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

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2638995 C 2014/07/15

(11)(21) 2 638 995

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2008/08/20

(41) Mise à la disp. pub./Open to Public Insp.: 2010/02/20

(45) Date de délivrance/Issue Date: 2014/07/15

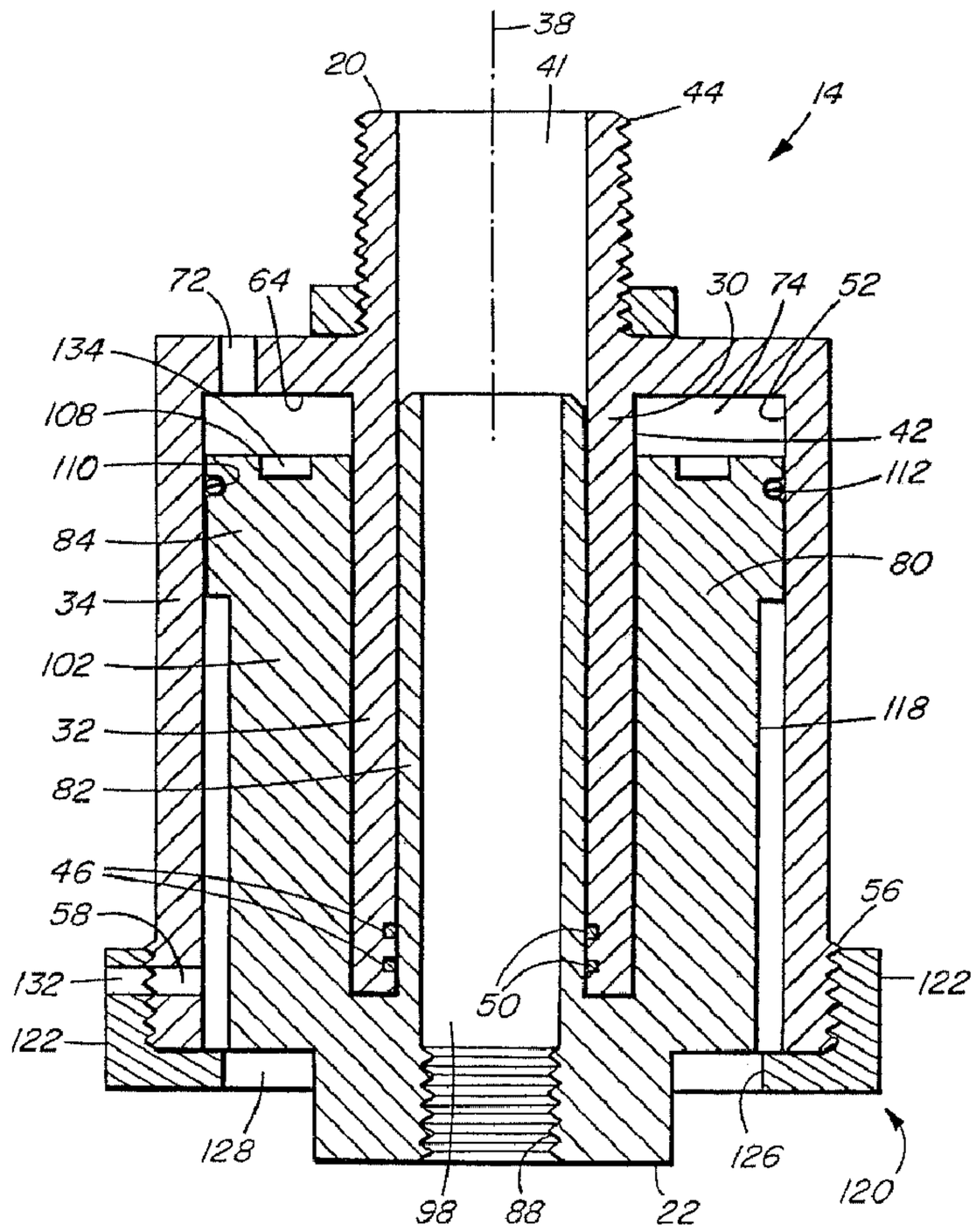
(51) Cl.Int./Int.Cl. *F16L 27/12* (2006.01),
B05B 3/00 (2006.01)

(72) Inventeurs/Inventors:
STEWART, DONALD GEORGE, CA;
VANDEKERCKHOVE, GEORDIE WAYNE, CA

(73) Propriétaire/Owner:
STEWART, DONALD GEORGE, CA

(74) Agent: SMART & BIGGAR

(54) Titre : COLONNE REGLABLE POUR TETE D'ARROSEUR AVEC REGION D'AMORTISSEMENT
(54) Title: ADJUSTABLE SPRINKLER HEAD RISER WITH CUSHIONING REGION



(57) Abrégé/Abstract:
An apparatus for changing a length of a pipe, the pipe including first and second pipe portions each having an interior, includes a cylinder having a first end wall and an open end, the cylinder being connectable to the first pipe portion. The apparatus also

CA 2638995 C 2014/07/15

(11)(21) 2 638 995

(13) C

(57) Abrégé(suite)/Abstract(continued):
includes a piston having a second end wall, the piston being receivable in slidable and sealable engagement with the cylinder, the piston being connectable to the second pipe portion, wherein the cylinder and the second end wall define a chamber physically isolated from the interiors of the first and second pipe portions, the chamber being adapted to receive a control fluid for displacing the piston relative to the cylinder to vary a distance between the first and second pipe portions while permitting fluid communication between the first and second pipe portions, the chamber including a cushioning region in communication with the chamber.

ABSTRACT

An apparatus for changing a length of a pipe, the pipe including first and second pipe portions each having an interior, includes a cylinder having a first end wall and an open end, the cylinder being connectable to the first pipe portion. The apparatus also includes a piston having a second end wall, the piston being receivable in slidable and sealable engagement with the cylinder, the piston being connectable to the second pipe portion, wherein the cylinder and the second end wall define a chamber physically isolated from the interiors of the first and second pipe portions, the chamber being adapted to receive a control fluid for displacing the piston relative to the cylinder to vary a distance between the first and second pipe portions while permitting fluid communication between the first and second pipe portions, the chamber including a cushioning region in communication with the chamber.

ADJUSTABLE SPRINKLER HEAD RISER WITH CUSHIONING REGION

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates generally to adjusting the length of a pipe, and more particularly, to an apparatus for adjusting the height of a sprinkler head riser.

2. Description of Related Art

In golf courses, lawns, and other grass covered areas, frequent watering is required to maintain the area in an esthetically pleasing and healthy condition. It is well known in the art that a network of distributed pipes and sprinkler head attachments may be provided underneath the surface of the ground to provide the required watering. Such an underground system is not visible when not in use, and does not require set up for each watering, but merely requires activation.

In the field of golf course design, in-ground sprinkler heads and their associated network of piping are common. The use of in-ground sprinkler systems in golf courses, however, presents unique design requirements due to the nature of the game of golf which is played around such sprinkler heads.

For example, the top surface of the sprinkler head should preferably be as level with the surrounding ground as possible. Should the sprinkler head extend above the surface of the surrounding ground, it may pose a hindrance or obstruction to any golf ball which may come into contact or close proximity to the sprinkler head. Conversely, should the sprinkler head be at a position below the surface of the surrounding ground, the sprinkler head may create a depression in the playing surface of the golf course with the result that golf balls tend to roll into such a depression. Therefore, should the top surface of the sprinkler head assembly not be flush with the surrounding ground, the sprinkler may serve to reduce the enjoyment of the golf players, due to the above-mentioned hindrances, thereby reducing the desirability of the course.

Also, a frequent activity of golf course maintenance is to distribute sand or other soil material across the top surface of the golf course. This addition of soil to the golf course may serve to reduce the height of the top surface of the sprinkler head relative to the surrounding ground as the additional soil is added. Therefore, it is frequently necessary to increase the height of the sprinkler head relative to the distribution piping network so as to maintain the top surface of the sprinkler head flush with the surrounding ground. In some arrangements, this activity may require excavation of the sprinklers so as to adjust the height of the sprinkler head relative to the water supply lines. This is commonly accomplished by adjusting the angle of a conventional swing joint. It will be appreciated that such an activity of excavating and adjusting the height of each individual sprinkler head on a golf course is a time consuming and expensive activity. This periodic excavation of the sprinkler heads, also serves to render the immediate vicinity around the sprinkler head unplayable for a certain period of time while the necessary adjustments are being made.

In addition, any grassy surface such as a golf course is required to be cut periodically through the use of a mower. On a property such as a golf course, such a mower may be a large piece of equipment having a substantial weight. During the process of mowing the golf course, the wheels of such a mower may ride over top of a sprinkler in the ground. This will transfer the large weight of mower to the sprinkler head and any equipment under it for a short period of time. The weight from mowers, or from other equipment or other heavy objects, may cause damage (such as a crack or another source of a leak, for example) to the sprinkler head, or to a pipe for supplying water to the sprinkler head. This damage may require repair, and may cause water to leak and be wasted. Also, leaking water may cause damage to surrounding terrain.

Many previous arrangements require the sprinkler head riser assembly to be excavated to access the adjusting means which is buried. In addition, many previous attempts have relied upon threading or ridges between a pair of telescoping bodies to adjust a height of a sprinkler head. These attempts have

relied on a fixed structure to extend the riser assembly and resist the compressive forces of the mower. Disadvantageously, such mechanisms may become damaged and jammed should the applied weight of the mower become too great. In addition, such mechanisms have a tendency to become jammed by the inclusion of dirt and other contaminants.

Other previous attempts have relied upon a biasing element securing a connection between two telescoping members. These mechanisms rely on a frictional or non-returning engagement between the biasing element and the telescoping members to secure relative position between them. These mechanisms have the disadvantage of not enabling the height of the sprinkler head to return to a set position after been forcibly compressed, for example, by the weight of a mower.

