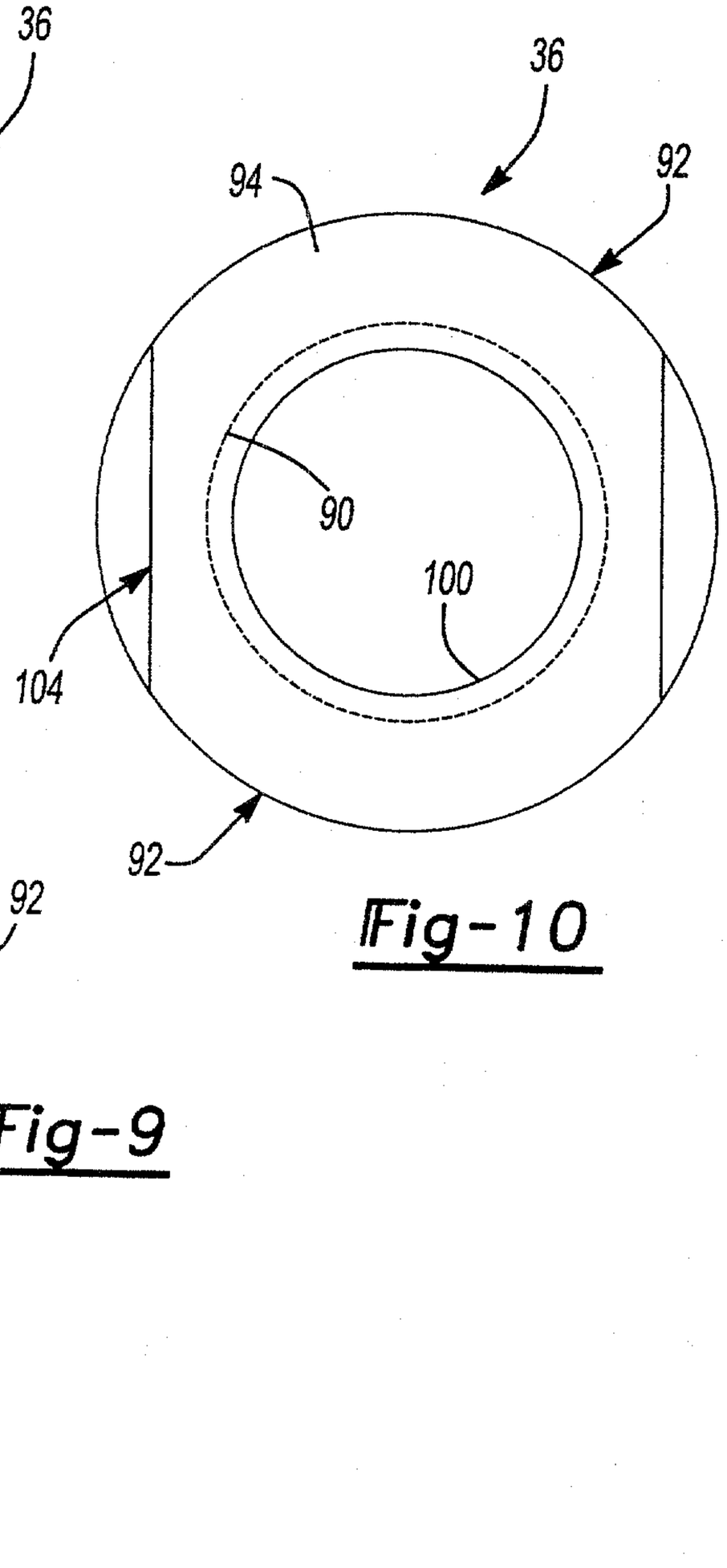
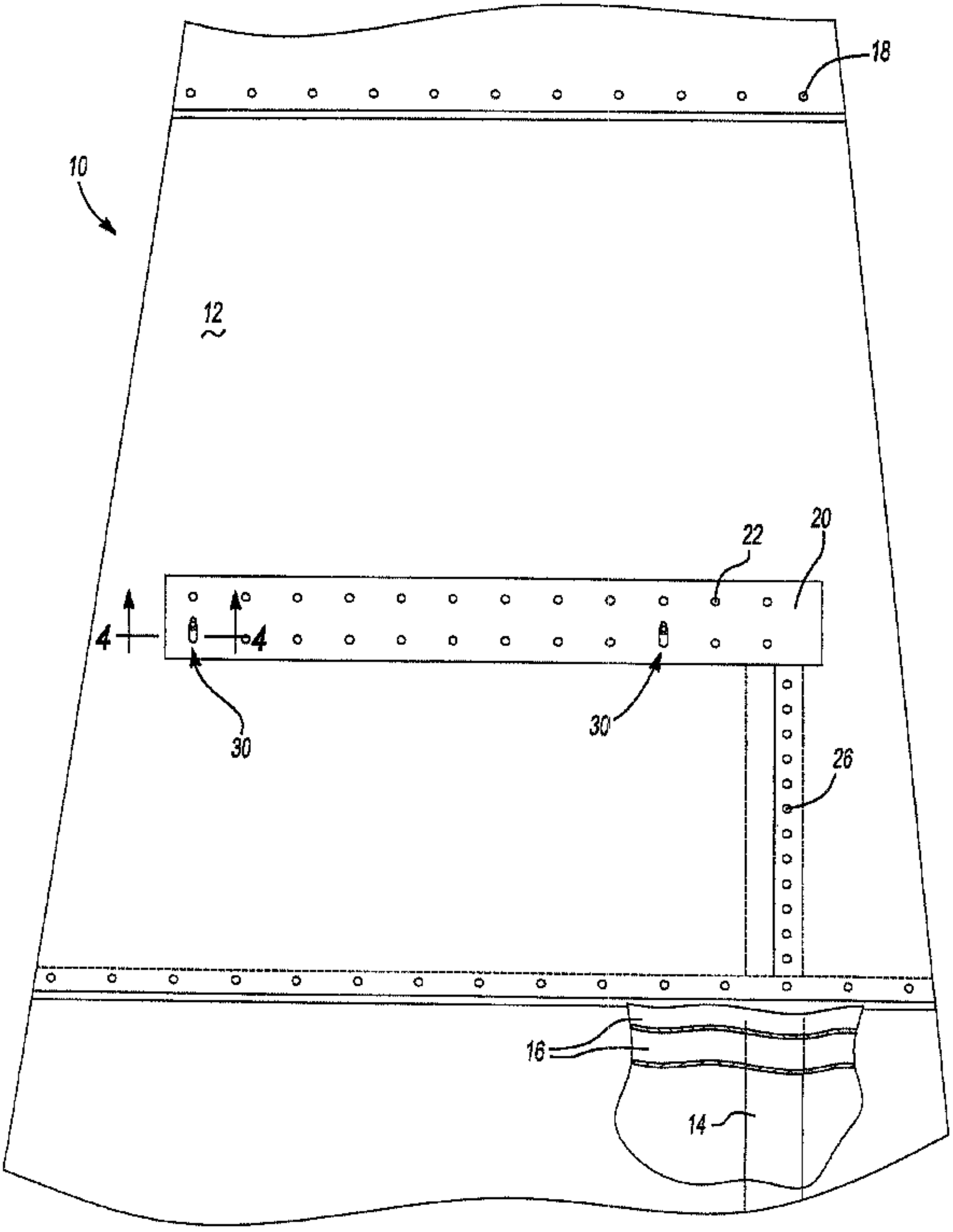


Fig-10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