

US00RE40440E

(19) **United States**
(12) **Reissued Patent**
Sesser

(10) **Patent Number:** **US RE40,440 E**
(45) **Date of Reissued Patent:** **Jul. 22, 2008**

(54) **MICRO-STREAM ROTATOR WITH
ADJUSTMENT OF THROW RADIUS AND
FLOW RATE**

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(21) Appl. No.: **11/022,428**

(22) Filed: **Dec. 27, 2004**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **6,499,672**
Issued: **Dec. 31, 2002**
Appl. No.: **09/532,772**
Filed: **Mar. 22, 2000**

U.S. Applications:

(63) Continuation-in-part of application No. 09/433,299, filed on
Nov. 3, 1999, now Pat. No. 6,244,521.

(51) **Int. Cl.**
B05B 3/04 (2006.01)

(52) **U.S. Cl.** **239/222.11**; 239/222.11;
239/232; 239/252; 239/262; 239/443; 239/484;
239/514; 239/518

(58) **Field of Classification Search**
239/222.11–222.21, 203–206, 252, 231–233,
239/262, 443, 476, 484, 514, 518
See application file for complete search history.

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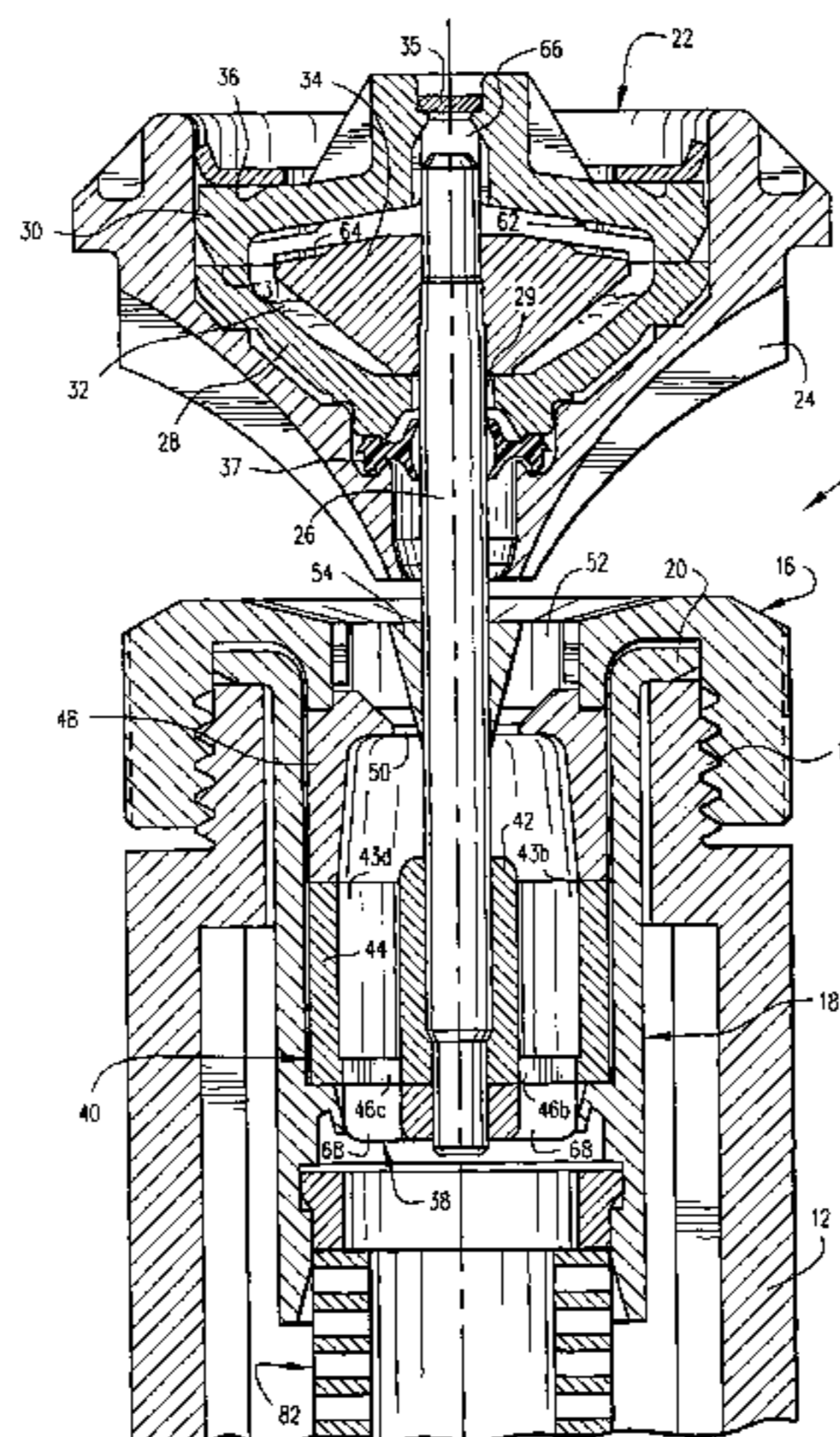
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(57) **ABSTRACT**

A rotating stream sprinkler including a rotor plate supported on one end of a shaft for rotation, in an operative mode, relative to the shaft; a nozzle located along the shaft upstream of the rotor plate; the rotor plate formed with a chamber and one end of the shaft has a stator fixed thereto within the chamber, the fluid chamber at partially filled with a viscous fluid; and wherein the chamber is at least partially closed at an upper end thereof by a rotor cap plate; and further wherein an underside of the rotor cap plate is provided with a first plurality of teeth and an upper surface of the stator is provided with a second plurality of mating teeth adapted to engage the first plurality of teeth to enable rotation of the rotor plate with the shaft in the adjustment mode. A flow rate adjustment mechanism includes a throttle member threadably mounted on the shaft for movement relative to the shaft, toward or away from an annular seat having a discontinuous edge such that the flow rate cannot be shut off by having the throttle member engage the seat.

43 Claims, 12 Drawing Sheets



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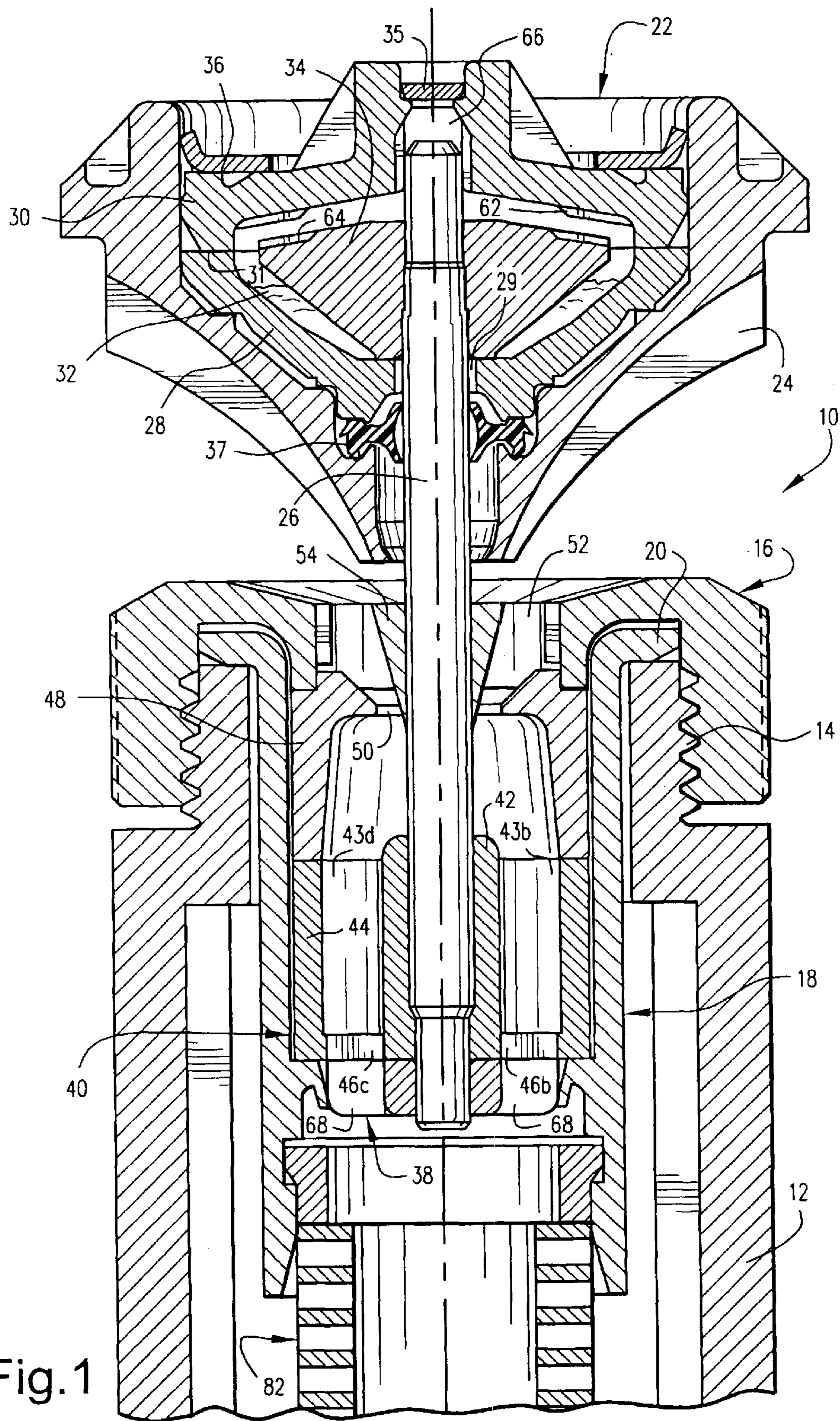
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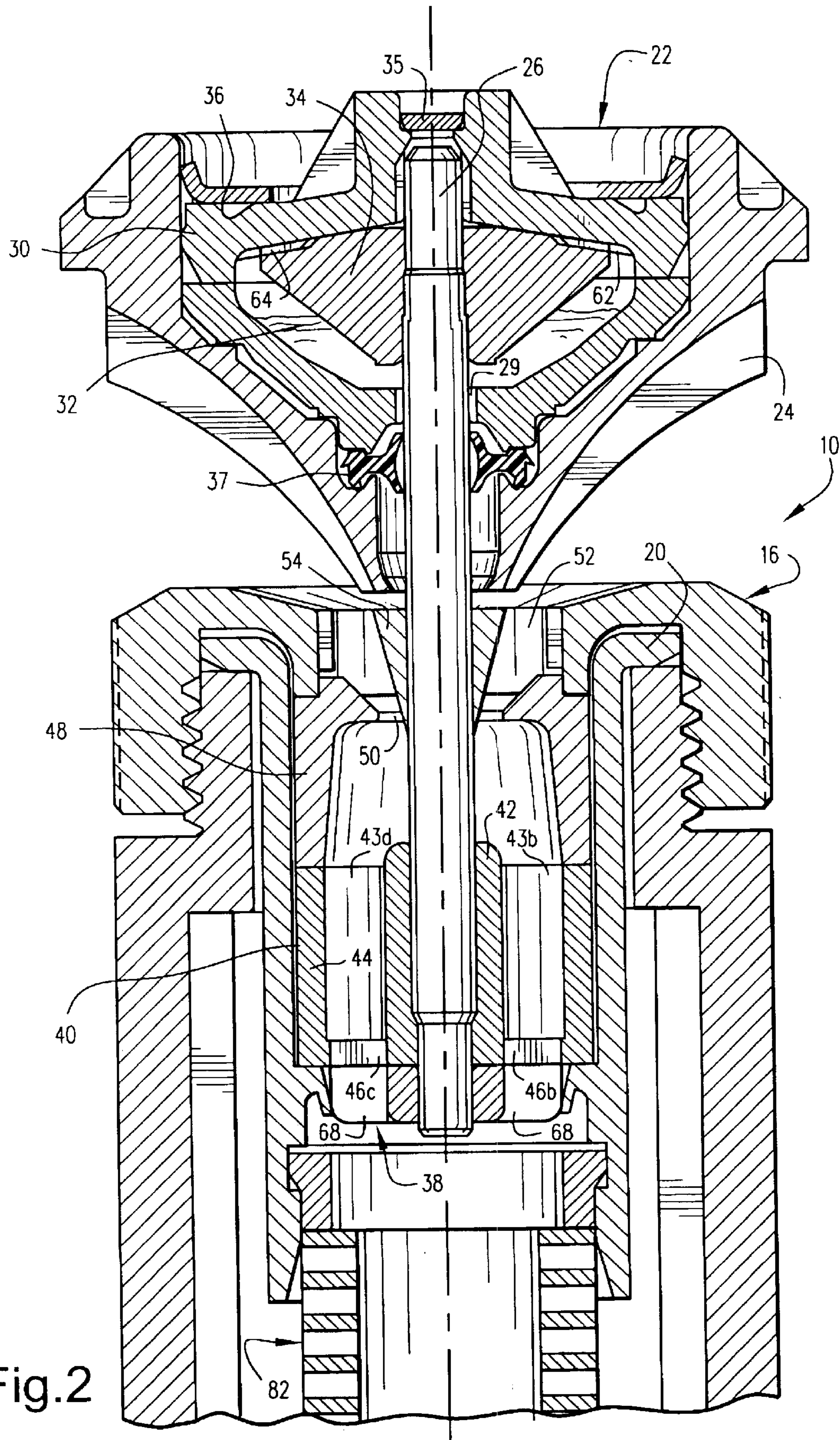


