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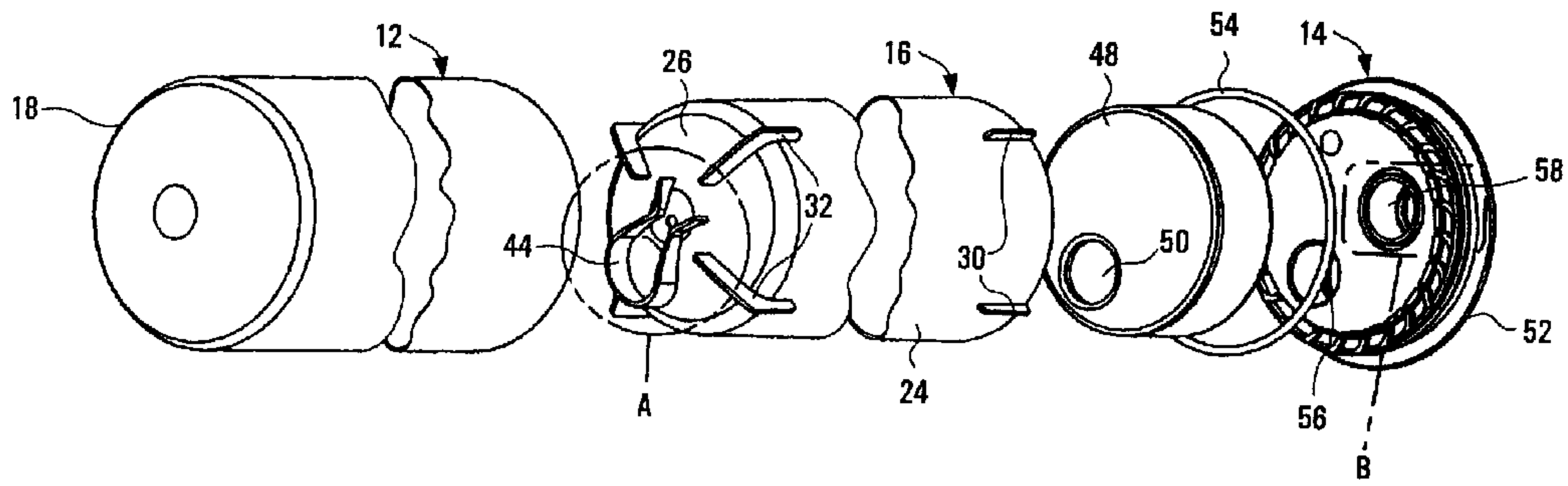
(71) Demandeur/Applicant:
HALLA CLIMATE CONTROL CANADA INC., CA

(72) Inventeurs/Inventors:
DICKSON, TIMOTHY RUSSELL, CA;
CRAM, KENNETH PETER LUKE, CA;
NUSS, MATTHEW BRYAN, CA;
RHODES, STEVEN MURRAY, CA;
RYU, KI-SUN JASON, CA;
STOBBART, MICHELLE MARIE, CA

(74) Agent: SMART & BIGGAR

(54) Titre : ACCUMULATEUR DE SYSTEME DE CONDITIONNEMENT D'AIR
(54) Title: ACCUMULATOR FOR AN AIR-CONDITIONING SYSTEM



(57) Abrégé/Abstract:
The present invention is for an accumulator for an air-conditioning system wherein the accumulator has fewer parts, is more effective, and is easier and cheaper to manufacture. It reduces flooding due to greater effective internal volume, better evaporator, an integral baffle, and controlled thermal properties. Further, the inlet fluid separation can be controlled, and it has greater control of the amount of compressor oil in circulation and adjustable coupling between the interior and the outlet passage. It can also accommodate desiccating material in many orientations, and can be made of various materials. The accumulator embodies an outer housing of two or more pieces and an inner liner that is of one or more pieces. The inlet directs the refrigerant into the inner volume formed by the liner, wherein the liquid refrigerant and compressor oil are contained and insulated from the wall of the outer housing.