SUMMARY OF THE INVENTION

In accordance with one aspect, there is provided an apparatus for changing a length of a pipe, the pipe including first and second pipe portions each having an interior. The apparatus includes a cylinder having a first end wall and an open end, the cylinder being connectable to the first pipe portion. The apparatus also includes a piston having a second end wall, the piston being receivable in slidable and sealable engagement with the cylinder, the piston being connectable to the second pipe portion, wherein the cylinder and the second end wall define a chamber physically isolated from the interiors of the first and second pipe portions, the chamber being adapted to receive a control fluid for displacing the piston relative to the cylinder to vary a distance between the first and second pipe portions while permitting fluid communication between the first and second pipe portions, the chamber including a cushioning region in communication with the chamber.

The cushioning region may include at least one groove formed in at least one wall of the chamber to increase the volume of the chamber.

The cushioning region may include an annular recess in the second end wall.

In accordance with another aspect, there is provided a sprinkler head riser apparatus for an in-ground sprinkler system. The apparatus includes an extendible pipe including first and second pipe portions each having an interior. The apparatus further includes a sprinkler head assembly attached to the extendible pipe, a cylinder having an end wall and an open end, the cylinder being connected to the first pipe portion, and a piston having an end wall. The piston is receivable in slidable and sealable engagement with the cylinder, and the piston is connected to the second pipe portion. The cylinder and the piston end wall define a first chamber fluidly isolated from the interiors of the first and second pipe portions. The first chamber is adapted to receive a first control fluid for displacing the piston relative to the cylinder to vary a distance separating an end of the first pipe portion and an end of the second pipe portion while permitting fluid communication between the first and second pipe portions. The first chamber includes a cushioning region in communication with the first chamber.

The cushioning region may include at least one groove formed in at least one wall of the first chamber to increase the volume of the first chamber.

The cushioning region may include an annular recess in the piston end wall.

The cushioning region may include a cavity formed in at least one wall of the first chamber to increase the volume of the first chamber.

The first chamber may have an annular shape disposed around the first pipe portion.

The first pipe portion may define an interior wall of the first chamber. The piston may be in slidable and sealable engagement with the first pipe portion.

The cylinder may further include a first inlet port operable to receive a first supply line to supply the first control fluid to the first chamber.

The sprinkler head riser apparatus may be buried.

The apparatus may further include a guard ring adapted to slidably enclose the open end of the cylinder around the piston.

The guard ring, the piston, and the cylinder may define a second chamber adapted to receive a second control fluid for displacing the piston relative to the cylinder to vary the distance between the end of the first pipe portion and the end of the second pipe portion.

The guard ring may further include a second inlet port operable to receive a second supply line to supply the second control fluid to the second chamber.

The apparatus may further include a spring operably configured for urging the guard ring in a direction relative to the piston portion.

The first pipe portion may be in slidable and sealable engagement with the second pipe portion.

The first pipe portion may be slidably and sealably received within the second pipe portion.

The second pipe portion may be slidably and sealably received within the first pipe portion.

The first pipe portion may further include the sprinkler head assembly disposed at a free end of the first pipe portion.

The apparatus may further include a plurality of the cylinders and corresponding pistons adjacent to the first and second pipe portions.

The first chamber may be adapted to receive the first control fluid to displace the piston relative to the cylinder to increase the distance between the end of the first pipe portion and the end of the second pipe portion.

The apparatus may further include a swing joint in fluid communication with the extendible pipe for adjusting a position of the apparatus.

The sprinkler head assembly may include a top surface and a sprinkler movable relative to the top surface.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

Figure **1** is a side view of an in-ground sprinkler head installation according to a first embodiment of the invention.

Figure **2** is a cross-sectional view of a sprinkler head riser apparatus according to a first embodiment of the invention.

Figure **3** is a cross sectional view of the cylinder portion of the sprinkler head riser apparatus of Figure **2**.

Figure **4** is a cross sectional view of the piston portion of the sprinkler head riser apparatus of Figure **2**.

Figure **5** is a cross sectional view of the guard ring of the sprinkler head riser apparatus of Figure **2**.

Figure **6** is a cross-sectional view of a sprinkler head riser apparatus according to a second embodiment of the invention.

Figure **7** is a cross sectional view of the cylinder portion of the sprinkler head riser apparatus of Figure **6**.

Figure **8** is a cross sectional view of the piston portion of the sprinkler head riser apparatus of Figure **6**.

Figure **9** is a cross sectional view of the guard ring of the sprinkler head riser apparatus of Figure **6**.

Figure **10** is a cross-sectional view of a sprinkler head riser apparatus according to a third embodiment of the invention.

DETAILED DESCRIPTION

First Embodiment

Referring to Figure **1**, an in-ground sprinkler system including an adjustable sprinkler head riser assembly **14** according to a first embodiment of the present invention is shown generally at **10**. The in-ground sprinkler system comprises a sprinkler head assembly **12**, a sprinkler head riser assembly **14**, a swing joint **16** and a water supply pipe **18**. The sprinkler head assembly **12**, swing joint **16** and water supply pipe **18** are conventional in the art.

The swing joint **16** comprises a tubular body having first and second pivotable joints that enables the height of the sprinkler head to be adjusted during installation by pivoting the swing arm assembly about the pivot connected to the water supply main. The adjustable sprinkler head riser assembly **14** may be threadably attached to the swing joint **16**. The sprinkler head assembly **12** may be threadably attached to the sprinkler head riser assembly. Accordingly, the swing joint **16** and sprinkler head riser assembly **14** form a continuous water conduit path between the water supply pipe **18** and the sprinkler head assembly **12**.

In a conventional in-ground sprinkler system, the height of the sprinkler head may be adjusted at the time of installation by means of the swing joint **16**. According to the present invention, the height of the sprinkler head may additionally be adjusted after installation by means of the adjustable sprinkler head riser assembly **14**. It will be appreciated that although the current embodiment of the present invention includes a swing joint **16**, such an assembly may not be necessary and the sprinkler head riser assembly **14** may be connected directly to the water supply pipe **18**.

Referring to Figure **2**, a cross-sectional view of an assembled adjustable sprinkler head riser assembly **14** in accordance with the first embodiment of the invention is shown. The sprinkler head riser assembly **14** comprises a substantially elongate extendible tubular body having first and second

opposite ends **20** and **22** respectively. The sprinkler head riser assembly **14** comprises a cylinder portion **30**, a piston portion **80**, and a guard ring **120**.

Referring to Figure **3**, a detail cross-sectional view of the cylinder portion of the first embodiment is shown generally at **30**. The cylinder portion **30** is comprised of an elongated cylindrical first pipe portion **32** surrounded by an outer tubular shell **34**. An end wall **36** connects shell **34** to pipe portion **32**. The first pipe portion **32** comprises an elongated cylindrical body having an axis **38** and includes the first end **20** of the sprinkler head riser assembly **14**. The first pipe portion **32** also includes an outer surface **42**, an inner surface **40** forming a bore **41** therethrough, and external threading **44** at the first end **20**. It will be appreciated that although external threading **44** is shown in the attached figures, other methods also be used to connect the sprinkler head riser assembly **14** to the sprinkler head assembly **12**. Such alternative connection means may include but are not limited to, connecting the sprinkler head riser assembly to the sprinkler head assembly by means of glue, solder, or a compression fitting. In addition internal threading on the cylinder portion may connect to external threading on the sprinkler head assembly. The first pipe portion **32** may also include one or more internal grooves **46** in the inner surface **40** at a second end **48** each adapted to receive an O-ring **50**.

The shell **34** comprises an elongated cylindrical body co-axially aligned with the first pipe portion **32** about axis **38**. The shell **34** includes an inner surface **52** and an outer surface **54**. The outer surface **54** may include external threading **56** and a set screw hole **58**.

The end wall **36** comprises an annular disc having a substantially planar shape between first and second radii defining inner and outer edges **60** and **62**, respectively. End wall **36** may be perpendicular to the axis **38** and includes an inner surface **64** and an outer surface **66**. The end wall is connected at its inner edge to the first pipe portion **32** and at its outer edge to the shell **34**. The outer surface **42** of the pipe portion **32**, the inner surface **52** of the shell **34** and the inner surface **64** of the end wall **36** define an annular

cavity **68** having an open lower end **70**. The end wall **36** may also include a bore **72** therethrough so as to permit the introduction of a control fluid into the cavity **68**. The bore **72** may be threaded to accept a correspondingly threaded first fluid control supply tube (**140** in Figure **1**).

Referring to Figure **4**, a cross-sectional view of the piston portion **80** of the first embodiment is shown. The piston body comprises a second pipe portion **82** surrounded by an annular piston **84**. The second pipe portion **82** comprises an elongate tubular body having a free first end **86**. The opposite end of the second pipe portion merges with the piston **84** to define the second end **22** of the sprinkler head riser assembly **14**. The second pipe portion **82** includes an outer surface **94** and an inner surface **96** defining a bore **98** therethrough. Bore **98** adjacent second end **22** may include internal threading **88**. It will be appreciated that although internal threading **88** is shown in the attached figures, other methods may also be used to connect the sprinkler head riser assembly to the swing joint **16** or water supply pipe **18**. Such alternative connection means may include but are not limited to, connecting the sprinkler head riser assembly to the sprinkler head assembly by means of glue, solder, or a compression fitting. In addition external threading on the piston portion may connect to internal threading on the sprinkler head assembly.

The piston **84** comprises a piston head **100** and a connecting portion **102**. The piston head **100** comprises an annular body aligned with axis **38**. The piston head **100** has an annular outer surface **104**, an annular inner surface **106**, and a generally disk-shaped end surface **108**. The outer surface **104** may include a circular groove **110** adapted to receive an outer O-ring **112**. The piston head **100** is connected to the second end **22** by piston connecting portion **102**. Piston connecting portion **102** consists of an elongated tubular body extending between the piston head **100** and the second end **22**. Piston connecting portion **102** also includes an outer cylindrical surface **118** having a central axis co-axial with axis **38**. Preferably, the end surface **108** is not flat, but rather defines at least one recess and/or at least one projection, for

defining a cushioning region. In the illustrated embodiment, the end surface **108** defines an annular recess **134** (which may also be termed an "annular groove").

Referring to Figure **5**, a cross-sectional view of the guard ring **120** of the first embodiment is shown. The guard ring **120** comprises an annular ring **122** having an axis common with axis **38**, and an internal lower flange **124**. The internal flange has an inner edge **126** which defines an opening **128**. The opening **128** has a radius matched to the radius of the outer cylindrical surface **118** of the piston connecting portion **102**. The guard ring **120** also includes internal threading **130** operable to engage the threading **56** on the cylinder body, and a set screw hole **132**.