Fig. 2

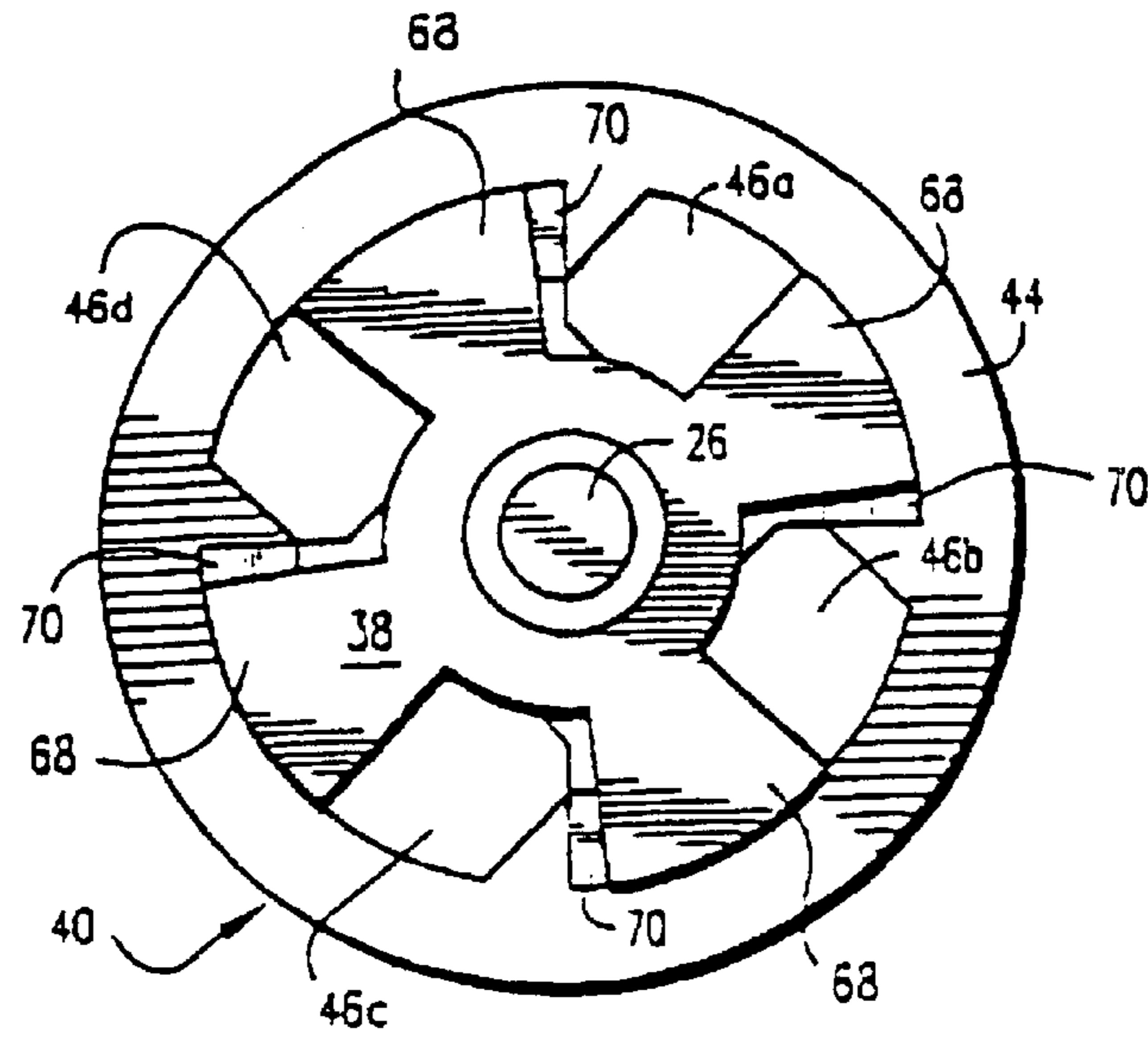


Fig.3

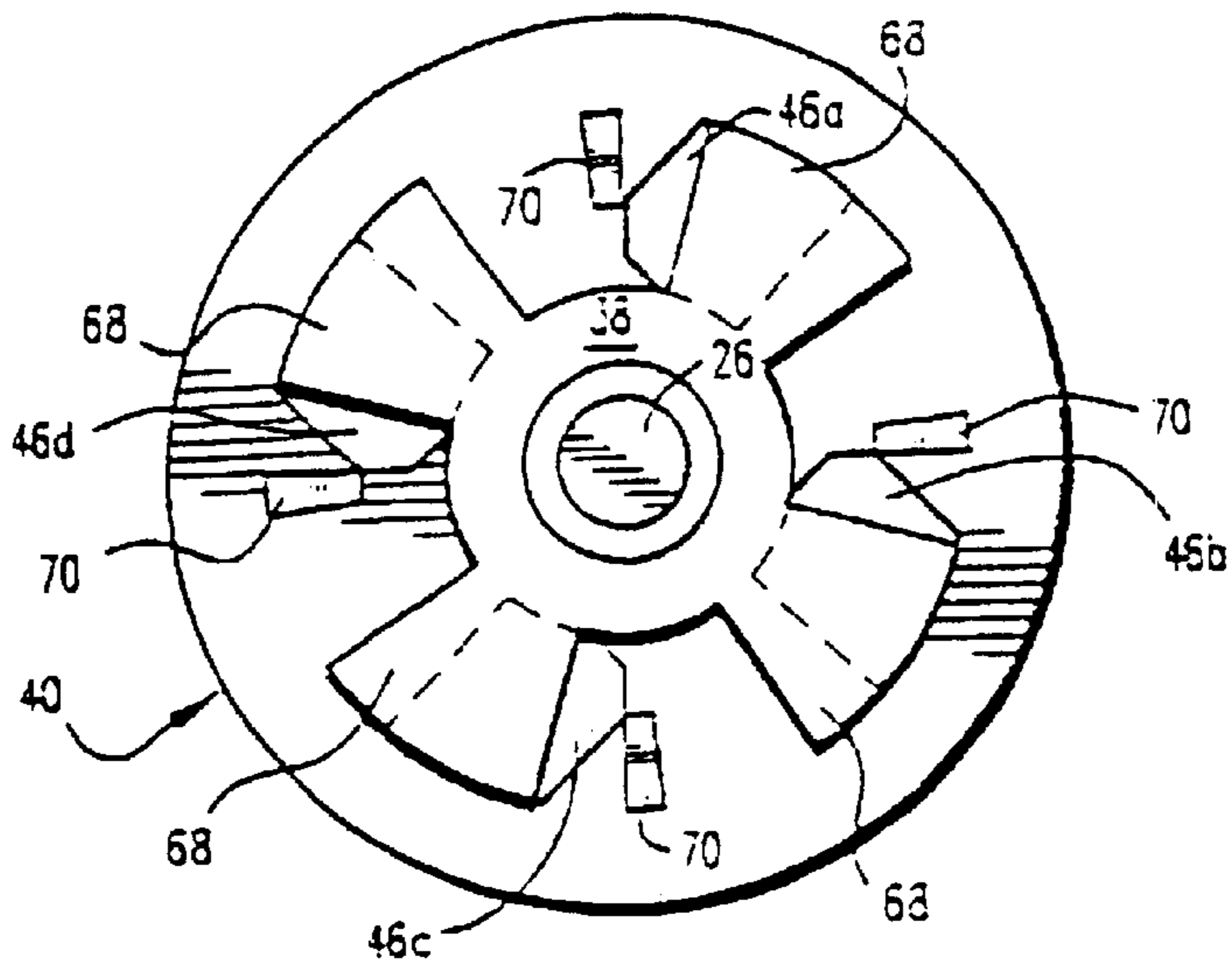


Fig.4

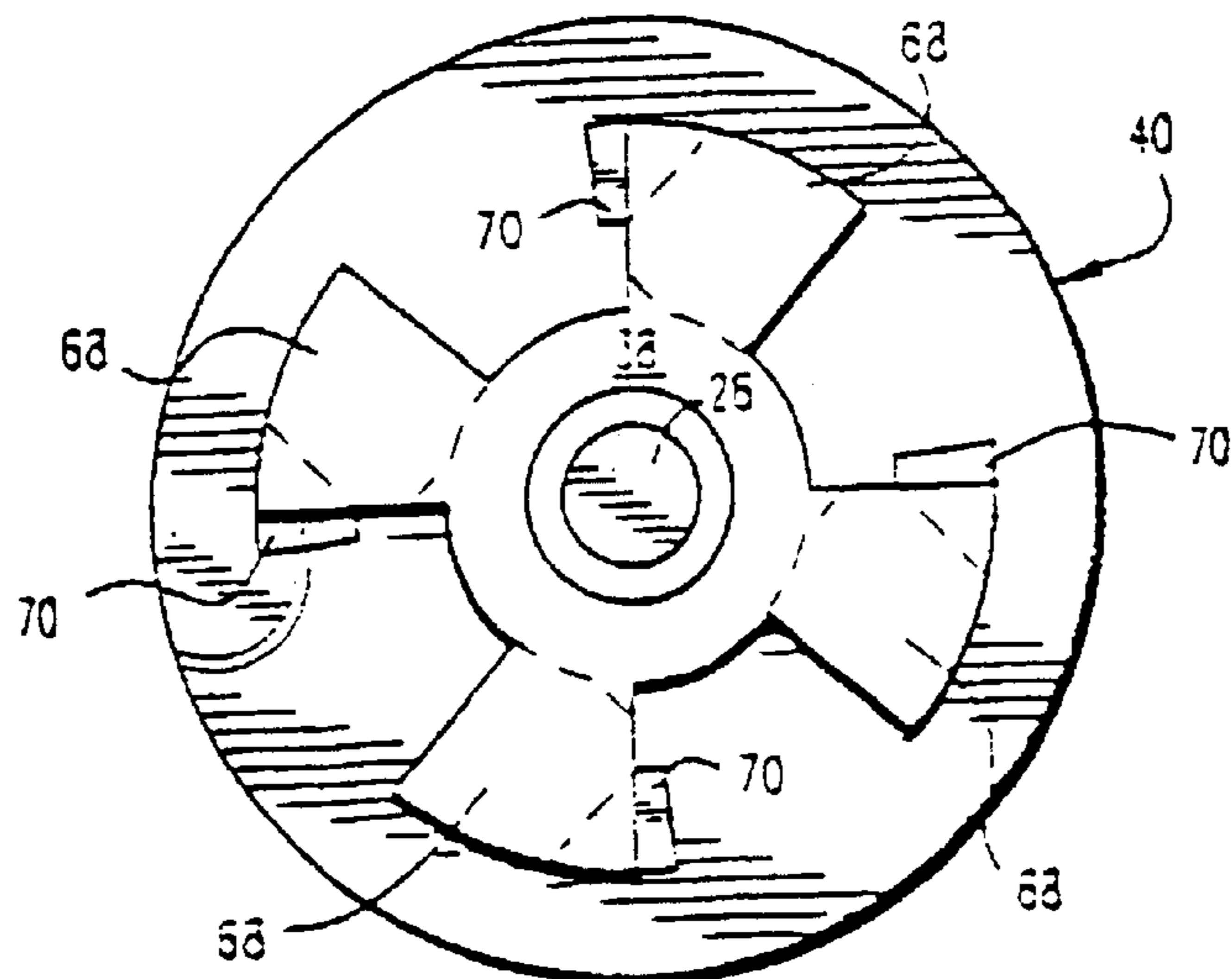


Fig.5

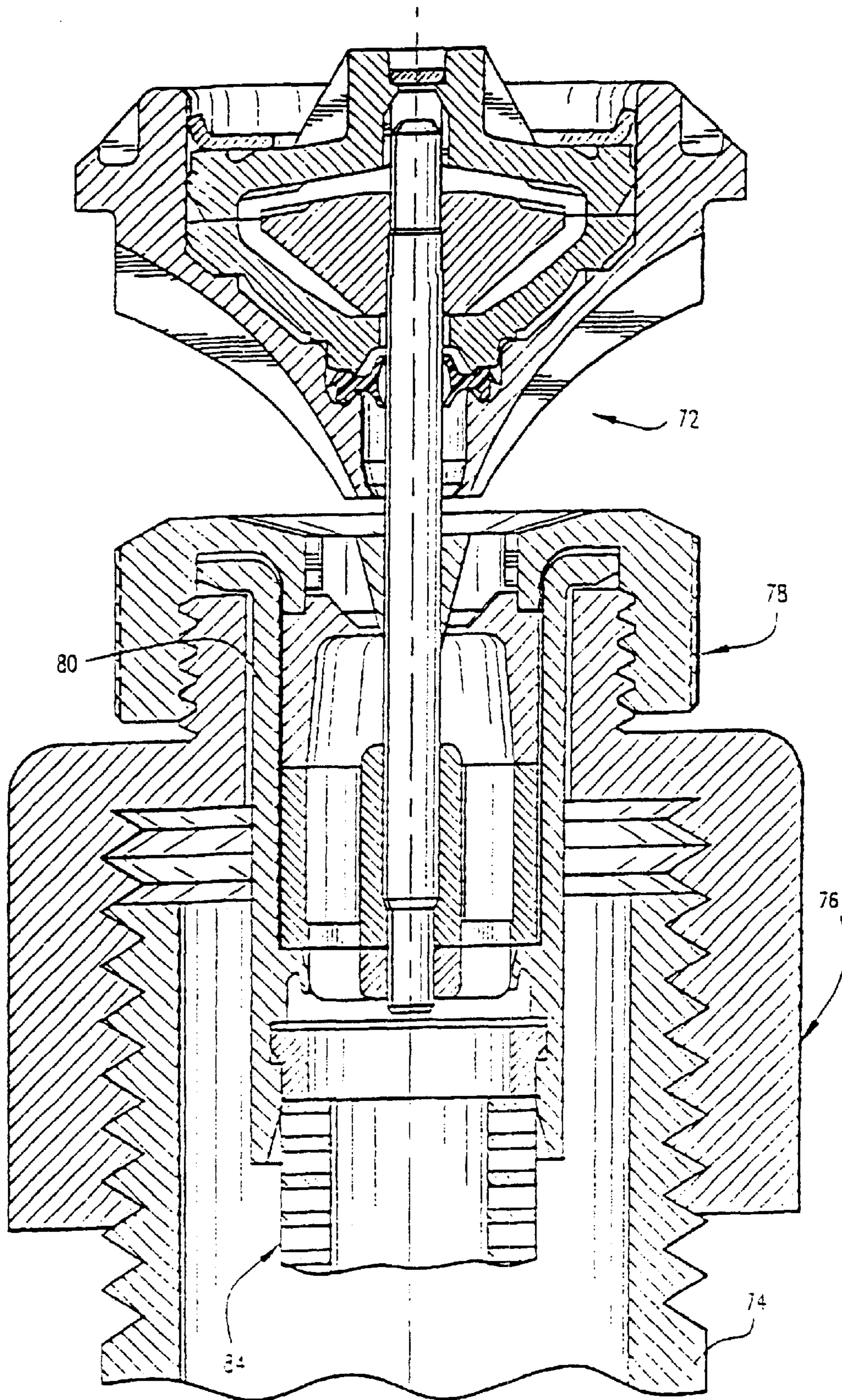


Fig.6

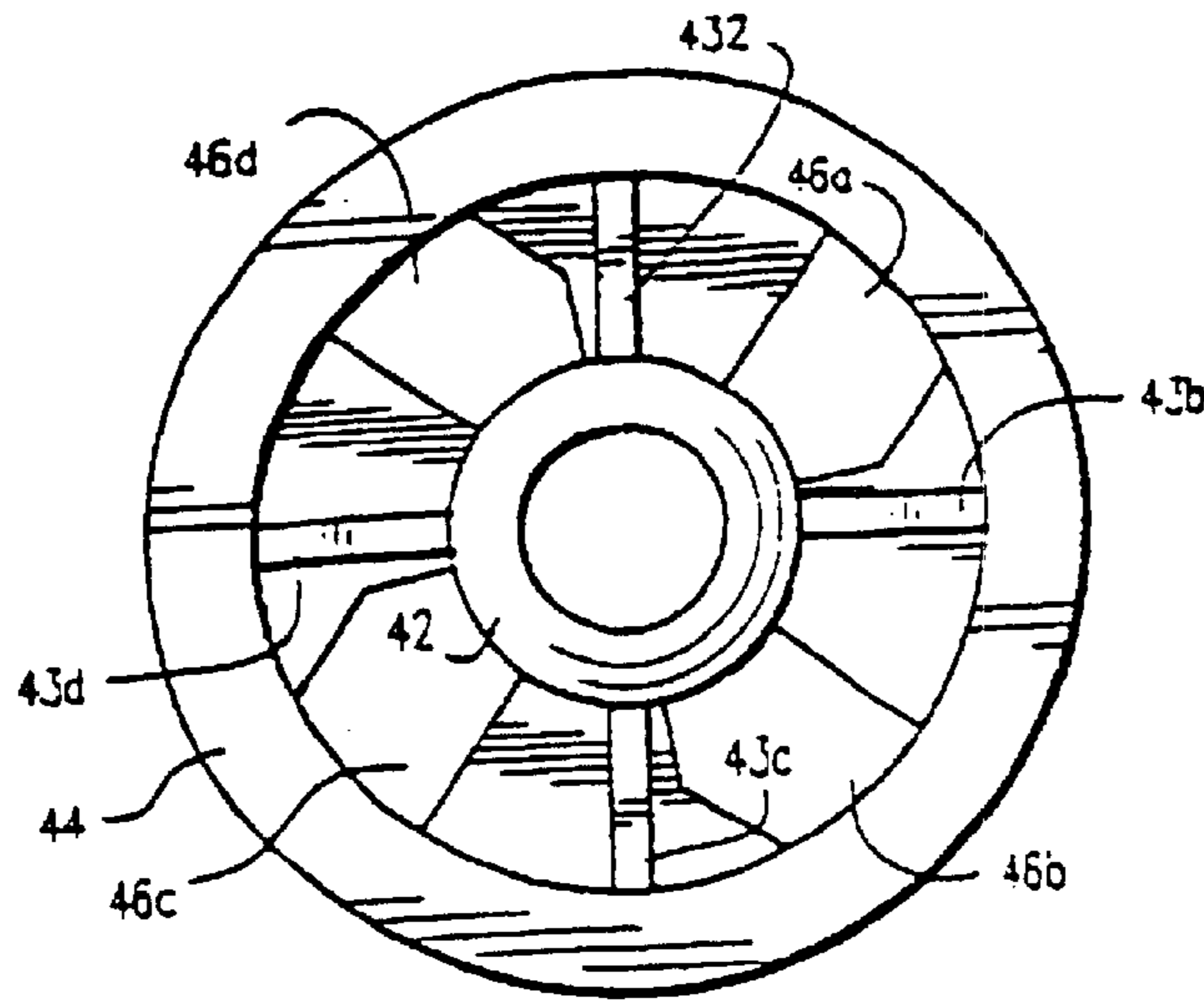


Fig.7

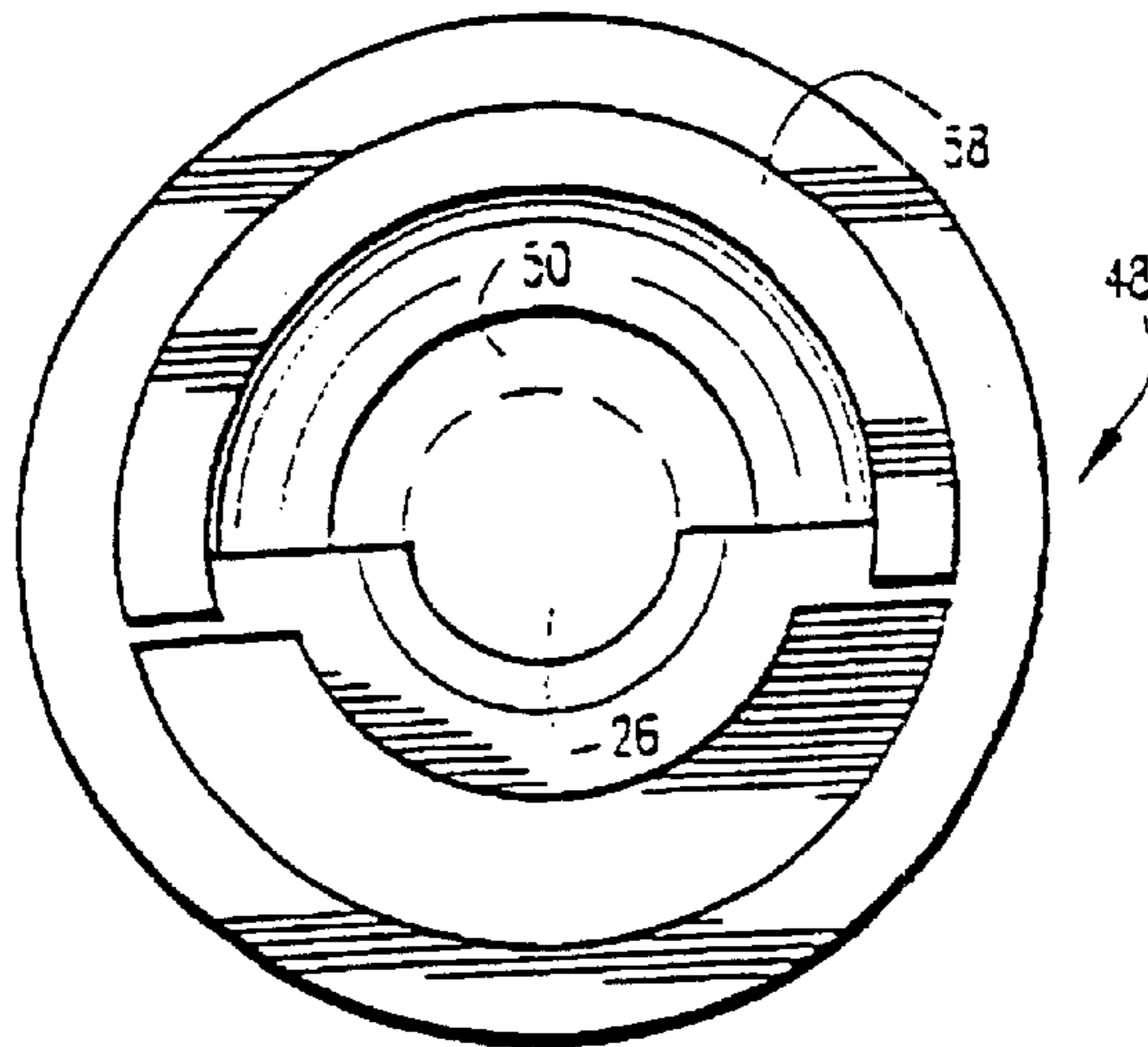


Fig.8

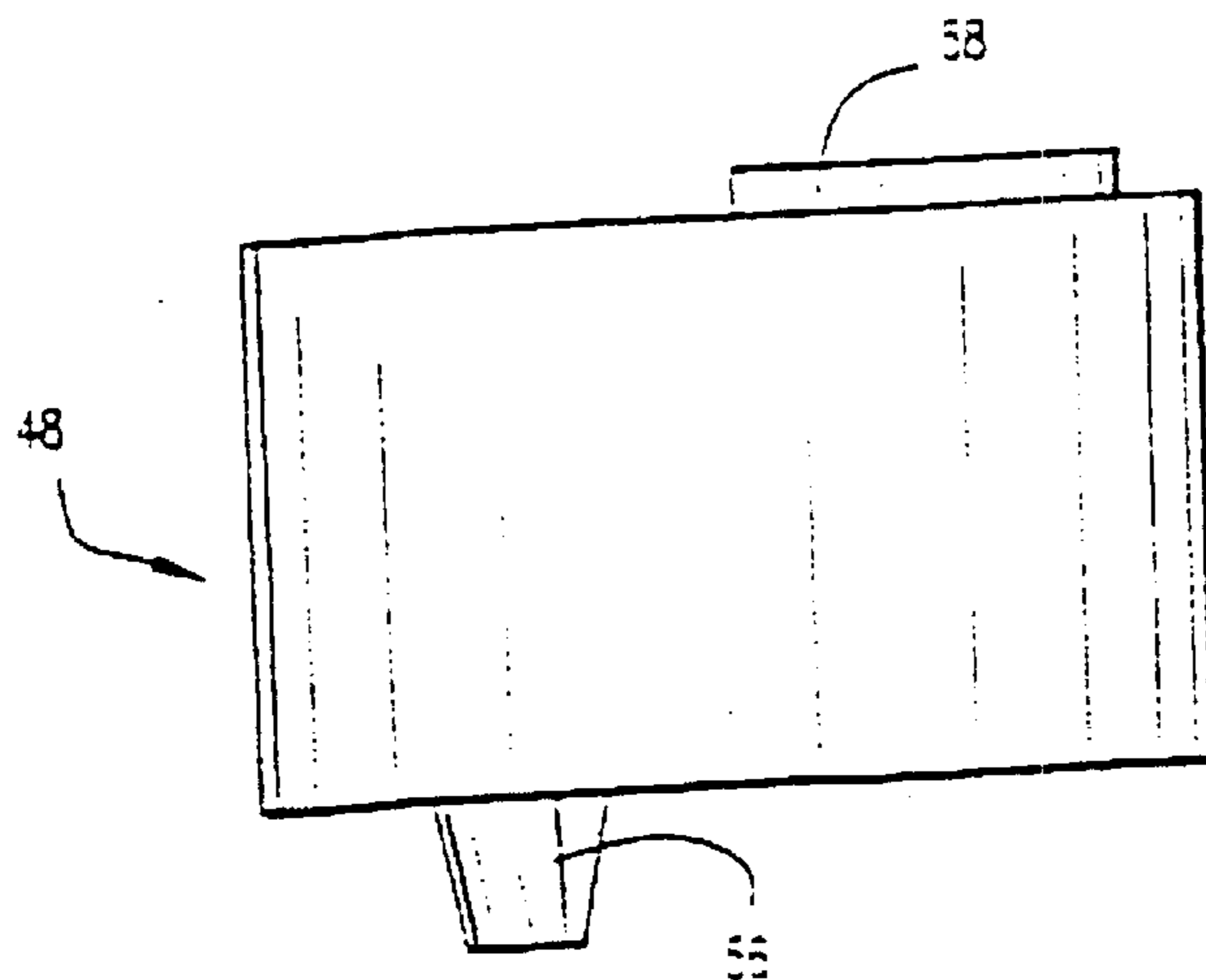


Fig.9

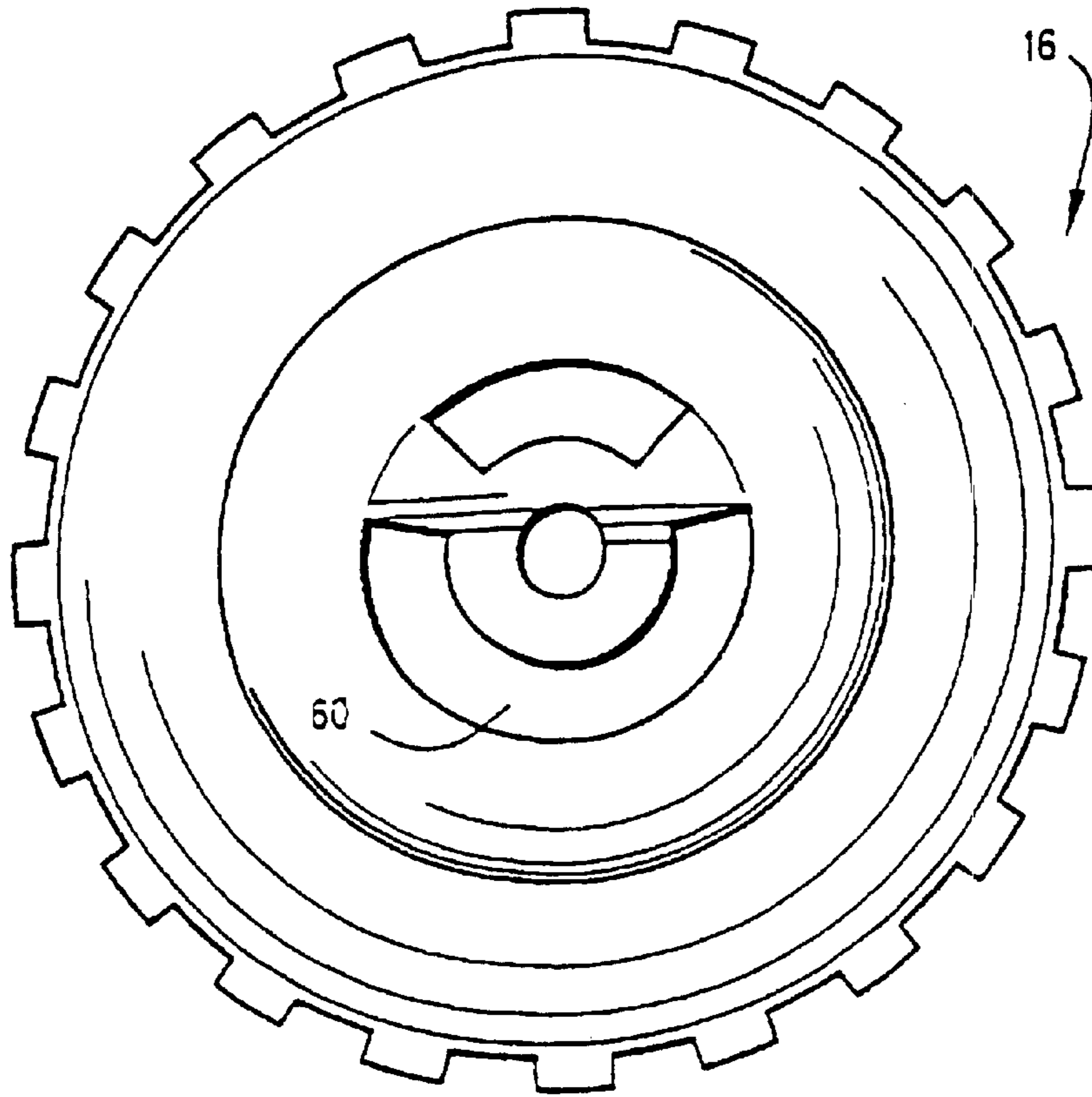


Fig. 10

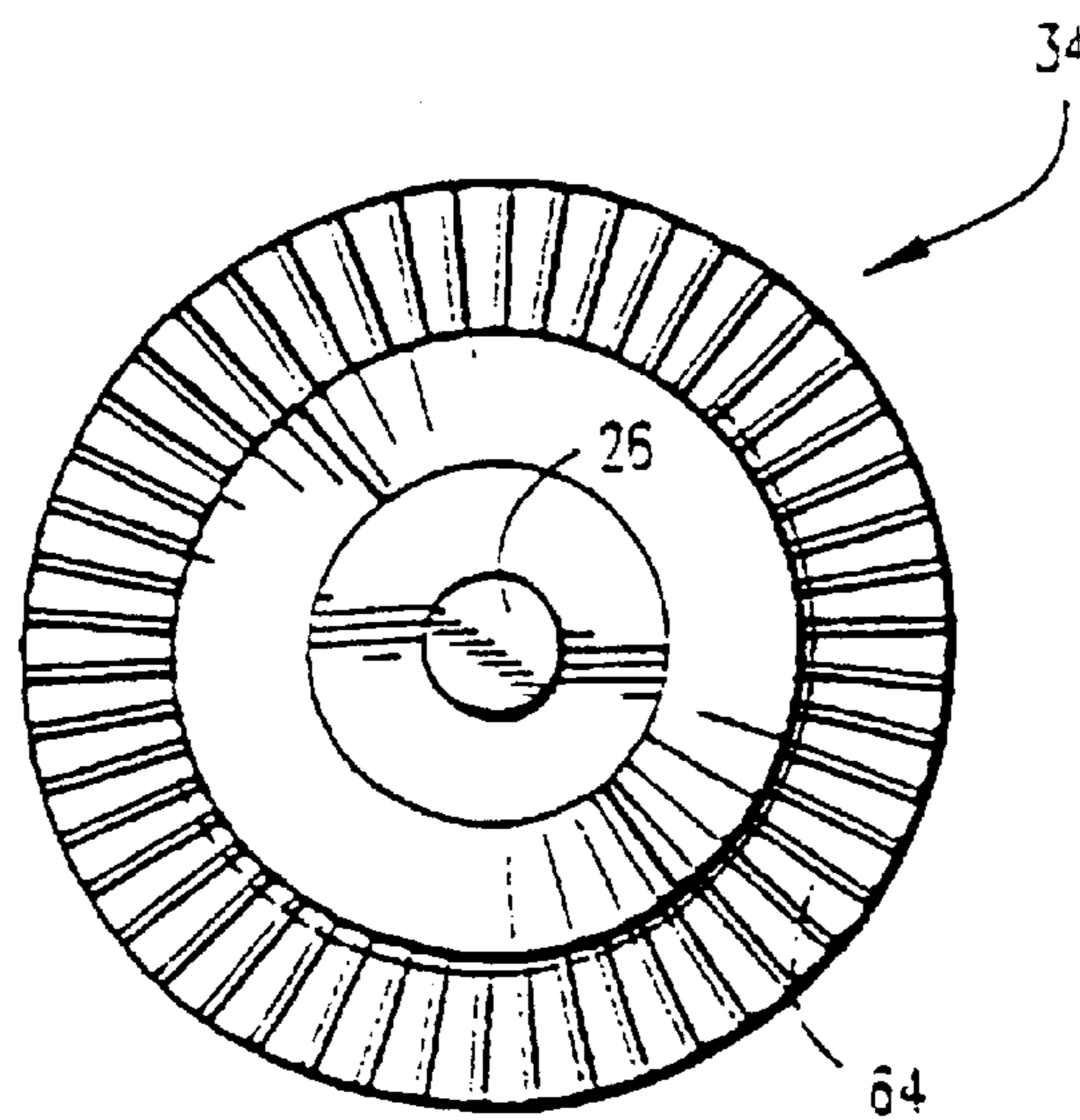


Fig. 11

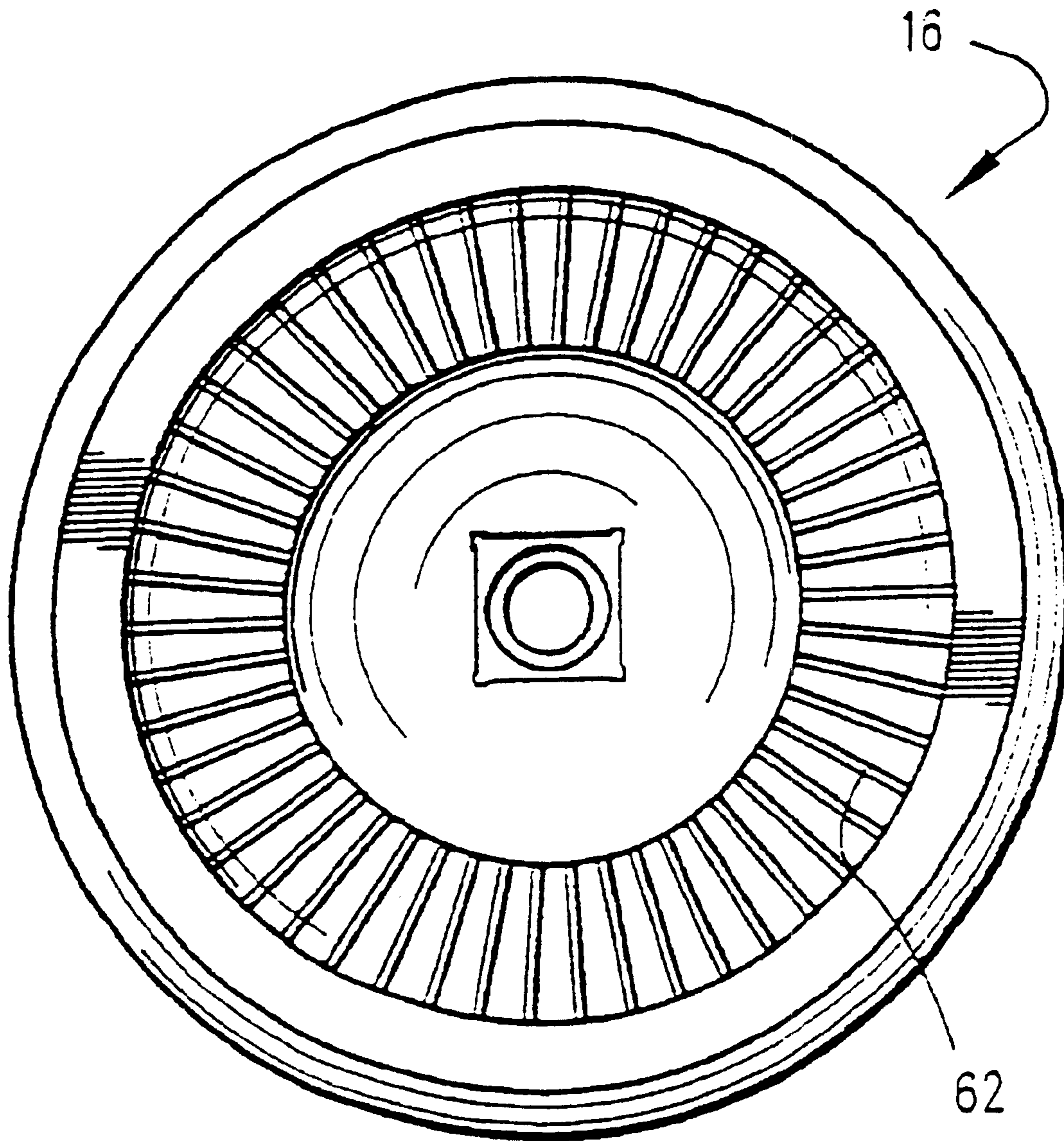


Fig. 12

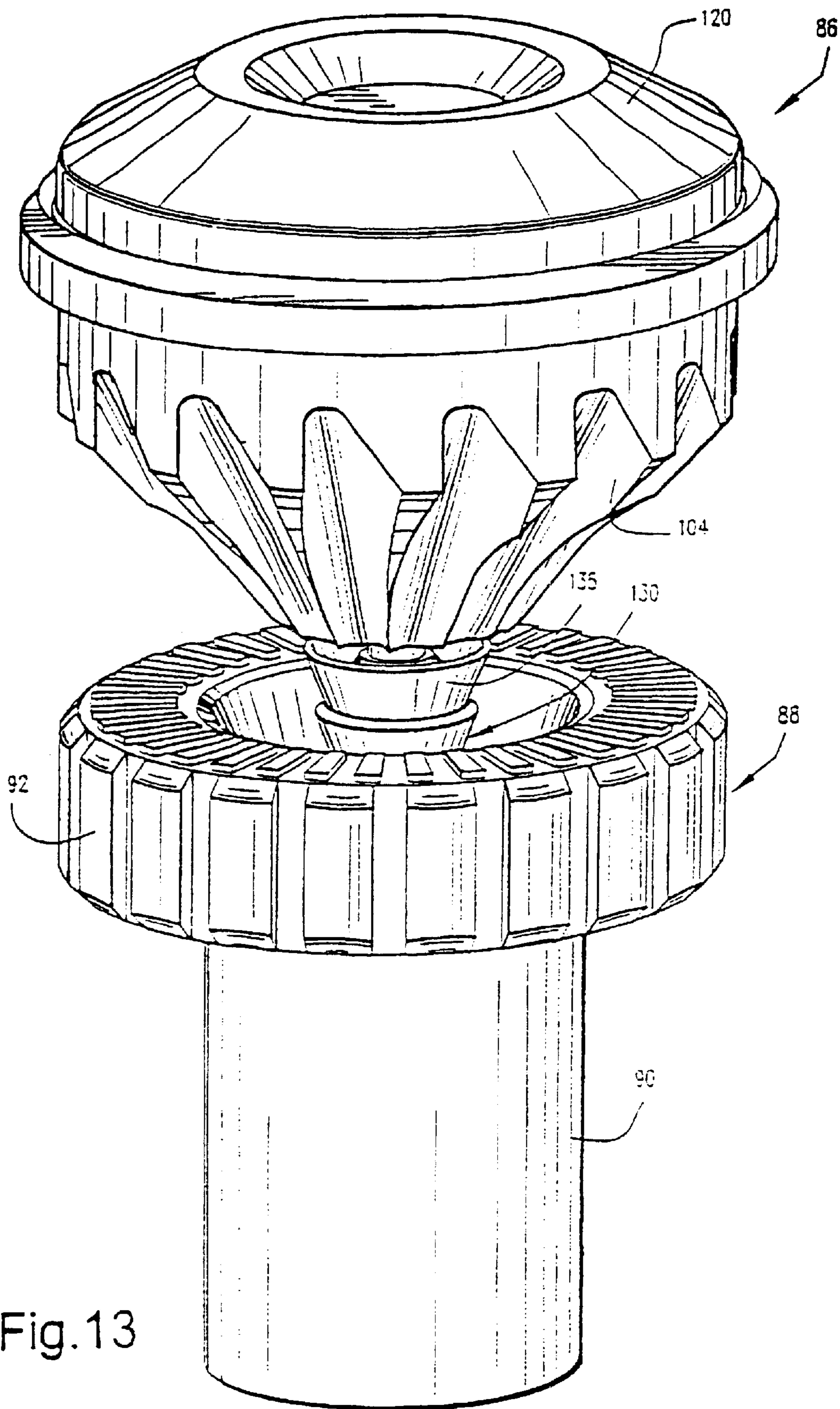


Fig. 13

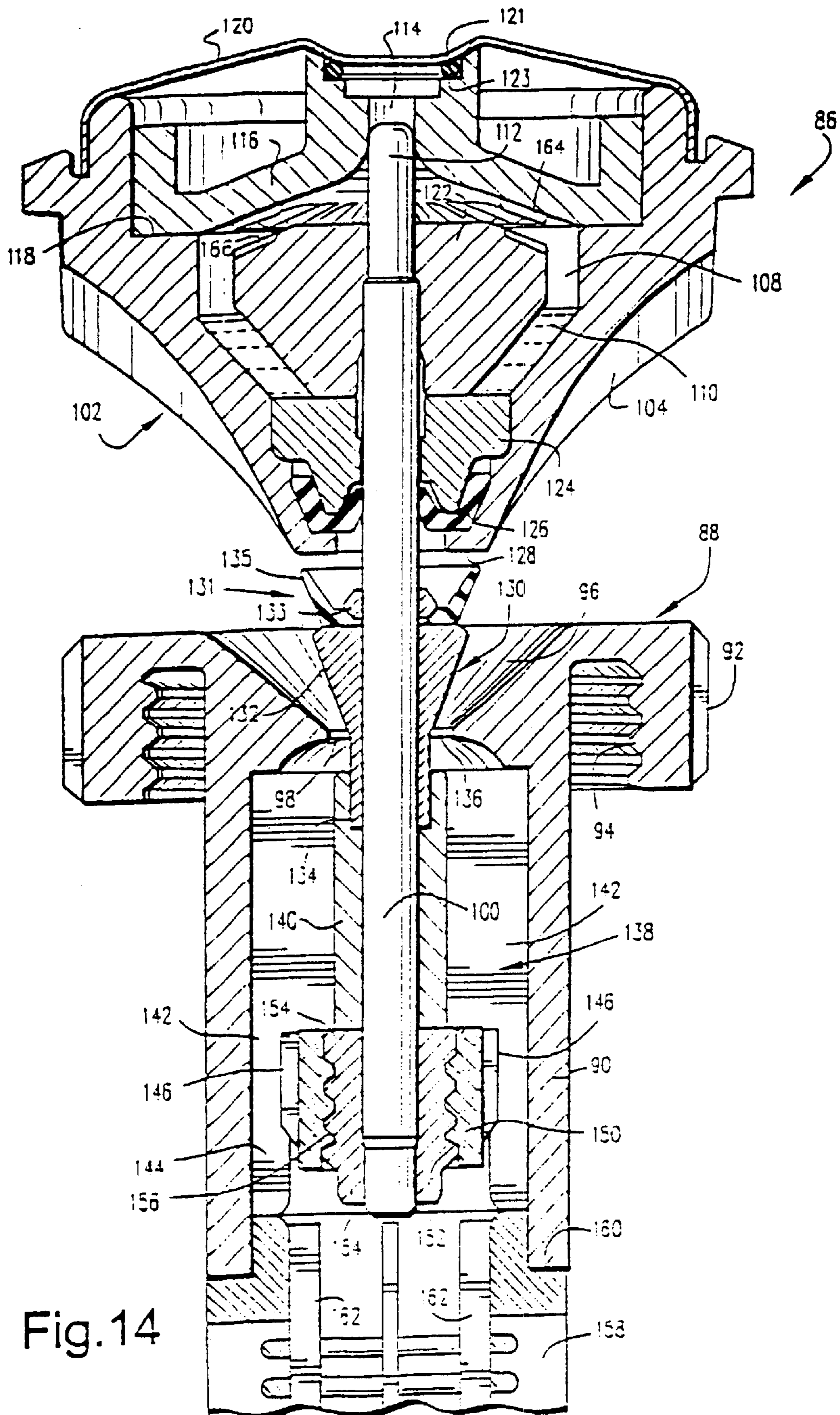


Fig. 14

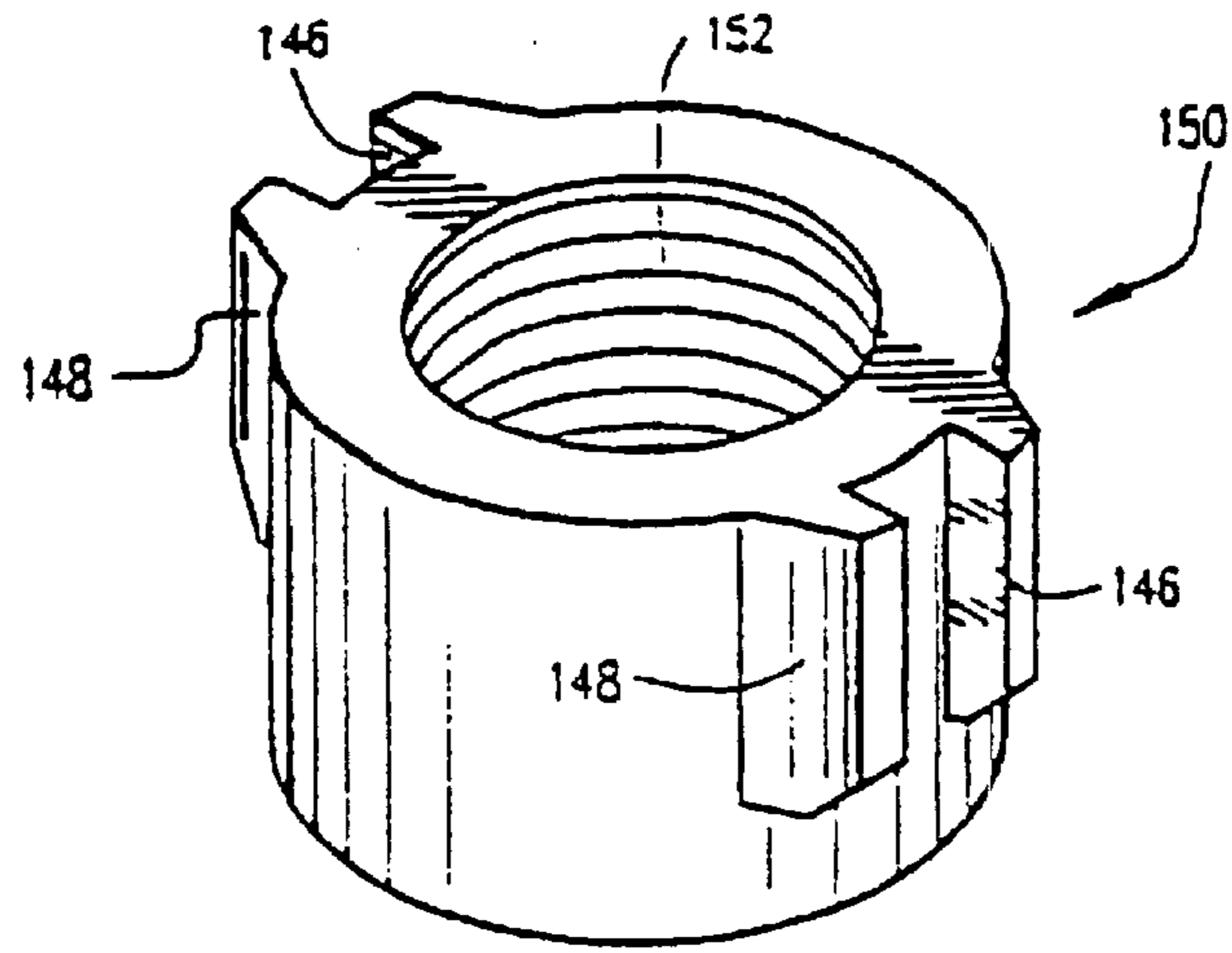


Fig. 15

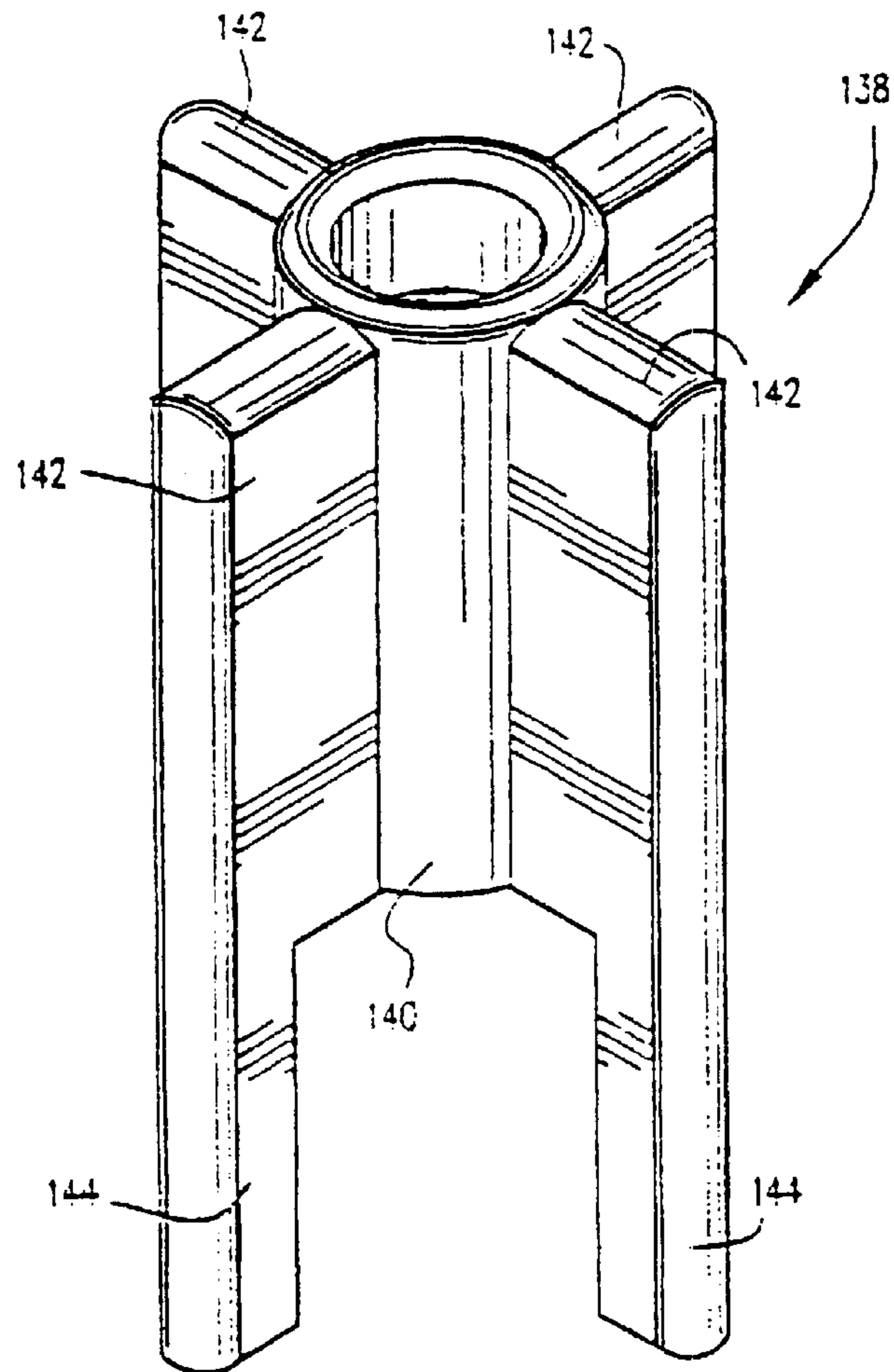


Fig. 16

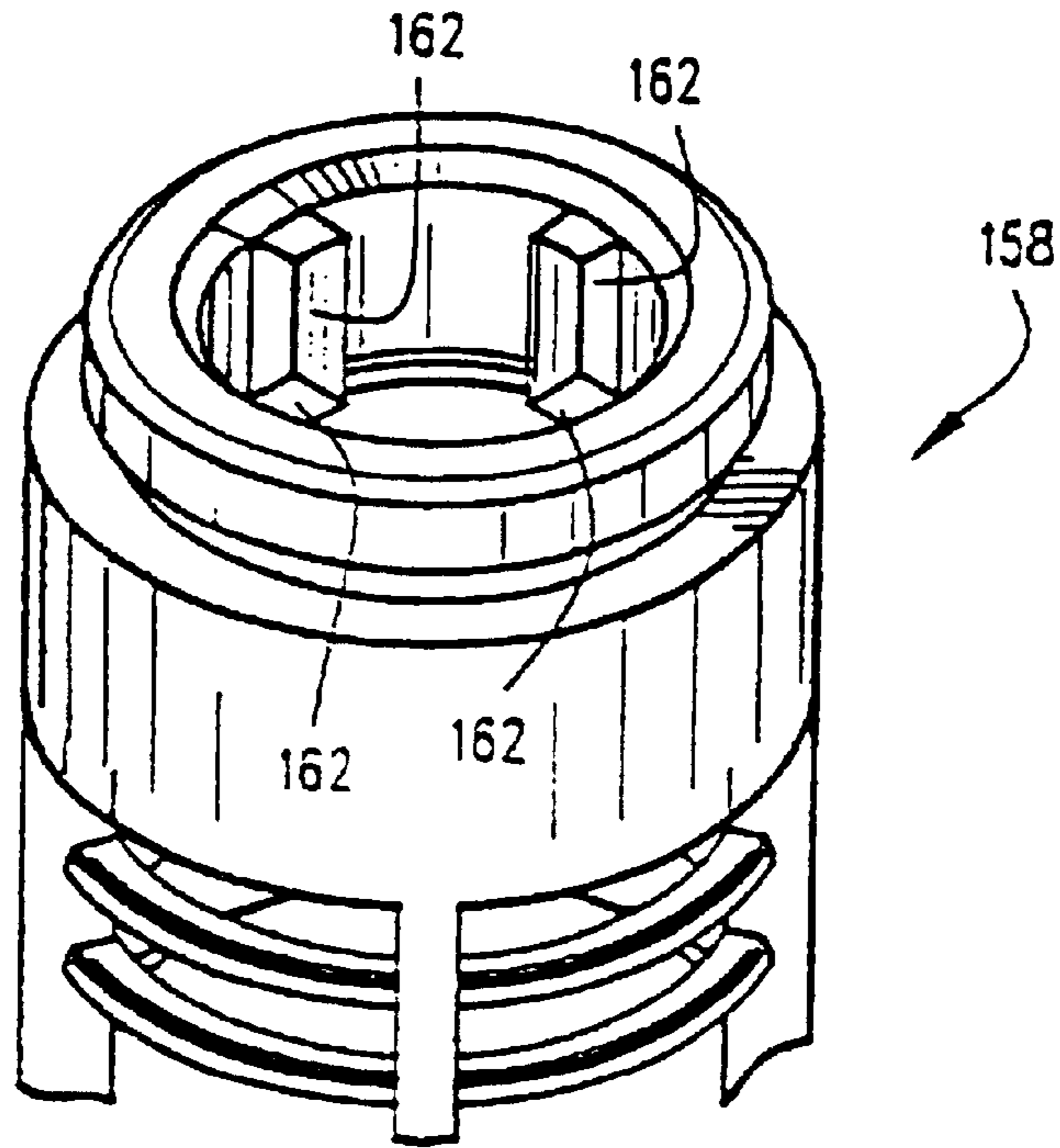


Fig. 17

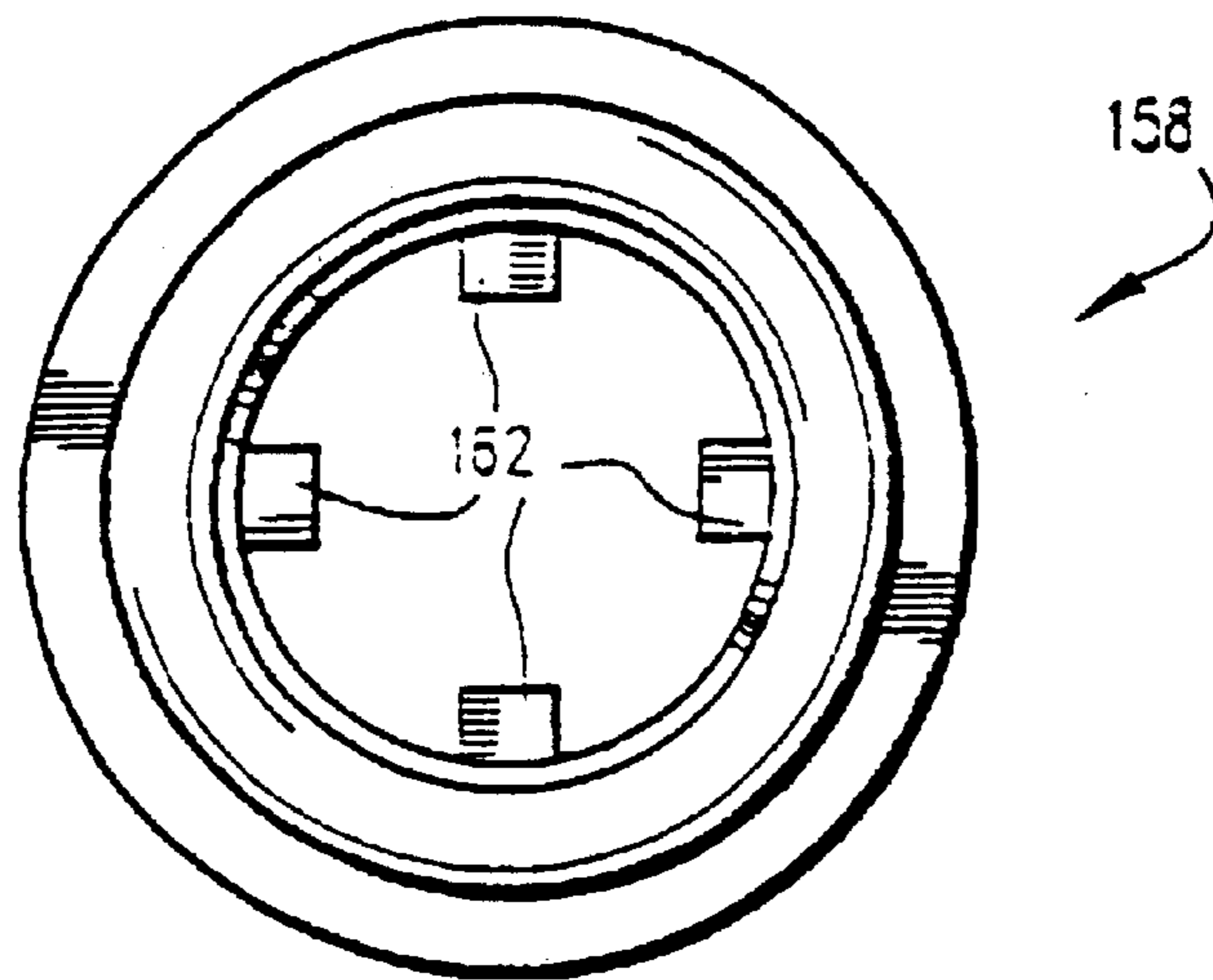


Fig. 18

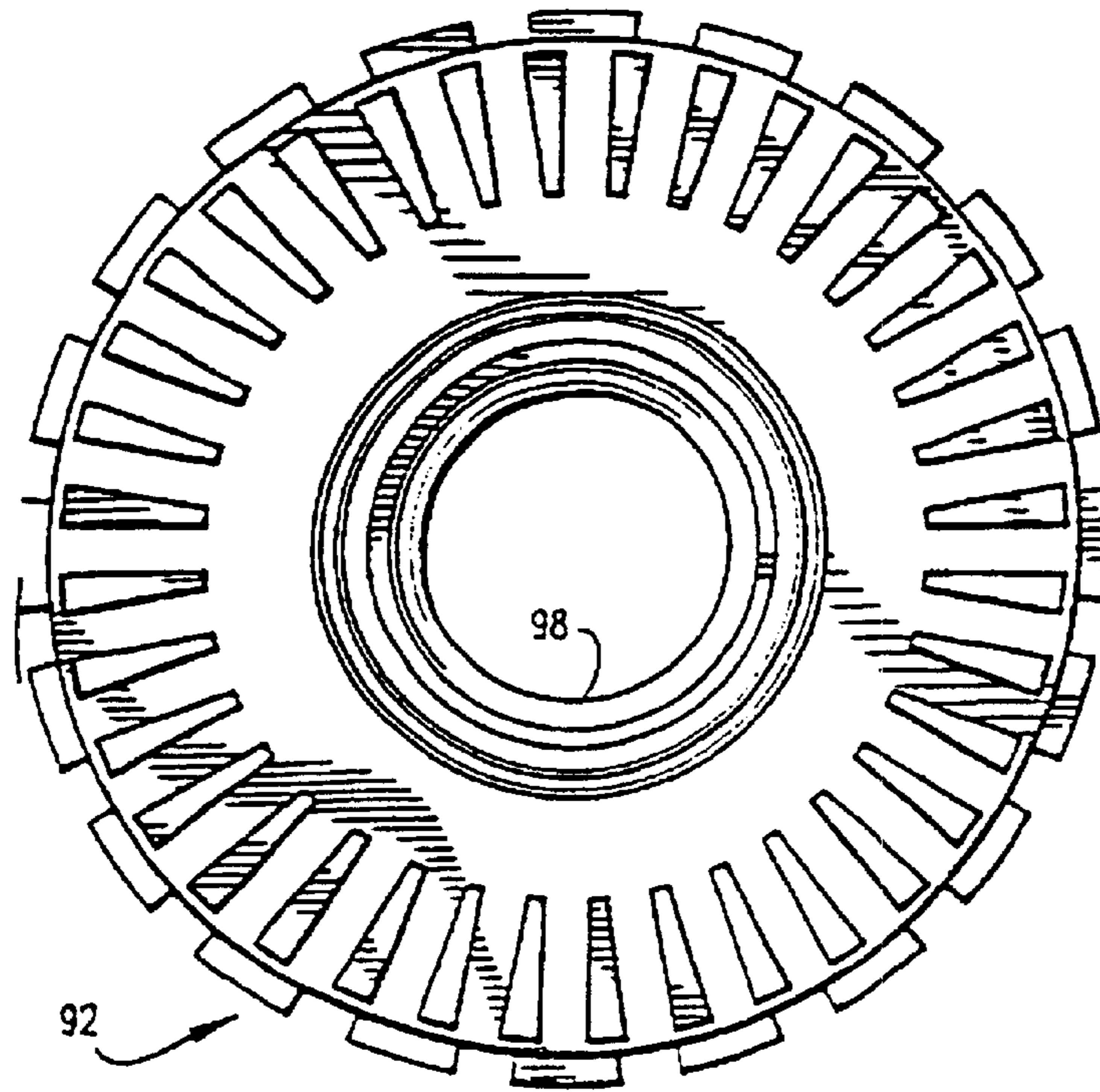


Fig. 19

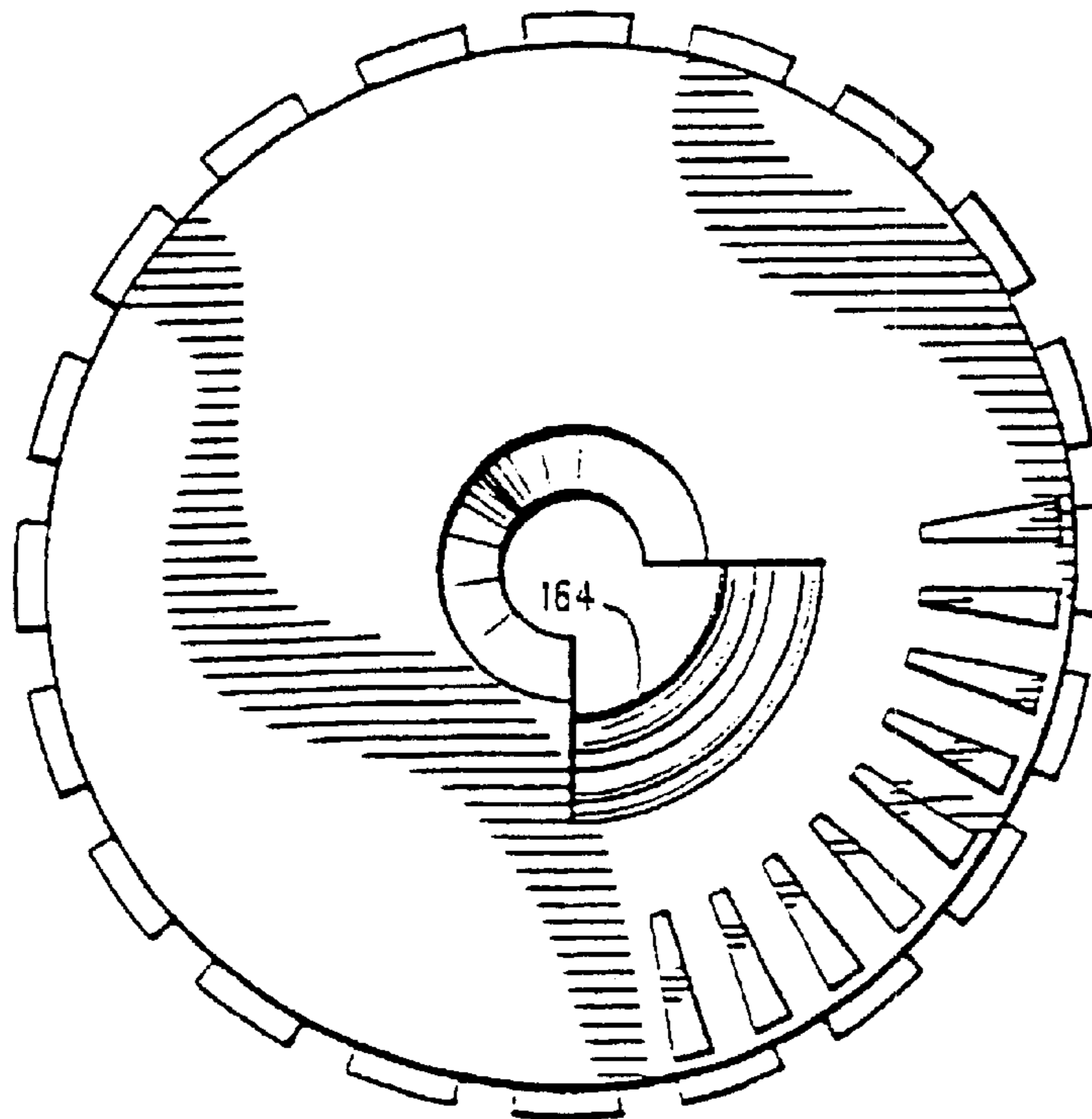


Fig. 20

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**MICRO-STREAM ROTATOR WITH
ADJUSTMENT OF THROW RADIUS AND
FLOW RATE**

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

RELATED APPLICATIONS

This is a continuation-in-part of application Ser. No. 09/433,299 filed Nov. 3, 1999, now U.S. Pat. No. 6,244,521.

TECHNICAL FIELD

This invention relates to landscape and agricultural irrigation sprinklers and, specifically, to a rotating, viscously damped sprinkler which permits adjustment of the stream pattern, throw radius and flow rate.

BACKGROUND