ABSTRACT

The present invention is for an accumulator for an air-conditioning system wherein the accumulator has fewer parts, is more effective, and is easier and cheaper to manufacture. It reduces flooding due to greater effective internal volume, better evaporator, an integral baffle, and controlled thermal properties. Further, the inlet fluid separation can be controlled, and it has greater control of the amount of compressor oil in circulation and adjustable coupling between the interior and the outlet passage. It can also accommodate desiccating material in many orientations, and can be made of various materials. The accumulator embodies an outer housing of two or more pieces and an inner liner that is of one or more pieces. The inlet directs the refrigerant into the inner volume formed by the liner, wherein the liquid refrigerant and compressor oil are contained and insulated from the wall of the outer housing.

Background of the Invention

Field of the Invention

The present invention relates to an accumulator for use in an air-conditioning system, and more particularly to a suction accumulator for use in an air-conditioning system of a motor vehicle.

Description of the Prior Art

Closed-loop refrigeration systems conventionally employ a compressor that is meant to draw in gaseous refrigerant at relatively low pressure and discharge hot refrigerant at relatively high pressure. The hot refrigerant condenses into liquid as it is cooled in a condenser. A small orifice or valve divides the system into high and low-pressure sides. The liquid on the high-pressure side passes through the orifice or valve and turns into a gas in the evaporator as it picks up heat. At low heat loads it is not desirable or possible to evaporate all the liquid. However, liquid refrigerant entering the compressor (known as "flooding") causes system efficiency loss and can cause damage to the compressor. Hence it is standard practice to include an accumulator between the evaporator and the compressor to separate and store the excess liquid.

An accumulator is typically a metal can, welded together, and often has fittings attached for a switch and/or charge port. One or more inlet tubes and an outlet tube pierce the top, sides, or occasionally the bottom, or attach to fittings provided for that purpose. The refrigerant flowing into a typical accumulator will impinge upon a deflector or baffle intended to reduce the likelihood of liquid flowing out the exit.

There are many inventions of baffles and deflectors in the prior art, all designed to reduce liquid carryover (see for instance US Patents 5787729, 5201792, 5184479, 5021792, 4768355, 4270934, and 4229949), and the prior art includes designs that claim not to need deflectors (US 5179844, US 5471854). However in current standard use most accumulators use a variation of the dome (US 4474035) or "dixie cup" (US 411005) deflector - usually because these are the simplest and most cost-effective.

All deflector designs sacrifice some effective internal volume, as the beginning of the outlet tube must be underneath the deflector. Size is critical in accumulator application, hence there is a need for a more cost-effective design that does not need a deflector.

Some prior art is concerned with reducing the turbulence of the inlet flow (US 5184480) as a way to reduce liquid carryover. Other designs are more concerned with the coupling between the inner reservoir and the outlet passage (US Patents 5660058, 5179844, 4627247), mainly to reduce the pressure drop across the accumulator (a critical system performance parameter).

The outlet tube is a main feature of accumulators in the prior art. Compressor oil is circulated with the refrigerant in all but very special systems. In systems where compressor oil circulates with the refrigerant the oil will settle out of the stream into the bottom of the liquid reservoir area of the accumulator. Some means must be provided to return this oil to circulation. Much of the prior art is concerned with various tubes, shapes and configurations to accomplish this with the minimum amount of oil inventory left in the accumulator (US Patents 5660058, 5778697, 5052193, 4354362, 4199960). The typical current practice uses a J-shaped outlet tube to carry the exiting gaseous refrigerant from the top of the accumulator down to the bottom and then back up to the outlet from the accumulator. A carefully sized orifice at the bottom of the J-tube entrains the oil from the bottom of the liquid area into the stream of exiting gas. Generally the orifice has a filter around it, and the filter and oil pickup may extend into a sump formed in the bottom of the can to collect the oil.

Another key feature of the prior art is the inclusion of a desiccant in the accumulator. Some refrigerant systems are more susceptible to moisture ingression and damage than others, especially less modern systems. For many systems it is necessary to remove any moisture, and the accumulator is a convenient spot to house the desiccant. Many early designs featured desiccant cartridges and the like(US Patents 4509340, 4633679, 4768355, 4331001), but the typical modern usage is a fabric bag of some suitable shape, full of desiccant beads and secured to some inner feature of the accumulator (like the J-tube) where the beads will contact the liquid refrigerant.