As shown in Figure **2**, piston portion **80** is received within cylinder portion **30** such that the piston **84** is received in slidable and sealable engagement within the cavity **68**, and the second pipe portion **82** is received within the first pipe portion **32**. All parts are co-axially aligned with common axis **38**. The piston **84** is received within the cavity **68** such that outer surface **104** slidably engages with inner surface **52** of the shell **34** and the inner surface **106** slidably engages with outer surface **42** of the first pipe portion **32**. O-ring **112** preferably serves to seal the connection between the piston and the cylinder. As assembled in this manner, a first sealed control chamber **74** is formed between the cylinder and the piston head **100**. Specifically, inner surface **52** of shell **34**, outer surface **42** of the first pipe portion **32**, inner surface **64** of end wall **36**, and end surface **108** of the piston head **100** form the first sealed control chamber **74**. The first sealed control chamber **74** has a volume, which changes as the piston **84** is displaced within the cylinder along axis **38**.

Guard ring **120** may then be secured to the external threading **56** on the shell **34** so as to enclose the bottom end of the cylinder. When the guard ring **120** is secured to the shell, the opening **128** of the guard ring may closely engage upon the outer cylindrical surface **118** of the piston connecting portion **102** so as to prevent the fouling of the riser apparatus by its surrounding soil, water

and other contaminants. The guard ring **120** may also be secured to the shell by means of a set screw being passed through set screw hole **132** of the guard ring and set screw hole **58** of the shell. In addition, it will be appreciated that set screw hole **58** or an additional hole in the shell may be used as a relief port to the cylinder when the sprinkler head riser assembly is extended. The set screw hole may be contained within the guard ring **120** or may optionally include an expellable plug that may be displaced under a predetermined pressure in the cylinder so as to relieve the pressure in the cylinder.

It will be appreciated that the cylinder and piston arrangement as described above is not necessarily limited to an annular arrangement. Other cylinder and piston arrangements may be used in addition to those specifically discussed above to achieve the same result. Specifically, the cylinder and piston may have a circular shape and be disposed adjacent to the first and second pipe portions **32** and **82** respectively. In such an arrangement, the adjacent cylinder may be connected to the first pipe portion **32** and the enclosed piston connected to the second pipe portion **82**. In addition, the apparatus may comprise a plurality of cylinders and associated pistons disposed around the first and second pipe portions. Such a plurality of cylinders and pistons may be arranged in an irregular or regular-radial peripheral array pattern around the first and second pipe portions **32** and **82** respectively. It will also be appreciated that in other embodiments, the first and second pipe portions **32** and **82** respectively need not be in axial alignment.

The sprinkler head riser assembly **14** according to the first embodiment may be installed as part of an underground sprinkler system as shown in Figure **1**. The underground sprinkler system may comprise a water supply pipe **18**, a swing joint **16**, and a sprinkler head assembly **12**. Water is supplied to the system by the water supply pipe **18**. This water is passed through the swing joint **16** and into the bore **98** at the second end **22** of the sprinkler head riser

assembly **14**. The water then passes through the bore **41** to the first end **20** and thereafter into the sprinkler head assembly **12**.

Referring to Figures **1** and **2**, a first control fluid supply tube **140** may be connected to the bore **72** in the sprinkler head riser apparatus. The first control fluid supply tube **140** comprises an elongated tube connectable to bore **72** to communicate the first sealed control chamber **74** with a control fluid source. The first control fluid supply tube includes a free end **144** disposed adjacent to the top surface **146** of the sprinkler head. The first control fluid supply tube may be free floating or secured to the sprinkler head assembly for the majority of its length. The first control fluid supply tube may also be incorporated into the sprinkler head assembly.

In operation, a user may connect a fluid source and pump (not shown) to the free end **144** of the first control fluid supply tube **140** as shown in Figure **1**. The pump is operable to supply a control fluid under pressure to the first control fluid supply tube **140**. The first control fluid supply tube **140** then supplies the fluid through its second end **142** which is connected to the bore **72** in the sprinkler head riser assembly.

In such a manner, the user may increase or decrease the amount of control fluid in the first sealed control chamber **74**. Varying the amount of control fluid within the first sealed control chamber **74** will serve to displace the piston **84** relative to the cylinder **30**. As the piston **84** is displaced relative to the cylinder **30**, the distance between the first and second ends **20** and **22**, respectively, of the sprinkler head riser assembly **14** is varied.

The control fluid may include but is not limited to hydraulic fluid, water or any other suitable fluid. It will be preferable to use a control fluid that is an environmentally safe, viscous fluid. Examples of such fluids may include vegetable and grain based oils and greases as well as environmentally safe anti-freeze solutions. In addition, water may be used as a control fluid in locations where there is no risk of freezing.

Alternatively, a compressible control fluid, such as air, for example, may be desirable so that forces exerted on the top surface **146** of the sprinkler head by a mower wheel, or by any other heavy object, may be absorbed by compression of the compressible control fluid in the first sealed control chamber **74**. It will be appreciated that the control fluid in the first sealed control chamber **74** may also include a combination of fluids, such as air and water, for example.

Accordingly, the height of the top surface **146** of the sprinkler head assembly may be adjusted relative to the water supply pipe **18** from which it is supplied. In this way, the user may adjust the height of the sprinkler head relative to the surrounding ground to account for changes in settling soil as well as the addition of additional soil over time to maintain the top surface **146** of the sprinkler head at a desired height.

When force exerted by a mower wheel, or by any other heavy object, is absorbed by compression of a compressible control fluid in the first sealed control chamber **74**, a resulting transmitted force exerted by the adjustable sprinkler head riser assembly **14** on the water supply pipe **18** may be reduced or eliminated, and thus risk of damage to the water supply pipe **18** from mower wheels or other heavy objects may advantageously be reduced. Furthermore, when force is absorbed by compression of the control fluid in the first sealed control chamber **74**, the swing joint **16** may not be required to absorb such forces. Instead, the adjustable sprinkler head riser assembly **14** may be coupled directly to the water supply pipe **18**, for example, which may advantageously reduce cost of the system **10**.

Preferably, the control fluid that is introduced into the first sealed control chamber **74** can enter a cushioning region that is defined by the end surface **108** and in communication with the first sealed control chamber **74**, such as the annular recess **134**, for example. Therefore, when the control fluid in the first sealed control chamber **74** includes a compressible control fluid, and

when a mower wheel or another heavy object exerts a force on the top surface **146** of the sprinkler head, for example, the annular recess **134** (or any other cushioning region that is defined by the end surface **108**) may receive a portion of the control fluid in the first sealed control chamber **74**. Thus, the annular recess **134** may advantageously enable a greater absorption of a force that is exerted on the top surface **146** of the sprinkler head by a mower wheel, or by any other heavy object, for example.

It will be appreciated that the end surface **108** may define a cushioning region other than the annular recess **134**, and may also define a plurality of cushioning regions. For example, the end surface **108** may define one or more bores, grooves, channels, and/or other cavities of various configurations. Alternatively, the end surface **108** may define one or more projections to define a cushioning region when the one or more projections abut a portion of the inner surface **64**. More generally, any non-flat end surface **108** may define one or more cushioning regions for receiving control fluid in the first sealed control chamber **74**, to enable a greater absorption of a force exerted on the top surface **146** of the sprinkler head by the control fluid. Furthermore, in alternative embodiments, a cushioning region may additionally or alternatively be defined elsewhere in the first sealed control chamber **74**, such as by the inner surface **64**, for example.

It will further be appreciated that although as described above, the sprinkler head riser assembly **14** and the sprinkler head assembly **12** are described as separate components, the sprinkler head riser apparatus may be formed including the sprinkler head assembly. According to such an embodiment, the sprinkler head will be formed as continuous with the first pipe portion. In such an alternative embodiment, the fluid may be supplied to the first sealed control chamber **74** through a supply tube internal to the sprinkler head. In some such alternative embodiments the end wall **36** may be disposed close to the surface of the sprinkler head and therefore the fluid source and pump may be connected directly to the bore **72**.

Second Embodiment

Referring to Figure **6**, a cross-sectional view of an assembled adjustable sprinkler head riser apparatus in accordance with a second embodiment of the invention is shown generally at **200**. The sprinkler head riser apparatus **200** includes a cylinder portion **210**, a piston portion **240**, and a guard ring **280**.

Referring to Figure **7**, a detail cross-sectional view of the cylinder portion of the second embodiment is shown generally at **210**. The cylinder portion **210** includes an elongated cylindrical first pipe portion **212** surrounded by an outer tubular shell **218**. An end wall **220** connects the outer tubular shell **218** to the first pipe portion **212**. The first pipe portion **212** includes an outer surface **214** and an inner surface **216**, defining a bore **217** therethrough. The first pipe portion **212** also includes external threading **222** operably configured for coupling the cylinder portion **210** to the sprinkler head assembly **12** (Figure **1**). However, it will be appreciated that other methods, such as glue, solder, a compression fitting, or internal threading, may be used for coupling the cylinder portion **210** to the sprinkler head assembly **12**.

The first pipe portion **212** includes one or more grooves **224** in the outer surface **214**, each operably configured to receive an O-ring **226**. It has been found that in some manufacturing processes, it is easier to create the grooves **224** in the outer surface **214** of the first pipe portion **212** than it is to create internal grooves **46** in the inner surface **40** of the first pipe portion **32** of the first embodiment. It has also been found that in some manufacturing processes, it is easier to create the grooves **224** in the outer surface **214** of the first pipe portion **212** if the grooves **224** are made on a portion of the first pipe portion **212** that extends farther from the end wall **220** than the outer tubular shell **218**, as shown in Figure **7**.

The outer tubular shell **218** includes an elongated cylindrical body having an inner surface **228**, an outer surface **230**, and external threading **232**. In the second embodiment, the outer tubular shell **218** does not include a set screw

hole **58**. The end wall **220** includes an inner surface **221** and a bore **236**, and is substantially similar to the end wall **36** of the first embodiment. The outer surface **214** of the first pipe portion **212**, the inner surface **228** of the outer tubular shell **218**, and the inner surface **221** of the end wall **220** define a cavity **234**.