Sprinklers utilizing a fixed nozzle to emit a stream onto the grooves of a viscously damped rotor plate are known in the art and examples of such constructions may be found in commonly owned U.S. Pat. Nos. 5,288,022 and 5,058,806. Sprinklers of this type may be incorporated into pop-up type arrangements or they may be mounted on, for example, fixed riser pipes. In either case, it is possible to employ adjustable or interchangeable nozzles having orifices which emit a 360° stream, a 180° stream, a 90° stream, etc. so as to produce a desired sprinkling pattern, to be determined primarily by the location of the sprinkler. There is also a need, however, to be able to adjust the throw radius and flow rate of the sprinkler without varying the water pressure.

SUMMARY OF THE INVENTION

This invention provides, in one exemplary embodiment, an internal rotary valve in the base of the sprinkler mechanism which can be actuated by pressing down on the sprinkler rotor plate to thereby engage a valve drive mechanism, and then rotating the rotor plate to open or close the internal valve between maximum open or closed positions, or any position therebetween.

In another exemplary embodiment, the flow rate adjustment mechanism incorporates an axially movable flow restrictor that is configured to restrict, but not completely shut off, the flow of water to the sprinkler nozzle.

As is well known in the art, the rotor plate itself is provided with specially configured grooves which cause the rotor plate to rotate when a stream emitted from the nozzle impinges on the grooves. The plate itself is mounted for rotation about a normally fixed, i.e., non-rotating shaft. Within the rotor plate, there is a chamber adapted to be at least partially filled with a high viscosity fluid. At the same time, there is a fixed stator mounted on the shaft, located within the chamber. As the rotor plate and chamber wall rotate about the shaft and the fixed stator, shearing of the viscous fluid occurs, slowing down the rotation of the rotor plate to produce a uniform and more well defined pattern. The shaft extends out of the rotor plate and into the sprinkler body, through the center of the nozzle. The nozzle itself is interchangeable with other nozzles having various opening configurations.

In one exemplary embodiment, the nozzle and an underlying generally cylindrical core flow path component are sandwiched between a removable sprinkler body cap and a baffle

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fixed to the lower end of the shaft for rotation with the shaft. The baffle contains a series of spokes or lobes which can rotate relative to ports formed in the core flow path component to regulate the amount of water flowing to the nozzle.