Another feature typical of the prior art is an anti-siphon measure, which prevents the liquid from siphoning or flowing out of the accumulator reservoir when the system is switched off. Complicated systems have been proposed (US 5347829), but the standard technique is a hole near the top of the outlet J-tube to break any siphon effect. The size of the hole is a balance between breaking any siphon and reducing the effectiveness of oil pickup.

A further feature typical of the prior art is the use of insulation placed around the outside of accumulators to modify the thermal characteristics (US

5701759). This is an added expense and is only used when required to reduce flooding.

Many examples of prior art (for example US 5365751) are proposed as simple, flexible designs that can be easily manufactured for many installations. Since in practice several designs are in use, it is evident that such a multi-purpose design has not been realized in the prior art. An accumulator with reduced number of parts and improved performance is required.

Summary of the Invention

The invention provides an accumulator for use in an air-conditioning system comprising: a hermetically sealed outer housing comprising a cap, an inlet opening, a peripheral side wall, and a base; an inner liner positioned within said outer housing, said inner liner having a peripheral wall and a base which form a container to receive refrigerant delivered through said inlet opening, said inner liner being spaced from the peripheral wall and the base of said outer housing to define therewith an annular passage, said inner liner having an upper end that lies in contact with or adjacent said cap; passage means extending around the periphery of the upper end of said inner liner and communicating the interior of said inner liner with a first upper end of said annular passage; an outlet passage opening from a second lower end of said annular passage at a location between the base of the inner liner and the base of the outer housing, said outlet passage leading to the exterior of said outer housing; the arrangement being such that vaporized refrigerant can pass through said passage means from said inner liner to the upper end of said annular passage, descend downwards through said annular passage to the opening of said outlet passage, and exit said accumulator via said outlet passage.

The cap may be a separate component that is hermetically sealed to the top of the peripheral side wall of the outer housing and may include the inlet opening and also an outlet port for said outlet passage.

The inner liner preferably includes integral projections on the exterior thereof positioned to engage the outer container and provide a desired spacing therewith.

Preferably said passage means is formed by a substantially continuous gap between the upper end of the inner liner and the cap, and through this gap refrigerant in gaseous state can pass from the inner container to the annular passage where it can descend between the inner and outer walls to reach the outlet passage at the base. The annular gap is preferably baffled so that it is shielded from passage of liquid refrigerant added to the inner container through the inlet. The passage defined by the annular gap can be configured to create turbulence in the flow of refrigerant gas passing therethrough. The interior of the inner container preferably includes baffles to prevent excessive movement of the refrigerant liquid contained therein. Such a baffle may be provided in the form of a desiccant body positioned in the inner container to take up any water that may be present, the desiccant body preventing liquid refrigerant reaching to the top of the inner container as a result of erratic motion of the accumulator, as can typically occur in automotive installations.

The inner container is preferably of low thermal conductivity thus to prevent excessive heating of liquid refrigerant therein as a result of heat radiated from the outer container.

There is preferably a bleed hole in the base of the inner container through which accumulated oil can bleed to become entrained in the flow of refrigerant gas moving towards the outlet passage. Preferably rib means between the bases of the inner and outer containers directs such flow in refrigerant gas to pass over the oil bleed passage.

The invention also provides an accumulator for use in an air-conditioning system comprising: a hermetically sealed outer housing comprising a cap, an inlet opening, an outlet opening, a peripheral side wall, and a base; an inner liner positioned within said outer housing, said inner liner having a peripheral wall and a base which form a container to receive refrigerant delivered through said inlet opening, said inner liner being spaced from the peripheral wall and the base of said outer housing to define therewith an annular clearance, said inner liner having an upper end that lies in contact with or adjacent said cap; passage means for delivering refrigerant vapour from said container to said outlet opening; wherein said inner liner is of low thermal conductivity to shield liquid refrigerant from heat radiation from said outer container. The accumulator may also include any of the previously discussed preferred features.

The preferred embodiment of the accumulator for an air-conditioning system as hereinafter disclosed has fewer parts as compared to the prior art, is more effective, and is easier and cheaper to manufacture. It reduces flooding due to greater effective internal volume, better evaporation, an integral baffle, and controlled thermal properties. The inlet fluid separation can be controlled. Further, it has greater control of the amount of compressor oil in circulation, and adjustable coupling between the interior and the outlet passage. It can also accommodate desiccating material in many orientations, and can be made of various materials.