Referring to Figure **8**, a cross-sectional view of the piston portion of the second embodiment is shown generally at **240**. The piston portion **240** includes a second pipe portion **242** coupled to an annular piston **250**. The second pipe portion **240** includes an inner surface **244** defining a bore **248** therethrough. The inner surface **244** includes internal threading **246** operably configured for coupling the piston portion **240** to the swing joint **16** or to the water supply pipe **18** (Figure **1**). It will be appreciated that other methods, such as glue, solder, a compression fitting, or external threading, may be used for coupling the piston portion **240** to the swing joint **16** or to the water supply pipe **18**.

In the second embodiment, the second pipe portion **242** does not extend substantially along the length of the annular piston **250**. It has been found that in some manufacturing processes, manufacturing the piston portion **240** is easier than manufacturing a piston portion wherein the second pipe portion extends substantially along the length of the annular piston.

In the second embodiment, the annular piston **250** includes an annular outer surface **251**, an annular inner surface **252**, and a piston head **254**. The piston head **254** includes an annular outer surface **256** and a generally disk-shaped end surface **258**. The outer surface **256** includes a circular groove **260** operably configured for receiving an outer O-ring **262**, and the inner surface **252** includes a circular groove **264** operably configured for receiving an inner O-ring **266**. However, in other embodiments, the circular grooves **260** and **264** and the O-rings **262** and **266** may be omitted. In particular, the circular groove **264** and the O-ring **266** may be omitted because sealing between the outer

surface **214** and the annular inner surface **252** is provided by the O-ring **226** described above.

Preferably, the end surface **258** is not flat, but rather defines at least one recess and/or at least one projection, for defining a cushioning region, as described above with respect to the end surface **108** of the first embodiment. In the illustrated embodiment, the end surface **258** defines an annular recess **299** (which may also be termed an "annular groove"), but the annular recess or groove **299** is illustrated by way of example only. As described above with respect to the end surface **108** of the first embodiment, any non-flat end surface **258**, or any other surface defining the first fluid chamber **297** shown in Figure **6**, may define one or more cushioning regions for receiving control fluid.

Referring to Figure **9**, a cross-sectional view of the guard ring of the second embodiment is shown generally at **280**. The guard ring **280** includes an annular ring **282**, and an internal lower flange **284**. The internal lower flange **284** has an inner edge **286** that defines an opening **288** having a suitable radius for the annular piston **250** (Figure **8**) to pass therethrough such that the annular outer surface **251** may be in slidable and sealable engagement with the inner edge **286**. The inner edge **286** includes a circular groove **290** operably configured for receiving an O-ring **292**. The guard ring **280** also includes internal threading **294** operably configured for engaging the external threading **232** of the cylinder portion **210** (Figure **7**), but it will be appreciated that other methods, such as glue or solder, may be used for coupling the cylinder portion **210** to the guard ring **280**. In the second embodiment, the guard ring **280** does not include a set screw hole **132**. However, in the second embodiment, the guard ring **280** includes a bore **296** therethrough.

Referring back to Figure **6**, the annular piston **250** of the piston portion **240** is received within the cavity **234** of the cylinder portion **210** such that the outer O-ring **262** and the annular outer surface **256** of the piston head **254** are in slidable and sealable engagement with the inner surface **228** of the outer

tubular shell **218**, and the inner O-ring **266** and the annular inner surface **252** of the annular piston **250** are in slidable and sealable engagement with the O-ring **226** and the outer surface **214** of the first pipe portion **212**. Thus, a first sealed control fluid chamber **297** is formed between the piston head **254** and the end wall **220**, and the bores **217** and **248** form a continuous sealed water passage through the sprinkler head riser apparatus **200**. The guard ring **280** may be coupled to the cylinder portion **210** such that the annular outer surface **251** of the annular piston **250** is in slidable and sealable engagement with the O-ring **292** and the inner edge **286** of the internal lower flange **284** of the guard ring **280**. Although the first and second pipe portions **212** and **242** respectively are shown in axial alignment, it will be appreciated that the first and second pipe portions need not be in axial alignment.

The result of this assembly, and the operation of the sprinkler head riser apparatus **200**, are substantially as described above with reference to the first embodiment. However, in the second embodiment, the annular piston **250**, the outer tubular shell **218**, and the guard ring **280** define a second sealed control fluid chamber **298**. A second fluid control supply tube (not shown) may be coupled to the bore **296**, so that a user may supply a control fluid under pressure to the second sealed control fluid chamber **298**. Thus, in the second embodiment, a user may supply a control fluid under pressure independently through the bores **236** and **296** to "double acting" control fluid chambers **297** and **298** respectively, thereby exerting complementary forces on the piston portion **240** relative to the cylinder portion **210**.

<u>Third Embodiment</u>

Referring to Figure **10**, a sprinkler head riser apparatus in accordance with a third embodiment of the invention is shown generally at **300**. The sprinkler head riser apparatus **300** includes a cylinder portion **302**, a piston portion **304**, and a guard ring **310**. The piston portion **304** includes a piston head **306**, and the piston head **306** includes a disk-shaped lower surface **308**. The guard ring **310** includes an internal lower flange **312**. The sprinkler head riser apparatus **300** includes the elements of the first embodiment or the second embodiment,

and further includes a spring **314** for urging the annular lower surface **308** away from the internal lower flange **312**. The spring **314** may advantageously resist a potential tendency for water pressure in the sealed water passage to urge the annular lower surface **308** towards the internal lower flange **312**. However, in other embodiments, the spring **314** may urge the annular lower surface **308** towards the internal lower flange **312**.

Preferably, the piston head **306** has an end surface **316** that is not flat, but rather defines at least one recess and/or at least one projection, for defining a cushioning region, as described above with respect to the end surface **108** of the first embodiment. In the illustrated embodiment, the end surface **316** defines an annular recess **318** (which may also be termed an "annular groove"), but the annular recess or groove **318** is illustrated by way of example only. As described above with respect to the end surface **108** of the first embodiment, any non-flat end surface **316** or other surface may define one or more cushioning regions for receiving control fluid.

While specific embodiments of the invention have been described and illustrated, such embodiments should be considered illustrative of the invention only and not as limiting the invention as construed in accordance with the accompanying claims.

THE SUBJECT-MATTER OF THE INVENTION FOR WHICH AN EXCLUSIVE PRIVILEGE OR PROPERTY IS CLAIMED IS DEFINED AS FOLLOWS:

1. A sprinkler head riser apparatus for an in-ground sprinkler system, the apparatus comprising:

an extendible pipe comprising first and second pipe portions each having an interior;

a sprinkler head assembly attached to the extendible pipe;

a cylinder having an end wall and an open end, said cylinder being connected to the first pipe portion; and

a piston having an end wall, said piston being receivable in slidable and sealable engagement with said cylinder, said piston being connected to the second pipe portion, wherein said cylinder and said piston end wall define a first chamber fluidly isolated from the interiors of the first and second pipe portions, said first chamber being adapted to receive a first control fluid for displacing said piston relative to said cylinder to vary a distance separating an end of the first pipe portion and an end of the second pipe portion while permitting fluid communication between the first and second pipe portions, said first chamber comprising a cushioning region in communication with said first chamber.

2. The apparatus of claim **1**, wherein said cushioning region comprises at least one groove formed in at least one wall of the first chamber to increase the volume of the first chamber.

3. The apparatus of claim **1** or **2**, wherein said cushioning region comprises an annular recess in said piston end wall.

4. The apparatus of claim **1**, wherein said cushioning region comprises a cavity formed in at least one wall of the first chamber to increase the volume of the first chamber.

5. The apparatus of any one of claims **1** to **4**, wherein said first chamber has an annular shape disposed around the first pipe portion.

6. The apparatus of claim **5**, wherein the first pipe portion defines an interior wall of said first chamber, and wherein said piston is in slidable and sealable engagement with the first pipe portion.

7. The apparatus of any one of claims **1** to **6**, wherein said cylinder further includes a first inlet port operable to receive a first supply line to supply said first control fluid to said first chamber.

8. The apparatus of any one of claims **1** to **7**, wherein said sprinkler head riser apparatus is buried.

9. The apparatus of any one of claims **1** to **8**, further including a guard ring adapted to slidably enclose said open end of said cylinder around said piston.

10. The apparatus of claim **9**, wherein said guard ring, said piston, and said cylinder define a second chamber adapted to receive a second control fluid for displacing said piston relative to said cylinder to vary said distance between the end of said first pipe portion and the end of said second pipe portion.

11. The apparatus of claim **10**, wherein said guard ring further includes a second inlet port operable to receive a second supply line to supply said second control fluid to said second chamber.

12. The apparatus of claim **9**, **10**, or **11**, further comprising a spring operably configured for urging said guard ring in a direction relative to said piston portion.

13. The apparatus of any one of claims **1** to **12**, wherein the first pipe portion is in slidable and sealable engagement with the second pipe portion.

14. The apparatus of any one of claims **1** to **12**, wherein the first pipe portion is slidably and sealably received within the second pipe portion.

15. The apparatus of any one of claims **1** to **12**, wherein the second pipe portion is slidably and sealably received within the first pipe portion.

16. The apparatus of any one of claims **1** to **15**, wherein the first pipe portion further includes said sprinkler head assembly disposed at a free end of the first pipe portion.

17. The apparatus of any one of claims **1** to **16**, further comprising a plurality of said cylinders and corresponding pistons adjacent to said first and second pipe portions.

18. The apparatus of any one of claims **1** to **17**, wherein said first chamber is adapted to receive said first control fluid to displace said piston relative to said cylinder to increase said distance between said end of said first pipe portion and said end of said second pipe portion.

19. The apparatus of any one of claims **1** to **18**, further comprising a swing joint in fluid communication with the extendible pipe for adjusting a position of the apparatus.

20. The apparatus of any one of claims **1** to **19**, wherein the sprinkler head assembly comprises a top surface and a sprinkler movable relative to the top surface.