5 A rotor plate cap, held in place on the rotor plate by a retainer ring, is formed with an annular array of teeth adapted to engage with a mating annular array of teeth formed in the upper surface of the stator within the fluid chamber. The rotor plate cap and rotor plate can be pressed downwardly (assuming an upright orientation for the sprinkler) on the shaft (and relative to the shaft) so as to cause the teeth on the rotor plate cap and the fixed stator to engage. With the teeth so engaged, a "drive" mechanism is established between the rotor plate and the shaft so that manual rotation of the rotor plate causes the shaft to rotate as well. This results in the baffle rotating relative to the core flow path component to thereby throttle the flow through ports in the core to achieve the desired throw radius. When the rotor plate is returned upwardly to its original position, the respective teeth on the rotor plate cap and stator are disengaged, and the rotor plate is then free to rotate relative to the shaft in a normal operating mode.

In a second exemplary embodiment, the sprinkler body is simplified by incorporating three separate component parts, i.e., the sprinkler body cap, an inner sleeve and a part of the nozzle into a single base piece. The remaining components are mounted on the shaft, including a second nozzle component and the flow rate adjustment mechanism. With regard to the latter, a collar is press fit onto the lower end of the shaft, with threads formed on its exterior surface. A sleeve-like throttle member, constrained against rotation by interaction with a spider component, is threaded onto the collar so that manual rotation of the axially stationary shaft results in the throttle member moving up or down on the shaft, depending upon the direction of rotation of the shaft. The throttle member thus moves axially toward or away from a fixed seat secured to an otherwise conventional filter device which is itself fixed to the lower end of the base. The fixed seat comprises four vertically extending ribs in an annular array so that, when the throttle member is fully engaged with the seat, water flow to the nozzle will be restricted but not shut off. The way in which the shaft is rotated manually via the rotor plate to make the desired adjustment is otherwise as described above in connection with the first embodiment.

Thus, in accordance with its broader aspects, the present invention relates to a rotating stream sprinkler comprising a rotor plate supported on one end of a shaft for rotation, in an operative mode, relative to the shaft; a nozzle located along the shaft upstream of the rotor plate; the rotor plate formed with a chamber and one end of the shaft has a stator fixed thereto within the chamber, the fluid chamber at least partially filled with a viscous fluid; and wherein the chamber is at least partially closed at an upper end thereof by a rotor cap plate; and further wherein an underside of the rotor cap plate is provided with a first plurality of teeth and an upper surface of the stator is provided with a second plurality of mating teeth adapted to engage the first plurality of teeth in an adjustment mode.