The outer housing of the accumulator may be of two or more pieces which can be welded, crimped, or otherwise hermetically joined together, and the inner liner has one or more pieces. The outer housing may have various fittings attached for switches, charge ports, or other items. The refrigerant enters the accumulator through an inlet which may be a tube or a hole in the top or side of the outer housing. An inlet tube may be integrally formed or snap-in, or be swaged, brazed, welded or otherwise attached. An inlet hole may be a simple hole or have features formed or machined into it, e.g. a flow director. To direct the flow, reduce turbulence, and/or aid in separating the gaseous refrigerant from the liquid, the inlet may have a diffuser, director, rain hat separator, or flow channellizer attached to, formed with, or held near the inner end. The inlet directs the refrigerant into the inner container formed by the liner. The liquid refrigerant and compressor oil settle to the bottom of the liner where they are contained and insulated from the wall of the outer housing, which may be hot according to the ambient temperature. Hence this arrangement reduces boiling and frothing which might otherwise lead to liquid carryover.

Evaporation of the refrigerant liquids can be controlled by adjusting the thermal connection between the inner liner and the outer housing.

Gaseous refrigerant from the inner container and drawn by the compressor must flow over the top of the inner liner through the annular gap between the liner and the outer housing. This gap may be baffled by features on the outer housing or on the liner, or by separately added pieces. The baffle can reduce the likelihood of liquid refrigerant splashing into the outlet and/or spilling out if the accumulator is tilted.

Furthermore, the peripheral gap can be formed by a plurality of fine holes, or by an attached filter element in order that the refrigerant gas can be filtered as it exits the inner container. The gap may also be sized for optimum flow and/or shaped for optimum coupling between the inner volume and the outlet passage, and may furthermore be designed to impart favourable momentum (e.g. spin) to the exiting refrigerant gas, all with no additional parts or significant additional cost. Since this outlet gap is at the very top of the accumulator the effective internal volume of the accumulator is maximized.

Refrigerant leaving the inner liner must flow down the annular passage between the liner and the outer housing to reach the bottom of the accumulator. The exiting refrigerant is thus in good thermal contact with the outer wall and can pick up heat from the external environment through that wall (which is typically of a good heat conducting material such as aluminium) thus evaporating any liquid refrigerant that may inadvertently have become entrained with the gas. It will be understood that this avoids the above discussed flooding phenomenon.

The outlet passage leading from the bottom of the accumulator towards the exterior may be in the form of a free-standing outlet tube within the liner or attached to an edge thereof, or may even be in thermal contact with the outer housing, again to improve evaporation of any liquid. The discharge end of the outlet tube may be directed out of the top or of the side of the outer housing. The outlet tube is omitted if discharge from the accumulator is arranged to exit at the bottom thereof.

Brief Description of the Drawings

The invention will further be described, by way of example only, with reference to the accompanying drawings wherein:

Figure 1 is an exploded isometric view of a presently preferred embodiment of an accumulator in accordance with the present invention;

Figure 2 is a view similar to Figure 1 but showing the accumulator components from a different perspective;

Figure 3 is an enlarged view of the circled portion A from Figure 2;

Figure 4 is an enlarged view of the outlined portion B from Figure 2;

Figure 5 is a longitudinal sectional view of the assembled accumulator;

Figure 6 is an enlarged view of the circled portion C in Figure 5;

Figure 7 is an enlarged view of the circled portion D in Figure 5; and

Figure 8 is a perspective view of the bottom of the inner container of the accumulator.

Referring to Figures 1 and 2, the components of the accumulator will be seen as comprising a two-part outer housing formed by an open-top bottom can 12 and a head cap 14, and a cup shaped cylindrical inner liner 16 that is sized to fit within the bottom can as shown in Figure 5. As shown, the bottom can 12 is of thin walled cylindrical form and has a rounded base 18 and a circular top edge 20.

The inner liner 16 is similar in shape to the bottom can 12 but is slightly smaller, having a thin cylindrical peripheral wall 24 and a rounded base 26, and fits within the bottom can 12 as shown in Figure 5, the walls and bases of the bottom can 12 and inner liner 16 being mutually spaced to define an annular passage 28 which extends downwards from the top of the inner liner wall 16 to the base thereof.