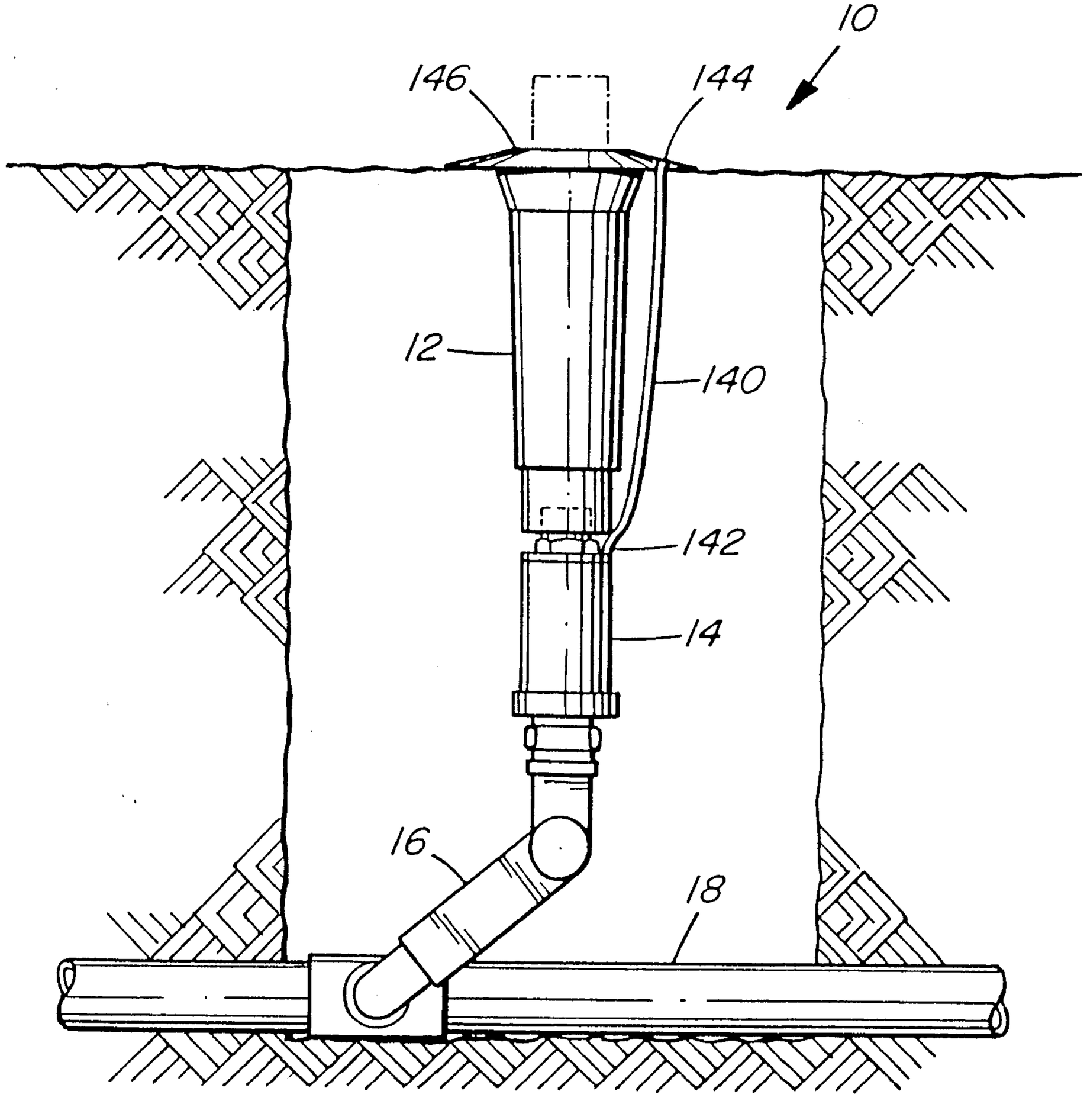


FIG. 1

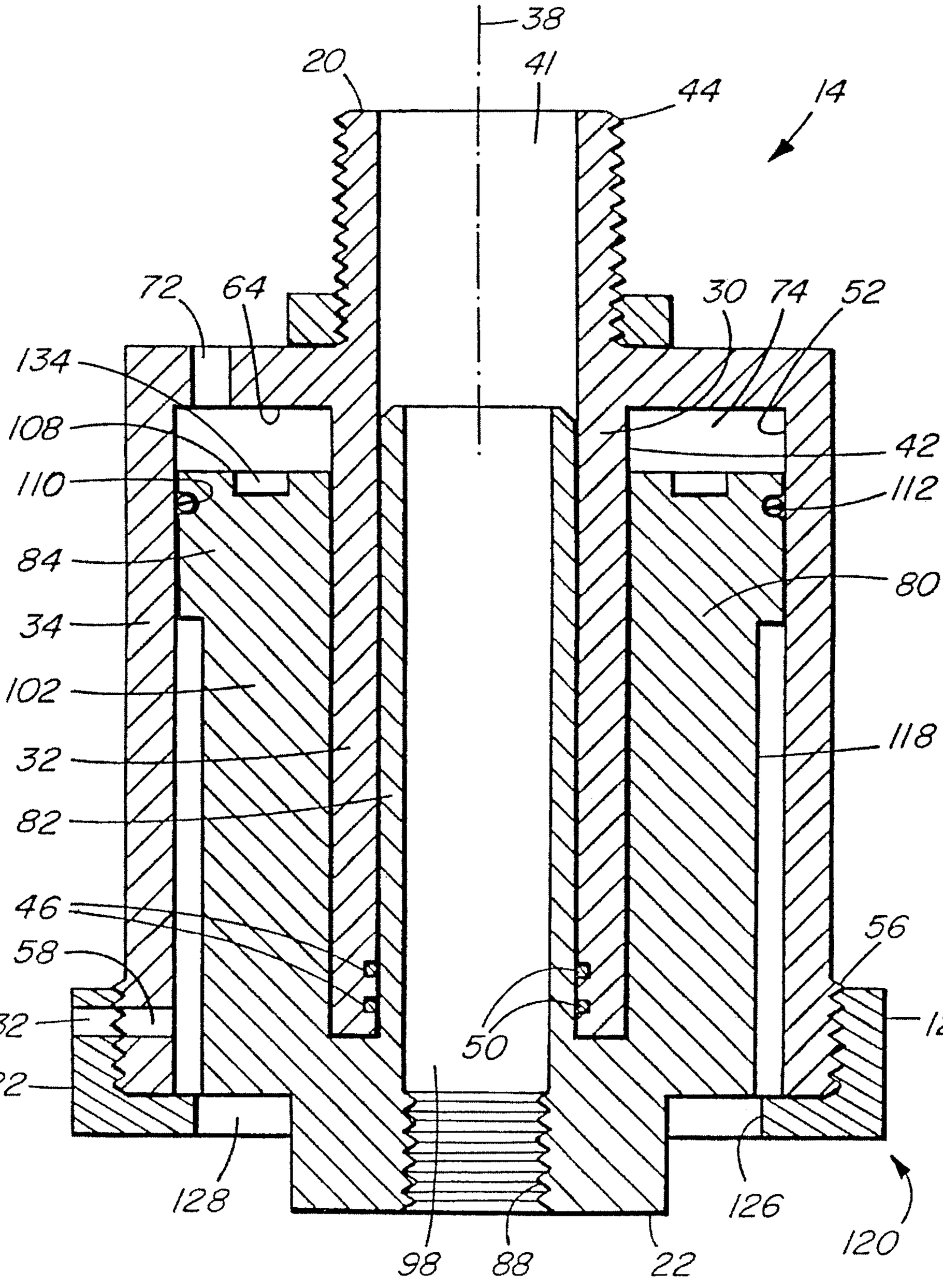

38
20
41
44
14
72
64
30
74
52
134
108
42
110
112
84
80
34
102
118
32
82
46
56
58
50
122
132
122
128
126
120
98
88
22