In accordance with another aspect, the present invention relates to a rotating sprinkler comprising a sprinkler body having an inlet and an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on a shaft downstream of the nozzle and having stream distribution grooves adapted to receive a stream from the nozzle and to distribute the stream; and means for adjusting the flow rate of water flowing to the nozzle.

In accordance with still another aspect, the present invention relates to a rotating sprinkler comprising a sprinkler

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body having an inlet and an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on a shaft for rotation relative to the shaft, the distributor plate located downstream of the nozzle and having stream distribution grooves adapted to receive a stream from the nozzle and to distribute the stream; a flow rate adjustment mechanism comprising a throttle member threadably mounted on the shaft for movement relative to the shaft, toward or away from an annular seat having a discontinuous edge such that the flow rate cannot be shut off by having the throttle member engage the seat.

In still another aspect, the present invention relates to a rotating stream sprinkler comprising means for delivering liquid to a nozzle; means downstream of the nozzle for distributing liquid emitted from the nozzle in a desired sprinkling pattern; means for adjusting flow rate of water to the nozzle; and means for controlling speed of rotation of the means for distributing the liquid.

In still another aspect, the present invention relates to a rotating sprinkler comprising a sprinkler body; having an inlet, an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on a shaft for rotation relative to the shaft, the distributor plate located downstream of the nozzle and having stream distribution grooves adapted to receive a stream from the nozzle and to distribute the stream; the distributor plate having a chamber formed therein at least partially filled with a viscous fluid, and a stator fixed to the shaft within the chamber, wherein rotational speed of the rotatable stream distributor plate is viscously dampened; and a flow rate adjustment mechanism comprising a throttle member threadably mounted for movement relative to the shaft, toward or away from an annular seat upstream of the throttle member.

Other advantages of the subject invention will become apparent from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial side elevation of a micro-stream rotating type sprinkler in accordance with a first embodiment of the invention;

FIG. 2 is a partial side section similar to FIG. 1, but with the rotor plate of the sprinkler pressed downwardly to a position that permits adjustment of the flow rate;

FIG. 3 is a bottom plan view of a baffle and core flow through component, with the ports in the core wide open;

FIG. 4 is a view similar to FIG. 3 but illustrating the baffle rotated to a position that partially closes the ports in the core;

FIG. 5 is a view similar to FIG. 4 but with the baffle rotated to a position that fully closes the ports in the core;

FIG. 6 is a partial side section of a micro-stream rotator in accordance with a variation of the embodiment shown in FIGS. 1-5;

FIG. 7 is a top plan view of the core flow path component incorporated in FIGS. 1 and 2 and shown partially in FIGS. 3-5;

FIG. 8 is a top plan view of the nozzle component incorporated in the sprinkler shown in FIGS. 1, 2 and 6;

FIG. 9 is a side elevation of the nozzle component shown in FIG. 8 but rotated 90° in a clockwise direction;

FIG. 10 is a top plan view of the sprinkler body cap incorporated in the sprinkler shown in FIGS. 1, 2 and 6;

FIG. 11 is a top plan view of the stator component incorporated in the sprinkler shown in FIGS. 1, 2 and 6;

FIG. 12 is a bottom plan view of the rotor plate cap component incorporated in the sprinkler shown in FIGS. 1, 2 and 6; and

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FIG. 13 is a perspective view of a micro-stream rotating type sprinkler in accordance with a second and preferred embodiment of the invention;

FIG. 14 is a cross section of the sprinkler shown in FIG. 13;

FIG. 15 is a perspective view of a throttle member incorporated in the sprinkler shown in FIG. 14;

FIG. 16 is a perspective view of a spider component incorporated in the sprinkler shown in FIG. 14;

FIG. 17 is a perspective view of a part of a filter incorporating a flow restrictor seat incorporated in the sprinkler shown in FIG. 14;

FIG. 18 is a top plan view of the filter illustrated in FIG. 17;

FIG. 19 is a plan view of the sprinkler base incorporated in the sprinkler shown in FIGS. 13 and 14; and

FIG. 20 is a plan view of a variation of the sprinkler body cap shown in FIG. 19.

DETAILED DESCRIPTION OF THE DRAWINGS

With reference now to FIG. 1, a rotary sprinkler device 10 is shown in connection with a well known pop-up sprinkler (partially shown) which includes a generally cylindrical riser or outer sleeve 12 which moves up and down within a sprinkler body (not shown) in response to water pressure. A pop-up sprinkler of this type is disclosed in the '806 patent, but this invention may be used with other pop-up sprinklers as well. The sleeve or riser 12 has a threaded upper end 14 to which is threadably engaged a sprinkler body cap 16. The sprinkler mechanism in accordance with this invention is supported within the riser 12 by means of an inner sleeve 18 having a radially outwardly directed flange 20 at the upper end thereof. The inner sleeve 18 is supported on the upper edge of the threaded upper end 14 of the outer sleeve or riser 12 and is held in place by the cap 16. The sprinkling mechanism itself includes a rotor plate or rotatable stream distributor plate 22, the underside of which is formed with a plurality of off-center circumferentially arranged grooves 24 which are configured to cause the rotor plate to rotate when a stream emitted from the sprinkler body impinges on the grooves. The rotor plate is supported on a generally stationary shaft 26 for rotation relative to the shaft. Within the rotor plate, there is a dish-shaped bearing 28, the lower end of which is formed with a hole 29 through which the shaft 26 passes. The upper end of the bearing is engaged by a lower edge 31 of an annular rotor body cap 30, these two components defining an internal fluid chamber 32. A fixed stator 34 is press fit onto the shaft 26 and is located within the chamber. The chamber is adapted to be filled or partially filled with a highly viscous fluid in order to slow the rotating or whirling speed of the rotor plate to a degree which maximizes stream uniformity. The rotor plate cap 30 is secured to the rotor plate 22 by means of an annular retainer ring 36. An annular flex seal 37 seals the lower end of the chamber 32 to prevent leakage of fluid as well as to prevent the ingress of dirt or debris into the chamber. The upper end of the chamber 32 is sealed by a plug 35 press fit in the top of the rotor plate cap 30. It is significant that there is a space between the top of the shaft 26 and the plug 35 which permits axial downward movement of the rotor plate 22 on and relative to the shaft 26 as explained further below.

The opposite end of the shaft 26 supports three axially aligned components within the inner sleeve 18 in the sprinkler body. The first of these components is a baffle 38 (see also FIGS. 3-5) fixed to the lower end of the shaft 26. A core

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flow path component **40** is slidably received on the shaft above the baffle **38**, and includes an inner wall **42** and an outer wall **44** with an annular space therebetween. The space is divided into four discrete flow passages by internal ribs **43a, b, c** and **d**. These passages are accessed by four ports **46a, b, c** and **d** at the lower end of the core, best seen in FIGS. **1** and **7**. The ports **46** are smaller in cross sectional area than the passages themselves.

Supported above the core component is an annular nozzle **48** which has an open lower end axially aligned with the flow passages in the core component. The upper end of the nozzle has a restricted orifice **50** which may extend, e.g., 360° , about the shaft **26**; 180° (see especially FIG. **8**) about the shaft; or 90° about the shaft, depending on the desired shape of the sprinkling pattern. In the illustrated embodiment, the orifice extends approximately 180° . Note that the sprinkler body cap **16** includes a similarly shaped orifice **52** extending about a conically shaped, annular mounting sleeve **54** through which the shaft **26** passes.

With reference now also to FIGS. **8** and **9**, the nozzle component **48** has a depending tab **56** which seats within one of the discrete flow passages in the core flow path component **40**. At the same time, the upper end of the nozzle component **48** is provided with a raised arcuate rib **58** extending approximately 180° about the circumference of the nozzle component, that is adapted to seat within the similarly shaped groove **60** on the underside of the sprinkler body cap **16** (see FIG. **10**). Since the cap **16** is threadably secured on the riser **12**, it will be appreciated that by "keying" the nozzle to both the core flow path component **40** and the sprinkler body cap **16** (via tab **56** and rib **58**, respectively), the core flow path component **40** and the nozzle **48** are prevented from any rotation within the sleeve **18**. On the other hand, the baffle **38** is rotatable with the shaft **26** relative to the ports **46a, b, c** and **d** in an adjustment mode as described further below.

Returning to FIG. **1**, it may be seen that the underside of the rotor plate cap **30** is provided with an annular array of teeth **62** and the upper surface of the stator **34** is provided with an annular array of mating teeth **64**. Since the shaft **26** is sized to allow an axial space **66** between the upper end of the shaft and the plug **35** which prevents escape of any viscous fluid from the upper end of the rotor plate, the rotor plate **22** as well as the rotor body cap **30** and bearing **28** can be pressed downwardly along the shaft **26** relative to the fixed stator **34**. This movement is apparent from FIG. **2** which shows the mating teeth **60** and **62** in engagement by reason of a downward pressing action on the rotor plate **22**. With the rotor plate and stator so engaged, it will be appreciated that by rotating the rotor plate, the shaft **26** as well as the baffle **38** at the lower end of the shaft will rotate relative to the fixed core component **40**.

Turning now to FIGS. **3-5**, it can be seen that radially extending lobes **68** on the baffle **38** are rotatable between a fully open position as shown in FIG. **3**, where the ports **46a** through **d** in the core flow path component **40** are wide open, and where the lobes **68** have been rotated against one side of stop elements **70** to positions as shown in either FIG. **4** or **5** (or anywhere in between). Thus, in FIG. **4**, the baffle **38** has been shown rotated slightly in a counterclockwise direction to partially close the ports **46a** through **d**. This will reduce the flow rate of water through the apertures and into the nozzle component, thus reducing both the flow rate and the radius of throw of the emitted stream. FIG. **5** illustrates a condition where the baffle **38** has been rotated to the maximum extent possible in a counterclockwise direction, so that the lobes **68** engage the opposite sides of stop elements **70**,

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and, in this position, the ports **46a** through **d** in the core flow path component **40** are fully closed, thus preventing any flow from reaching the nozzle component. It is not necessarily anticipated that the ports would be fully closed in any normal application, but the drawings nevertheless indicate the full range of movement of the baffle **38**.

Returning to FIG. **2**, after the flow adjustment-described above, the rotor plate **22** is pulled upwardly and returned to the position shown in FIG. **1** such that the mating arrays of teeth **62** and **64** will become disengaged so that rotation of the rotor plate **22** will not cause commensurate rotation of the shaft **26**. Thus, when water flows through the nozzle **48** and impinges on the grooves **24**, the rotor plate **22** will rotate about the shaft **26** to distribute the water stream radially outwardly in the desired sprinkling pattern, with a reduced (or increased) radius of throw and reduced (or increased) flow rate, depending on the adjustment.

In FIG. **6**, an alternative sprinkler arrangement is shown where the sprinkler mechanism as described above (indicated generally by numeral **72**) is mounted on a fixed riser **74**, rather than in a pop-up type sprinkler body. In this embodiment, an adapter **76** is threadably engaged between the fixed riser **74** and a cap **78** similar to sprinkler body cap **16**. Note also that flanged sleeve **80** (similar to sleeve **18**) is supported on the upper edge of the adapter **76** and sandwiched between the upper edge of the adapter and the cap **78**.

In both of the illustrated embodiments, a filter element **82** (or **84**) is supported by the respective sleeves **18** and **80**, but is not considered part of the invention per se.

Turning now to FIG. **13**, a sprinkler **86** in accordance with a preferred embodiment of the invention is illustrated. In this embodiment, a base piece or component **88** combines the earlier described sprinkler body cap **16** and inner sleeve **18** into a single, integral part. The base **88** thus includes an inner sleeve portion **90** and a cap portion **92** having an interiorly threaded flange **94** by which the sprinkler may be attached to a riser or sleeve (as shown, for example, at **12** in FIG. **1**) or the like. The base **88** is also formed with a downwardly and radially inwardly tapering surface **96** terminating at an annular edge **98** defining the outer radius (or diameter) of the nozzle orifice.

A shaft **100** extends from the base **88** through the nozzle orifice and into a rotor plate **102** that, like the rotor plate **22**, is formed with a plurality of off-center, circumferentially arranged grooves **104** that are configured to cause the rotor plate to rotate relative to the shaft **100** when a stream emitted from the nozzle impinges on the grooves **104**.

The rotor plate **102** is formed with an internal fluid chamber **108** that is adapted to be filled (or at least partially filled) with a viscous fluid **110**. The shaft **100** extends through the chamber, with the remote end **112** of the shaft seated in a recess **114** formed in the cap **116**. The latter is press fit within the rotor plate, seated on an annular ledge **118** and partially closing the chamber **108**. The upper end of the chamber is then sealed by a cover **120**. An O-ring **121** sits on an annular shoulder **123** and also engages the cover **120** to thereby seal the chamber **108**, preventing leakage around the upper end **112** of the shaft **100**. Note that the shaft is loosely seated in recess **114**, allowing the rotor plate to rotate about the shaft.

A stator **122** is fixed to the shaft **100** and located within the chamber **108**. Stator **122** engages a bearing **124**, loosely fit on the shaft. An annular seal **126** is captured between the bearing **124** and a lower edge **128** of the rotor plate to thereby seal the lower end of the rotor plate against leakage

from the chamber **108**. Thus, in a manner similar to the earlier described embodiment, rotation of the rotor plate will be slowed by the viscous shearing of fluid between the stator **122** and the rotor plate wall forming the chamber **108**.

A deflector **130**, is press fit onto the shaft **100** so as to be located adjacent the nozzle outer edge **98**. The deflector **130** is formed with an inwardly and downwardly tapering (as viewed in FIG. **14**) surface **132** and a lower cylindrical portion **134**. Thus, the nozzle orifice **136** is defined by the outer edge **98** and the lowermost part of the tapered surface **132** of the deflector **130**. Note that the tapered surface **132** of the nozzle will produce a stream that exits the nozzle orifice at about a 20° angle to the shaft axis. In the event the nozzle orifice extends a full 360°, then the edge **98** defines the nozzle orifice OD and surface **132** of the deflector **130** defines the nozzle orifice ID. It should be noted that by keeping the nozzle orifice close to the shaft axis, for any given flow rate, the nozzle opening is maximized to thereby reduce the possibility of plugging.