Two sets of integral projections 30, 32 carried on the inner liner 16 are positioned to engage the inner sides of the bottom can wall and base (as shown in Figure 5) and cooperate therewith to maintain the inner liner 16 at the desired location coaxially within the outer can 12.

A tubular conduit 34 has an opening 36 at the base 26 of the inner liner, the tubular conduit extending vertically within the inner liner to an upper end 38.

In the base 26 of the liner at its lowermost point is a small oil bleed hole 40 at the upper side of which is an oil filter 42 within the bottom of the inner liner container. The base of the inner liner 16 also carries an integral somewhat U-shaped wall 44 (Figure 3) which has a bight portion which surrounds part of the periphery of the opening 36 and two limbs which extend across the base first convergently and then divergently to form a narrowed throat 46 in the vicinity of the oil bleed hole 40.

The wall 44 spans the spacing between the inner liner base 26 and the bottom can base 18.

A disc-shaped desiccant container 48 is located within the inner liner 16, the desiccant container being secured by any suitable means (not shown) to the tubular conduit 34 in the upper portion of the inner liner 16 as seen in Figure 5, the container having a hole 50 through it in which the tubular conduit 34 is received. The desiccant container 48 has an outer diameter which fits closely against the interior of the wall 24 of the inner liner. The desiccant container 48 substantially fills the cross section of the inner liner 16, but is porous to a degree sufficient to permit flow of gas and drainage of liquid therethrough. However the desiccant container 48 is sufficiently dense as to prevent "sloshing" of liquid from the lower side to the upper side thereof e.g. during cornering, acceleration, or braking of an automobile.

The head cap 14 is of cylindrical disc-like form and is joined to the bottom can 12 as shown in Figure 5 by an hermetic seal provided by swaging or crimping of a peripheral lip on the head can 14 into tight engagement with the upper edge 20 of the bottom can, and by the inclusion of an O-ring seal 54 received in a peripheral groove of the head cap 14 and engaging the inner surface of the wall of the bottom can.

The upper end 38 of the tubular conduit 34 is seated in an outlet port 56 in the head cap 14 and sealed thereto by any suitable means.

An inlet port 58 also extends through the head cap 14 and opens into the interior of the inner liner 16. The inlet and outlet ports 58 and 56 are configured for attachment thereto in known manner of conduits (not shown) for supplying refrigerant from the evaporator of the air conditioning system and delivering refrigerant gas from the accumulator to the compressor of the system. On the underside of the head cap 4, the inlet port 58 is surrounded by a circumferential lip 60 which in use acts to overcome the Coanda effect and ensure that refrigerant liquid delivered to the accumulator through the port 58 is directed downwards into the liner reservoir, rather than clinging to and moving laterally on the underside of the head cap 14.

As seen in Figures 2, 4, 5 and 6, round the periphery of the lower side of the head cap 14 there is a series of passages 62 extending radially and partly circumferentially, these passages being separated by ribs 64. The components are dimensioned such that when the bottom can 12 is secured to the head cap 14, the upper edge 25 of the inner liner 16 is pressed against the series of ribs 64 (see Figure 7) thus serving to fix the inner liner 16 against the cap 14. In this configuration as seen in Figure 6 the passages 62 provide communication for gas flow from the container 16 to the annular passage 28. As seen in Figure 6, the lower side 61 of the cap 14 is positioned at a level below the upper edge 25 of the inner liner 16, and this produces a baffle effect which reduces the likelihood of drops of liquid refrigerant entering directly into the passages 62.

In operation in an air conditioning system, as is well understood, a supply of liquid refrigerant will be contained in the accumulator, refrigerant gas being drawn from the accumulator, compressed, expanded and condensed and then delivered to an evaporator heat exchanger where it extracts heat from the air that is to be cooled, and is then returned to the accumulator. The flow of refrigerant returning to the accumulator 10 through the inlet 58 may contain both gas and liquid, and it is directed downwards and after passing through the desiccant container 48 the liquid is stored in a reservoir formed by the bottom of the inner liner 16.