FIG. 2

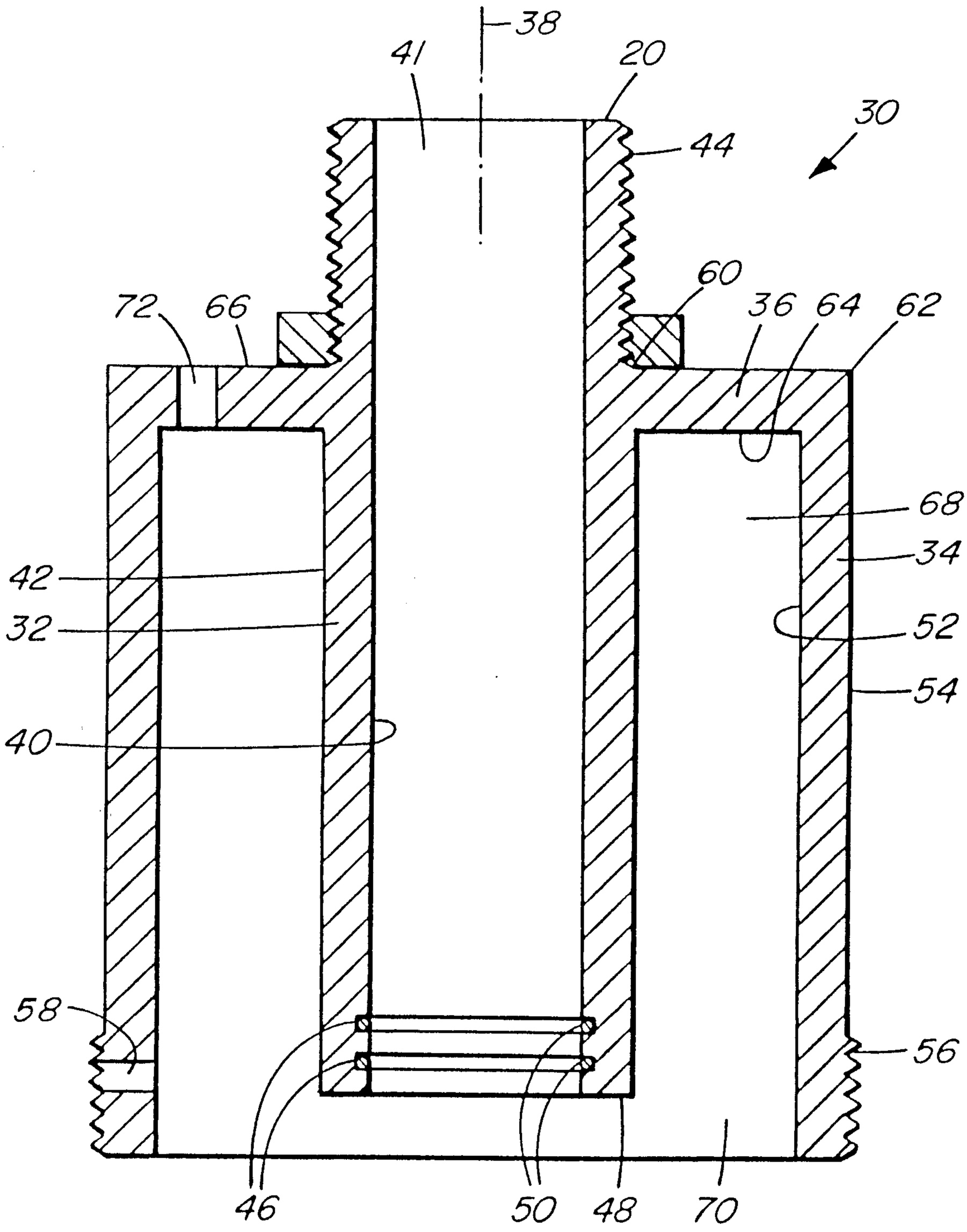


FIG. 3

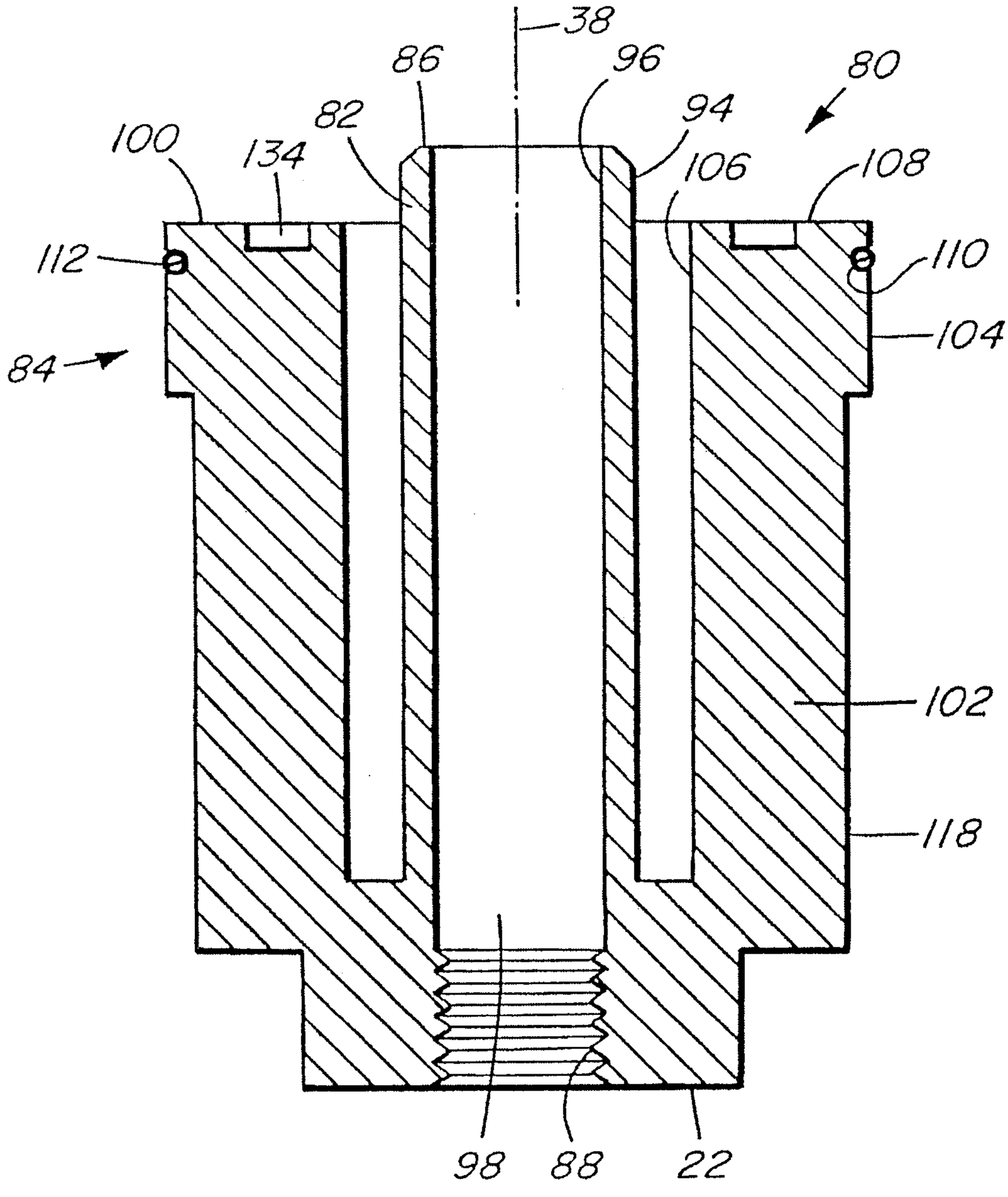


FIG. 4

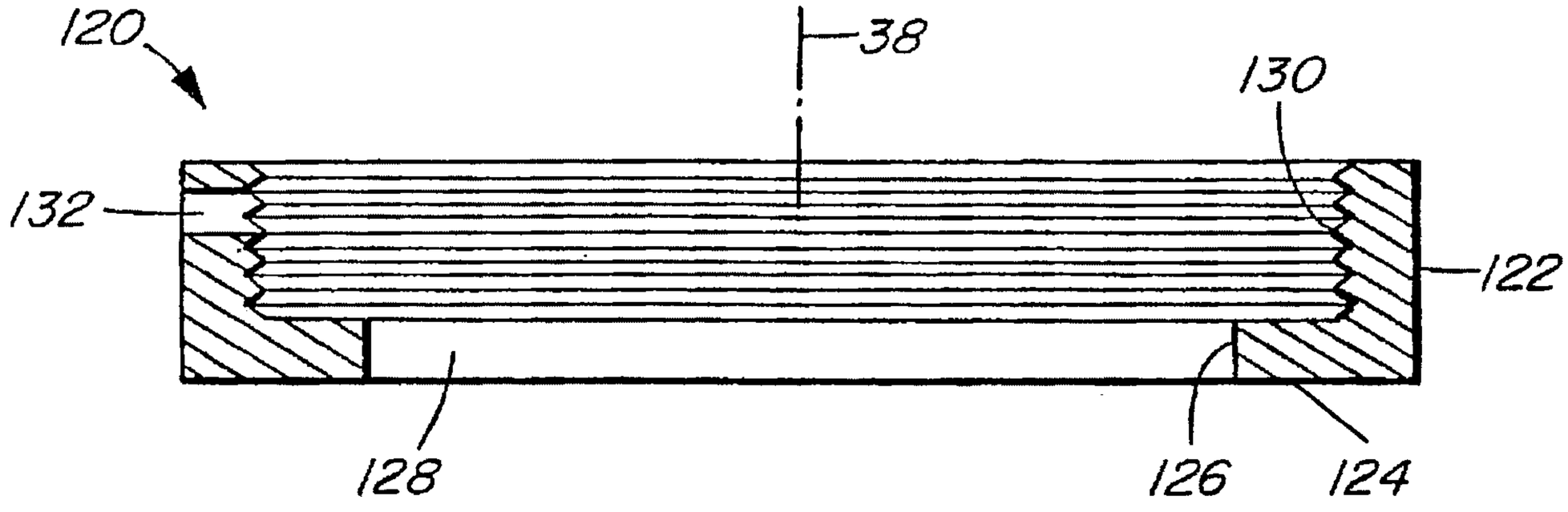


FIG. 5

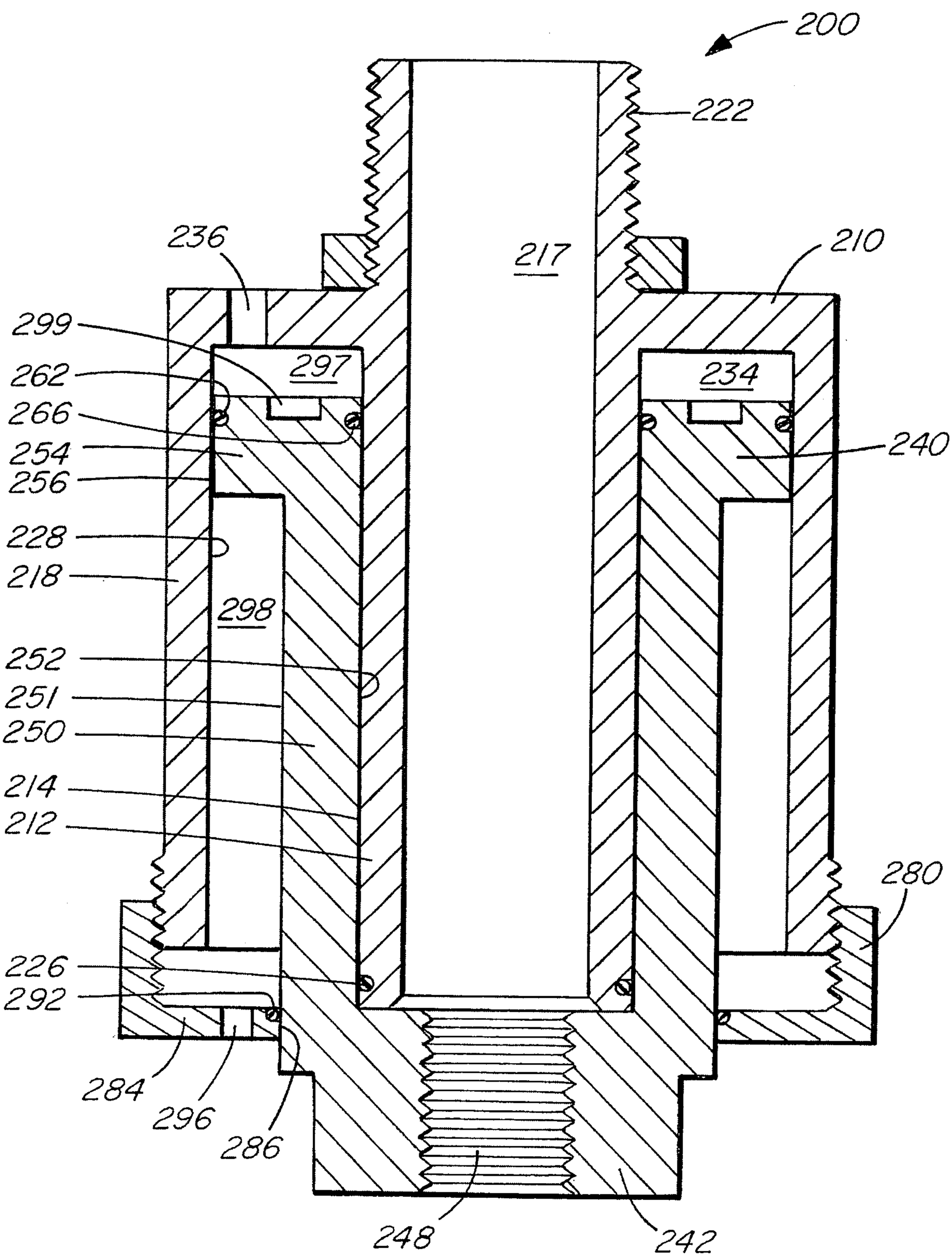

200
222
236
217
210
299
297
234
262
266
240
254
256
228
218
298
252
251
250
214
212
280
226
292
284
296
286
248
242