An elastomeric shield **131** is seated in a groove **133** formed at the upper end of the deflector **130**, with an angled flange **135** extending upwardly and radially outwardly toward the apex of the rotor plate. This shield serves to insure that water will not impinge upon the seal **126**, and it prevents said particles from becoming jammed between the rotor plate **86** and the sprinkler body cap portion **92**. This arrangement, along with the deflector **130** itself, facilitates keeping the nozzle orifice close to the shaft axis while at the same time insuring that the stream is directed to the grooves in the rotor plate.

Within the sprinkler base component **88**, a spider component **138** is located on the shaft, below the deflector **130**. The spider **138**, best seen in FIG. **16**, includes a tubular sleeve portion **140** which slides over the shaft **100**, and a plurality (preferably four at 90° intervals) of radially outwardly extending ribs **142** having lower portions **144** that extend beyond (below) the sleeve portion **140**. Rib portions **144** of two opposed ribs **142** are receivable within or between respective pairs of axial ribs **146**, **148** provided on the external surface of a throttle member **150**. The throttle member **150** is cylindrical in shape, with a threaded interior bore **152**. A collar **154** is threaded on its exterior surface **156** so that the throttle member can be threaded onto the collar. After the deflector **130** and spider **138** are in place on the shaft **100**, the sub-assembly of the throttle member **150** and collar **154** is press fit onto the shaft. This sub-assembly is oriented so that the lower rib portions **144** are located between the rib pairs **146**, **148**, ensuring that the throttle member **150** will not rotate when the shaft **100** is rotated in the adjustment mode. By constraining the throttle member against rotation, it is forced to move axially on the shaft, toward or away from a fixed seat (described below) depending on the direction of rotation of the shaft. A filter **158** may be ultrasonically welded (or otherwise fixed) to the sprinkler base **88** at **160**. This otherwise conventional filter is modified to the extent of having four axially extending ribs **162** arranged at 90° intervals about the inside diameter of the filter. These ribs **162** provide a fixed seat for the throttle member **150** when the latter is in its most restrictive flow position, i.e., fully seated on the ribs **162**. Since the ribs **162** present a discontinuous seat to the throttle member **150**, a complete shut-off of the flow is not possible.

FIG. **19** shows the nozzle orifice, as defined by radially outer edge **98** (the deflector **130** and shaft **100** are omitted), extending a full 360°. FIG. **20** shows one alternative nozzle configuration where the nozzle orifice, as defined by radially outer radius **164**, extends only about 90° about the shaft.

Other nozzle orifice configurations producing arcs of e.g., 180° or 270° are also within the scope of the invention.

Thus, for adjustment of the flow rate, the user presses downwardly on the rotor plate, causing the teeth **164** on the inside of the rotor body cap to engage with the teeth **166** on the upper surface of the stator establishing a drive mechanism by which the shaft will rotate with the rotor plate, causing the throttle member **150** to move upwardly or downwardly on the shaft **100** depending on the direction of rotation of the rotor plate. In this manner, the flow rate of water to the nozzle may be adjusted as desired.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A rotating stream sprinkler comprising:

a rotor plate supported on one end of a shaft for rotation, in an operative mode, relative to the shaft; a nozzle located along said shaft upstream of said rotor plate, said shaft and said nozzle supported within a base component of the sprinkler; said rotor plate formed with a chamber, with one end of said shaft having a stator fixed thereto within said chamber, said chamber at least partially filled with a viscous fluid; and wherein said chamber is at least partially closed at an upper end thereof by a rotor plate cap; and further wherein an underside of said rotor plate cap is provided with a first plurality of teeth and an upper surface of said stator is provided with a second plurality of teeth adapted to engage said first plurality of teeth to enable rotation of said rotor plate with said shaft in an adjustment mode.

2. The rotating stream sprinkler of claim 1 wherein said rotor plate is movable axially on said shaft to enable engagement of said first and second plurality of teeth.

3. The rotating stream sprinkler of claim 1 wherein said rotor plate is formed with a plurality of grooves in an exterior surface thereof adapted to receive a stream from said nozzle, said grooves configured to cause said rotor plate to rotate when said stream impinges on said grooves.

4. The rotating stream sprinkler of claim 1 wherein said shaft has an opposite threaded end and a throttle member threadably mounted on said opposite end, such that when said shaft is rotated with said first and second plurality of teeth engaged in said adjustment mode, said throttle member moves axially on said shaft.

5. The rotating stream sprinkler of claim 4 and further comprising a plurality of vertically arranged, circumferentially spaced ribs axially adjacent said throttle member and serving as a seat for said throttle member when said throttle member is moved to a most restrictive flow position.

6. The rotating stream sprinkler of claim 5 wherein said throttle has a plurality of axial ribs on an exterior surface thereof and adapted to intermesh with a plurality of axially extending ribs on a spider member fixed within said sprinkler body, thereby preventing said throttle member from rotating.

7. The rotating stream sprinkler of claim 6 wherein said spider member is mounted on said shaft axially between said nozzle and said throttle member.

8. The rotating stream sprinkler of claim 7 wherein a threaded collar is press fit on said shaft and said throttle member is threadably mounted on said collar.

9. The rotating stream sprinkler of claim 1 wherein said nozzle comprises radially inner and outer components, configured to emit a stream at an angle to a central axis of said sprinkler.

10. The sprinkler of claim 1 wherein said distributor plate includes a chamber at least partially filled with a viscous fluid and wherein a stator is fixed to said shaft within said chamber.

11. A rotating stream sprinkler assembly comprising a 5
sprinkler having an inlet, an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on a shaft downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to distribute said stream, said shaft and said nozzle supported within a base component of the sprinkler; and means for adjusting the flow rate of water flowing to said nozzle.

12. The rotating stream sprinkler of claim 11 wherein said nozzle is interchangeable with similar nozzles, each having a different sprinkling pattern.

13. The rotating stream sprinkler of claim 12 wherein said means is accessible exteriorly of said sprinkler body.

14. The rotating stream sprinkler of claim 11 wherein said distributor plate includes a chamber at least partially filled with a viscous fluid and wherein a stator is fixed to said shaft within said chamber.

15. The rotating stream sprinkler of claim 11 wherein said nozzle is configured to emit the stream to atmosphere at an angle relative to a center axis of said sprinkler body.

16. The rotating stream sprinkler of claim 15 wherein said shaft lies in said center axis, and wherein said nozzle includes a substantially conical deflector fixed on said shaft.

17. The rotating stream sprinkler of claim 16 wherein said deflector mounts an annular shield extending toward said stream distribution plate.

18. The rotating stream sprinkler of claim 16 wherein said nozzle and said conical deflector cooperate to emit the stream at an angle of about 20° relative to said center axis.

19. The rotating stream sprinkler of claim 11 wherein said stream distributor plate is in the shape of a truncated and inverted cone with grooves formed therein, a radially inner edge thereof forming an apex, said apex lying radially outwardly of an orifice of said nozzle.

20. The rotating stream sprinkler of claim 11 wherein said stream distribution plate has a plurality of circumferentially offset grooves so as to cause said plate to rotate when a stream from said nozzle impinges on said grooves.

21. A rotating stream sprinkler assembly comprising a sprinkler body having an inlet and an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on a shaft for rotation relative to the shaft, the distributor plate located downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to distribute said stream; a flow rate adjustment mechanism comprising a throttle member threadably mounted on said shaft for movement relative to said shaft, toward or away from an annular seat having a discontinuous edge such that the flow rate cannot be shut off by having said throttle member engage said seat.

22. The rotating stream sprinkler of claim 21 wherein said distributor plate rotates relative to said shaft during normal operation but rotates with said shaft during flow rate adjustment.

23. The rotating stream sprinkler of claim 22 including means for preventing said throttle member from rotating with said shaft during said flow rate adjustment.

24. The rotating stream sprinkler of claim 21 wherein said distributor plate includes a chamber at least partially filled with a viscous fluid and wherein a stator is fixed to said shaft within said chamber.

25. The rotating stream sprinkler of claim 21 wherein said discontinuous edge is defined by a plurality of circumferentially spaced, axially extending ribs.

26. A rotating stream sprinkler comprising means for delivering liquid to a nozzle; means downstream of said nozzle for distributing liquid emitted from said nozzle in a desired sprinkling pattern; means for adjusting flow rate of water to said nozzle; and means for controlling a speed of rotation of said means for distributing said liquid.

27. A rotating stream sprinkler comprising a sprinkler body having an inlet and an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on a shaft for rotation relative to the shaft, the distributor plate located downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to distribute said stream; said distributor plate having a chamber formed therein at least partially filled with a viscous fluid, and a stator fixed to said shaft within said chamber, wherein rotational speed of said rotatable stream distributor plate is viscously dampened; and a flow rate adjustment mechanism comprising a throttle member threadably mounted for movement relative to said shaft, toward or away from an annular seat upstream of said throttle member.

28. The rotating stream sprinkler of claim 27 wherein said annular seat has a discontinuous edge such that the flow rate cannot be shut off by having said throttle member engage said seat.

29. A rotating stream sprinkler assembly including a sleeve having an inlet and an outlet including a stationary nozzle; a rotatable stream distributor plate mounted on one end of a shaft for rotation relative to the shaft, said shaft supported in said sleeve, the distributor plate located downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to distribute said stream; a flow rate adjustment mechanism comprising a throttle member threadably mounted on said shaft for movement within said sleeve, relative to said shaft, toward or away from an annular seat having a discontinuous edge such that the flow rate cannot be shut off by having said throttle member engage said seat.

30. *A rotating stream sprinkler assembly comprising a sprinkler having an inlet, an outlet including a nozzle; a rotatable stream distributor plate mounted on a normally non-rotatable shaft downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to cause said distributor plate to rotate relative to said shaft in an operational mode to thereby distribute said stream, and a pair of throttle components including a first throttle component fixed to said shaft and having flow restriction surfaces thereon, and a second stationary throttle component located axially between said nozzle and said first throttle component and having flow ports therein, wherein said shaft and said first throttle component are rotatable in an adjustment mode to rotate said first throttle component relative to said second throttle component such that said flow restriction surfaces rotate relative to said flow ports to increase or decrease flow through said flow component and said nozzle.*

31. *The rotating stream sprinkler assembly of claim 30 wherein said nozzle is stationary.*

32. *The rotating stream sprinkler of claim 30 wherein said nozzle is interchangeable with similar nozzles, each adapted to produce a different sprinkling pattern.*

33. *A method of adjusting flow rate to a stationary nozzle in a rotating stream sprinkler where the nozzle is supported in an operative mode on one end of a shaft that is non-rotatable in said operative mode, and where a stream distributor plate is supported on the shaft for rotation relative to the shaft, axially downstream of the nozzle, the method comprising:*

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- (a) providing a pair of throttle components on the shaft upstream of the nozzle, one of said pair of throttle components fixed to an opposite end of the shaft and the other of said throttle components located axially between the first throttle component and the nozzle and keyed to the nozzle to prevent rotation thereof; and
- (b) in an adjustment mode, rotating said shaft and said first throttle component relative to said second throttle component to thereby adjust flow to the nozzle.
34. The method of claim 33 wherein step (b) is accomplished by engaging cooperating drive elements in said distributor plate and manually rotating said distributor plate.
35. A rotating stream sprinkler assembly comprising:
 a sprinkler having an inlet;
 an outlet including a nozzle;
 a rotatable stream distributor plate mounted on a normally non-rotatable shaft downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to cause said distributor plate to rotate relative to said shaft in an operational mode to thereby distribute said stream, and
 a pair of throttle components including a first throttle component fixed to said shaft and having flow restriction surfaces thereon, and a second throttle component having flow ports therein, wherein said shaft and said first throttle component are rotatable in an adjustment mode to rotate said first throttle component relative to said second throttle component such that said flow restriction surfaces rotate relative to said flow ports to increase or decrease flow through said flow component and said nozzle.
36. The rotating stream sprinkler of claim 35 wherein said nozzle is stationary.
37. The rotating stream sprinkler of claim 35 wherein said nozzle is interchangeable with similar nozzles, each adapted to produce a different sprinkling pattern.
38. The rotating stream sprinkler of claim 35 wherein said second throttle component is located axially between said nozzle and said first throttle component.
39. A method of adjusting flow rate to a stationary nozzle in a rotating stream sprinkler where the nozzle is supported in an operative mode on one end of a shaft that is non-

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- rotatable in said operative mode, and where a stream distributor plate is supported on the shaft for rotation relative to the shaft, axially downstream of the nozzle, the method comprising:
- (a) providing a pair of throttle components on the shaft upstream of the nozzle, said pair of throttle components including a first throttle component fixed to the shaft and a second throttle component keyed to the nozzle to prevent rotation thereof; and
- (b) in an adjustment mode, rotating said shaft and said first throttle component relative to said second throttle component to thereby adjust flow to the nozzle.
40. The method of claim 39 wherein step (b) is accomplished by engaging cooperating drive elements in said distributor plate and manually rotating said distributor plate.
41. The method of claim 39 wherein said first throttle component is fixed to an opposite end of the shaft.
42. The method of claim 39 wherein said second throttle component is located axially between said nozzle and said first throttle component.
43. A rotating stream sprinkler assembly comprising:
 a sprinkler having an inlet;
 a nozzle;
 a rotatable stream distributor plate mounted on a normally non-rotatable shaft downstream of said nozzle and having stream distribution grooves adapted to receive a stream from said nozzle and to cause said distributor plate to rotate relative to said shaft in an operational mode to thereby distribute said stream, and
 a pair of throttle components including a first throttle component fixed to said shaft and having one or more flow restriction surfaces thereon, and a second throttle component having at least one flow port therein, wherein said shaft and said first throttle component are rotatable in an adjustment mode to rotate said first throttle component relative to said second throttle component such that said one or more flow restriction surfaces rotate relative to said at least one flow port to increase or decrease flow through said flow component and said nozzle.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : RE40,440 E
APPLICATION NO. : 11/022428
DATED : July 22, 2008
INVENTOR(S) : George L. Sesser

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

Column 1 line 9 - Please insert

-- Notice: More than one reissue application has been filed for the reissue of U.S. Patent No. 6,499,672. The reissue applications of U.S. Patent No. 6,499,672 are U.S. Patent Application 13/205,591, filed August 8, 2011, U.S. Patent Application No. 11/871,456, filed October 12, 2007, now U.S. Patent No. RE42,596, and U.S. Patent Application No. 11/022,428, filed December 27, 2004, now U.S. Patent No. RE40,440. This application is a reissue application of U.S. Patent Application No. 09/532,772, filed March 22, 2000, now U.S. Patent No. 6,499,672, which is a continuation-in-part of U.S. Patent Application No. 09/433,299, filed Nov. 3, 1999, now U.S. Pat. No. 6,244,521. --

Signed and Sealed this
Sixth Day of May, 2014



Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office