To reach the outlet tube 34 from the inner container 16, refrigerant gas must pass over the upper edge 25 through the passages 62, these passages being curved as seen in Figure 6 to provide smooth flow, and being angled in the peripheral direction to impart a spin to the exiting gas to improve heat transfer between the refrigerant gas flowing downwardly in the annular passage 28 and the wall 24 of the bottom can. Although the ribs 64 sit upon the upper edge 25 of the wall 24, this does not impede the gas flow since the projecting ribs 30 on the wall 24 terminate slightly below the edge 25, are thin and widely spaced, and there are numerous passages 62.

The gas flow passes to the bottom of the annular passage and is then guided by the wall 44 to pass over the oil bleed hole 40 before reaching the opening 36 of the outlet conduit 34. In Figure 8 the broken line arrows illustrate the gas flow path from the annular passage 28 to the inlet 36 of the conduit 34.

The oil bleed hole 40 is located at the lowest point of the liner to minimize oil inventory since oil entrained in the refrigerant will settle to the bottom of the liner. The bleed hole 40 is a small precision hole provided with a filter 42. The wall 44 is configured to provide a desired velocity of gas flow in the region of the oil bleed hole 40 to provide effective entrainment of oil from the hole 40 into the flowing gas stream. As shown, the wall 44 can define a venturi throat 46 to increase gas flow velocity at this region.

The components of the accumulator can be fabricated in any suitable materials. Typically the bottom can 12 will be fabricated in steel or a lightweight metal such as aluminium. These materials are of good thermal conductivity so that in a typical automotive installation the bottom can will gain heat from the engine compartment and will radiate that heat into the annular passage 28, which is desirable to maintain refrigerant in that passage in a gaseous state. However it is not desirable for such radiated heat to reach the reservoir of liquid refrigerant contained within the inner liner 16, and for this purpose the inner liner is made of the material of low heat conductivity such as plastic, possibly foamed into closed cells, or a composite such as a metal foil heat shield wrapping a foam or fibrous layer which is applied to the solid plastic core. A suitable plastics material is nylon. The inner liner 16 may be an integral plastic molding including the tubular conduit 34, the ribs 30 and 32 and the wall 44.

Various details of the above described and illustrated accumulator can be altered to suit particular circumstances. For example, rather than providing the passages 62 in the periphery of the head cap 14, passages could be provided as an annular gap between the upper edge 25 of the inner liner and the cap 14, or as a series of fine holes or a mesh and extending around the upper end of the inner liner.

Within the ambit of the invention significant changes can be made in the dimensions, shapes, sizes and materials to meet the requirements of the air conditioning system in which the accumulator is installed. Likewise the external structure such as the cap, outer can, and the position and arrangement of the inlet and outlet ports can be modified as desired, as can the type and arrangement of the desiccant container and the oil bleed regulator and filter. All such modifications and variations are intended to be encompassed within the scope of the appended claims.

CLAIMS:

1. An accumulator for use in an air-conditioning system comprising:

a hermetically sealed outer housing comprising a cap, an inlet opening, a peripheral side wall, and a base;

an inner liner positioned within said outer housing, said inner liner having a peripheral wall and a base which form a container to receive refrigerant delivered through said inlet opening, said inner liner being spaced from the peripheral wall and the base of said outer housing to define therewith an annular passage, said inner liner having an upper end that lies in contact with or adjacent said cap;

passage means extending around the periphery of the upper end of said inner liner and communicating the interior of said inner liner with a first upper end of said annular passage;

an outlet passage opening from a second lower end of said annular passage at a location between the base of the inner liner and the base of the outer housing, said outlet passage leading to the exterior of said outer housing;

the arrangement being such that vaporized refrigerant can pass through said passage means from said inner liner to the upper end of said annular passage, descend downwards through said annular passage to the opening of said outlet passage, and exit said accumulator via said outlet passage.

2. An accumulator as claimed in claim 1 wherein said cap is a separate component that is hermetically sealed to the top of the peripheral side wall of the outer

housing and which also defines therein said inlet opening and an outlet port for said outlet passage.

3. An accumulator as claimed in claim 1 or claim 2 wherein said inner liner includes integral projections on the exterior thereof, said projections being positioned to engage interior surfaces of the peripheral wall and base of the outer housing to maintain a predetermined spacing of the inner liner with respect thereto.