FIG. 6

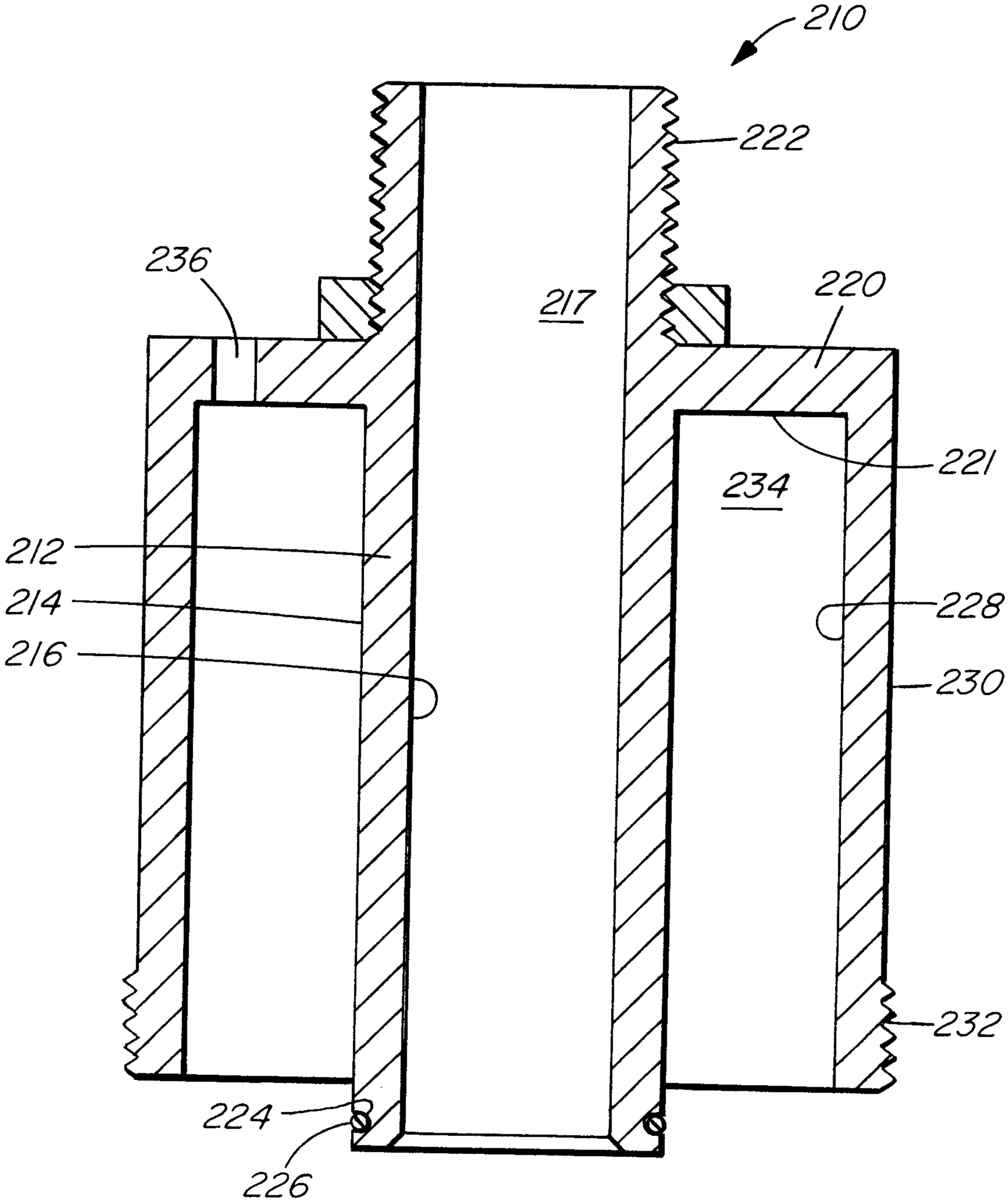


FIG. 7

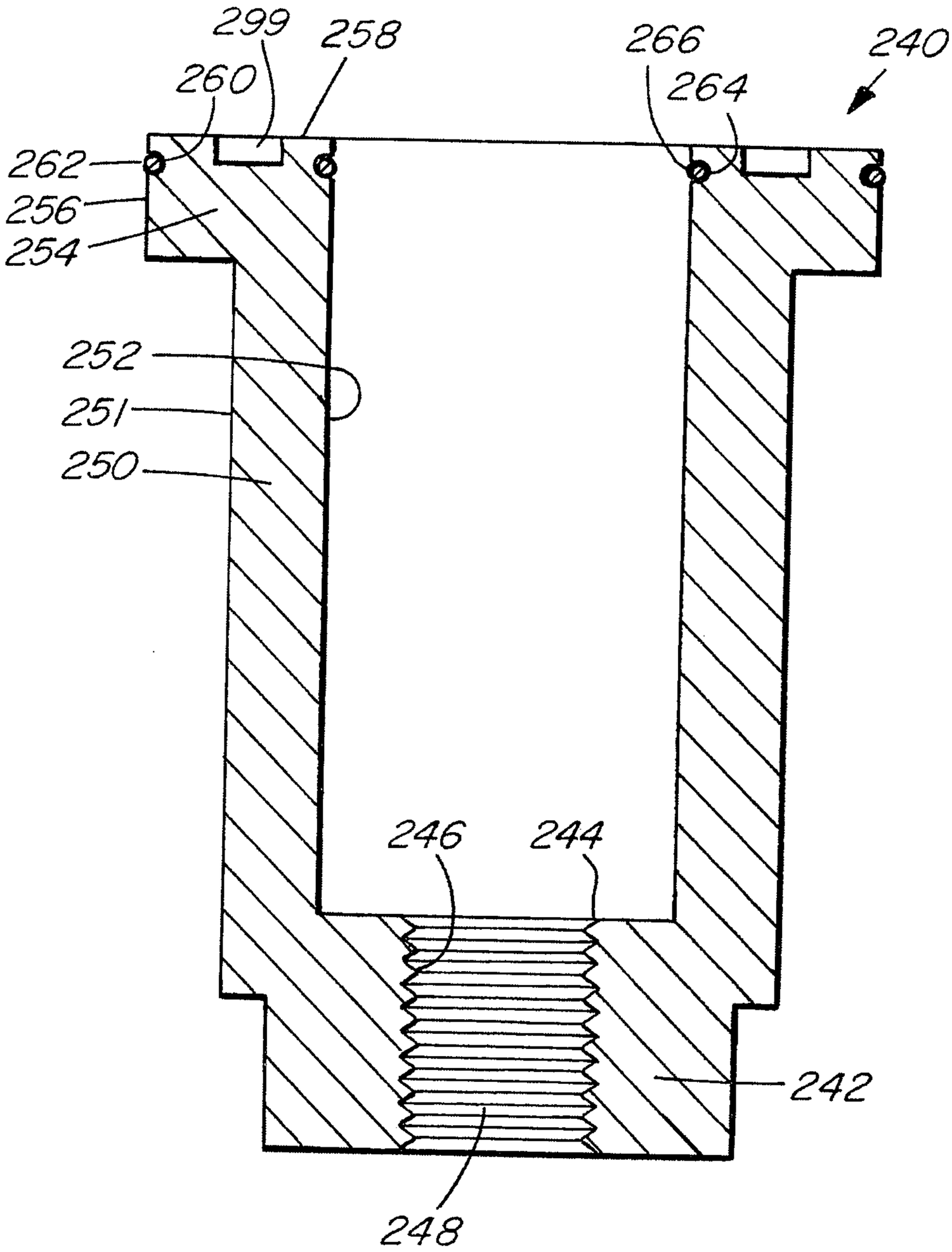

299
258
266
240
260
264
262
256
254
252
251
250
246
244
242
248

FIG. 8

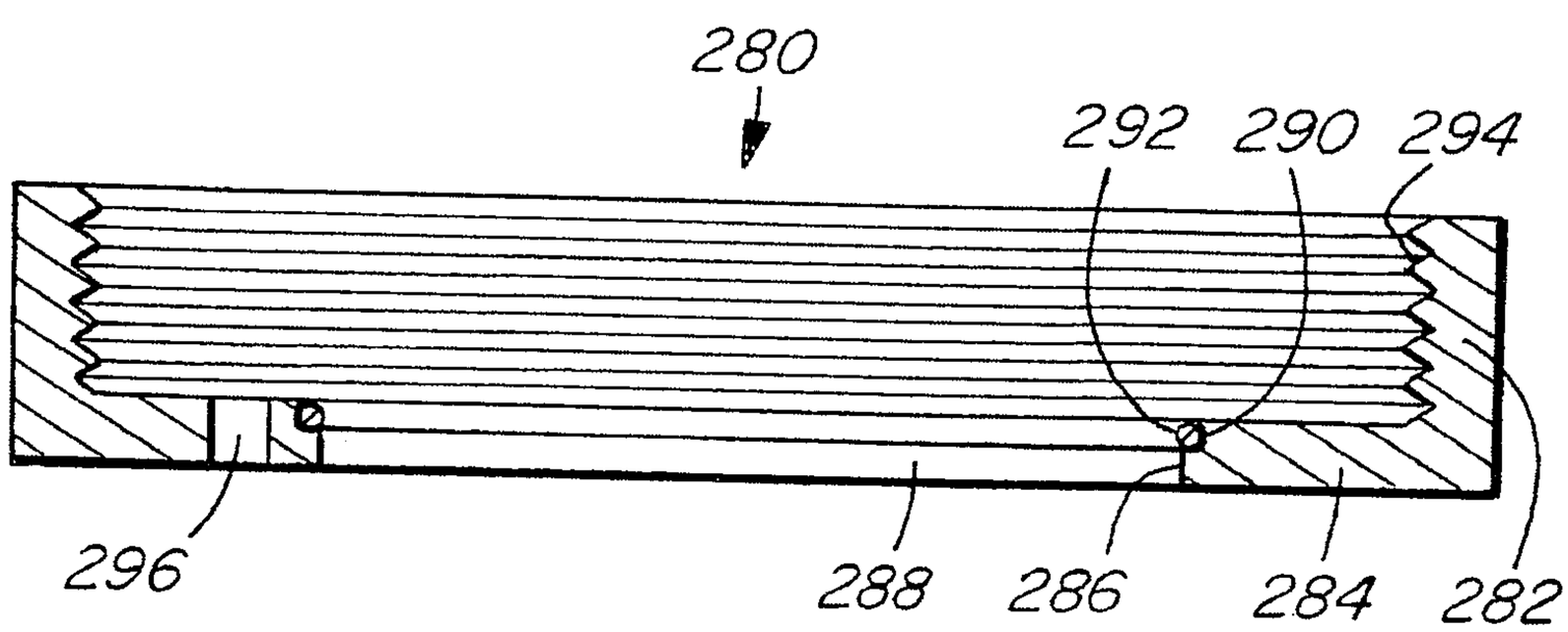

280
292
290
294
296