4. An accumulator as claimed in any one of claims 1 to 3 wherein said passage means comprises a substantially continuous gap between the upper end of said inner liner and said cap.

5. An accumulator as claimed in any one of claims 1 to 4 wherein said passage means is baffled to prevent entry thereto of liquid refrigerant delivered into said accumulator through said inlet opening.

6. An accumulator as claimed in claim 4 or 5 wherein the upper end of said inner liner is configured for engagement with said cap to provide proper alignment of said inner liner with respect to the outer housing.

7. An accumulator as claimed in any one of claims 1 to 6 wherein said passage means is configured to create turbulence in any flow of refrigerant gas passing therethrough.

8. An accumulator as claimed in any one of claims 1 to 7 wherein said inner liner has baffles in the interior thereof to prevent excessive movement of refrigerant liquid contained therein.

9. An accumulator as claimed in any one of claims 1 to 8 including ribs interacting between said inner liner and said outer housing to maintain a predetermined spacing therebetween.

10. An accumulator as claimed in any one of claims 1 to 9 wherein said inner liner is of a material of low thermal conductivity to prevent excessive evaporation of refrigerant contained therein as a result of heat radiating from said outer housing.

11. An accumulator as claimed in any one of claims 1 to 10 including a bleed orifice in the base of said inner liner to permit oil, which gathers at the bottom of said inner liner, to pass through and become entrained in refrigerant gas flowing to said outlet passage opening.

12. An accumulator as claimed in claim 11 including guide ribs spanning between the bases of said inner liner and said outer container, said guide ribs being configured to direct flowing refrigerant gas to pass over said bleed orifice.

13. An accumulator as claimed in claim 12 wherein said guide ribs surround a major part of said inlet opening and define an entry port through which flowing refrigerant gas is ducted.

14. An accumulator as claimed in claim 13 wherein said entry port defines a venturi throat in the region of said bleed orifice.

15. An accumulator for use in an air-conditioning system comprising:

a hermetically sealed outer housing comprising a cap, an inlet opening, an outlet opening, a peripheral side wall, and a base;

an inner liner positioned within said outer housing, said inner liner having a peripheral wall and a base which form a container to receive refrigerant delivered through said inlet opening, said inner liner being spaced from the peripheral wall and the base of said outer housing to define therewith an annular clearance, said inner liner having an upper end that lies in contact with or adjacent said cap;

passage means for delivering refrigerant vapour from said container to said outlet opening;

wherein said inner liner is of low thermal conductivity to shield liquid refrigerant from excessive heat transfer from said outer container.

16. An accumulator as claimed in claim 15 wherein said inner liner is of plastic material, either of closed-cell foam or solid, or of a composite material of metal and/or plastic layers.

17. An accumulator as claimed in claim 15 wherein said inner liner is of molded plastic material and includes integral projections positioned to maintain a desired separation between said inner liner and said outer housing.

18. An accumulator as claimed in any one of claims 15 to 17 wherein said inner liner includes integral ribs formed therein and positioned to duct refrigerant gas from said annular clearance towards an inlet end of a passage that leads said gas to said outlet opening.