288
286
284
282

FIG. 9

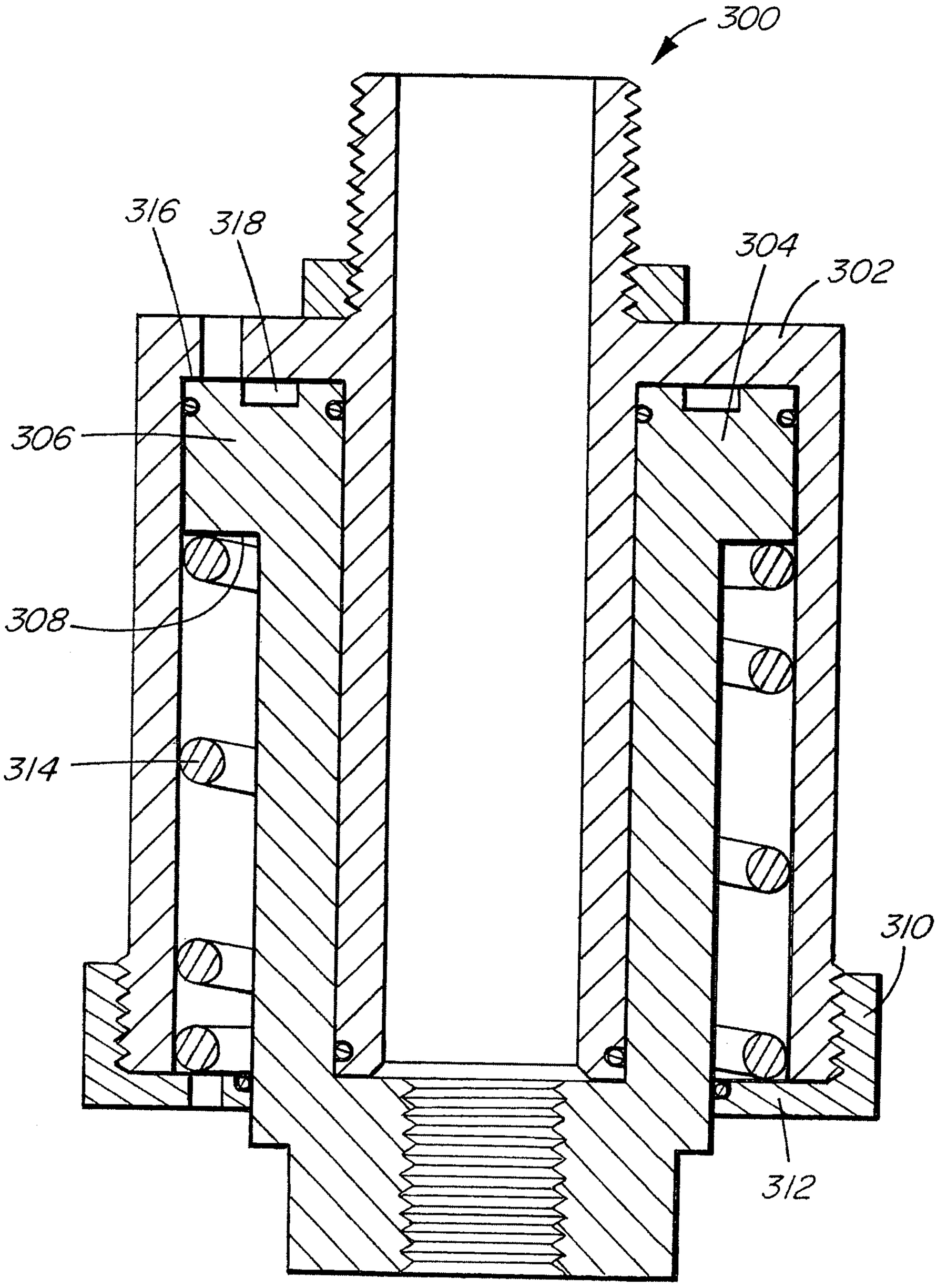
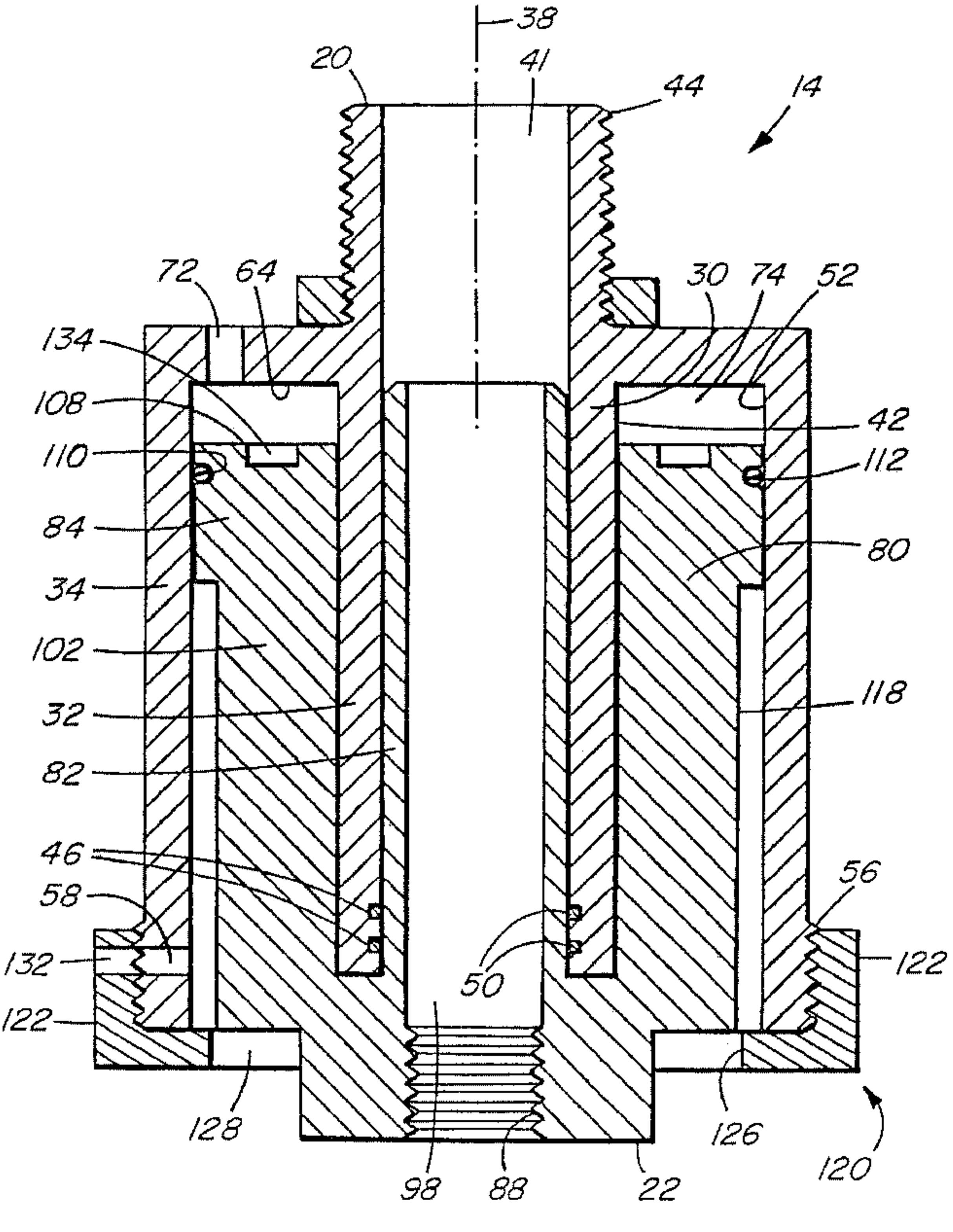


FIG. 10


38
20
41
44
14
72
64
30
74
52
134
108
42
110
112
84
80
34
102
118
32
82
46
58
56
132
122
50
122
128
126
120
98
88
22