Smart & Biggar
Ottawa, Canada
Patent Agents

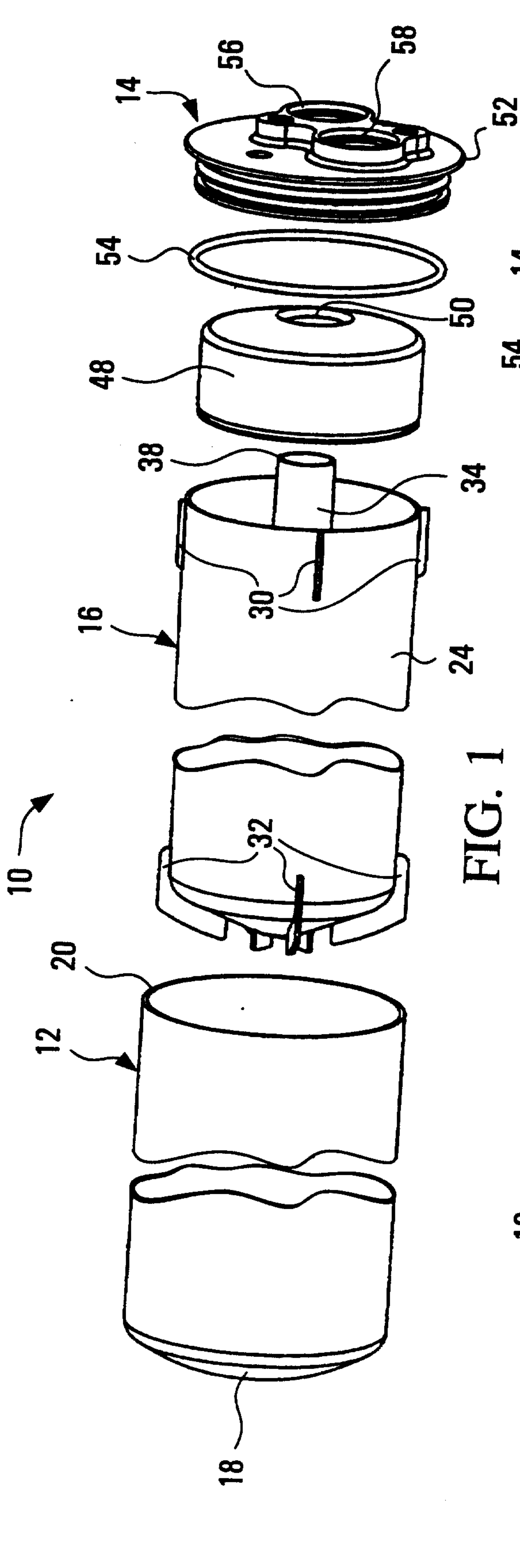

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FIG. 1

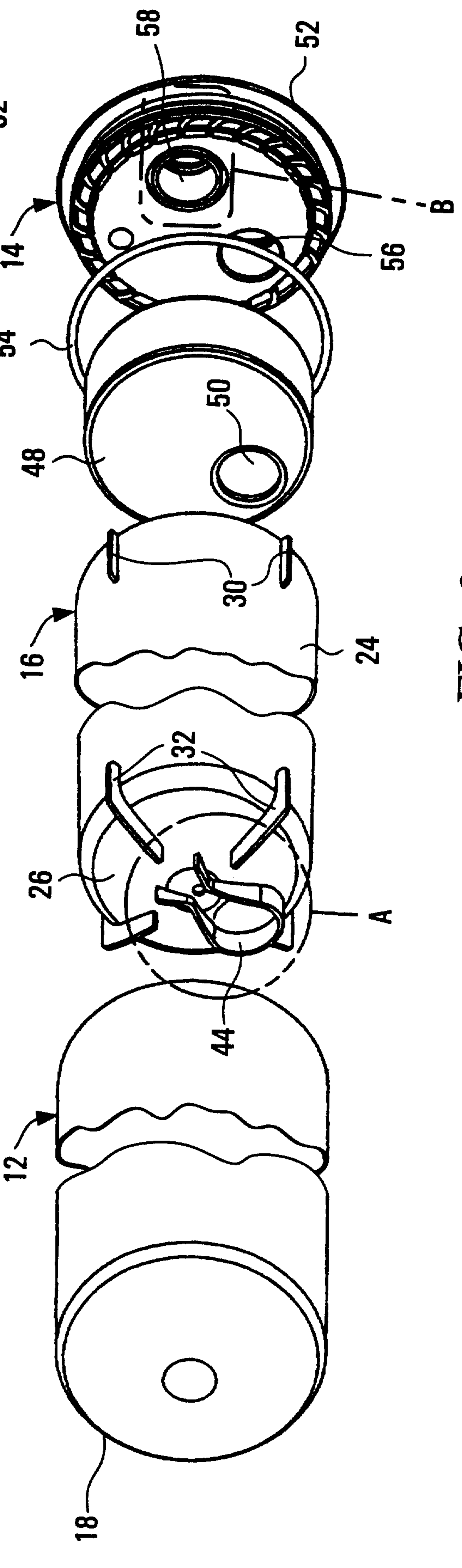
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FIG. 2

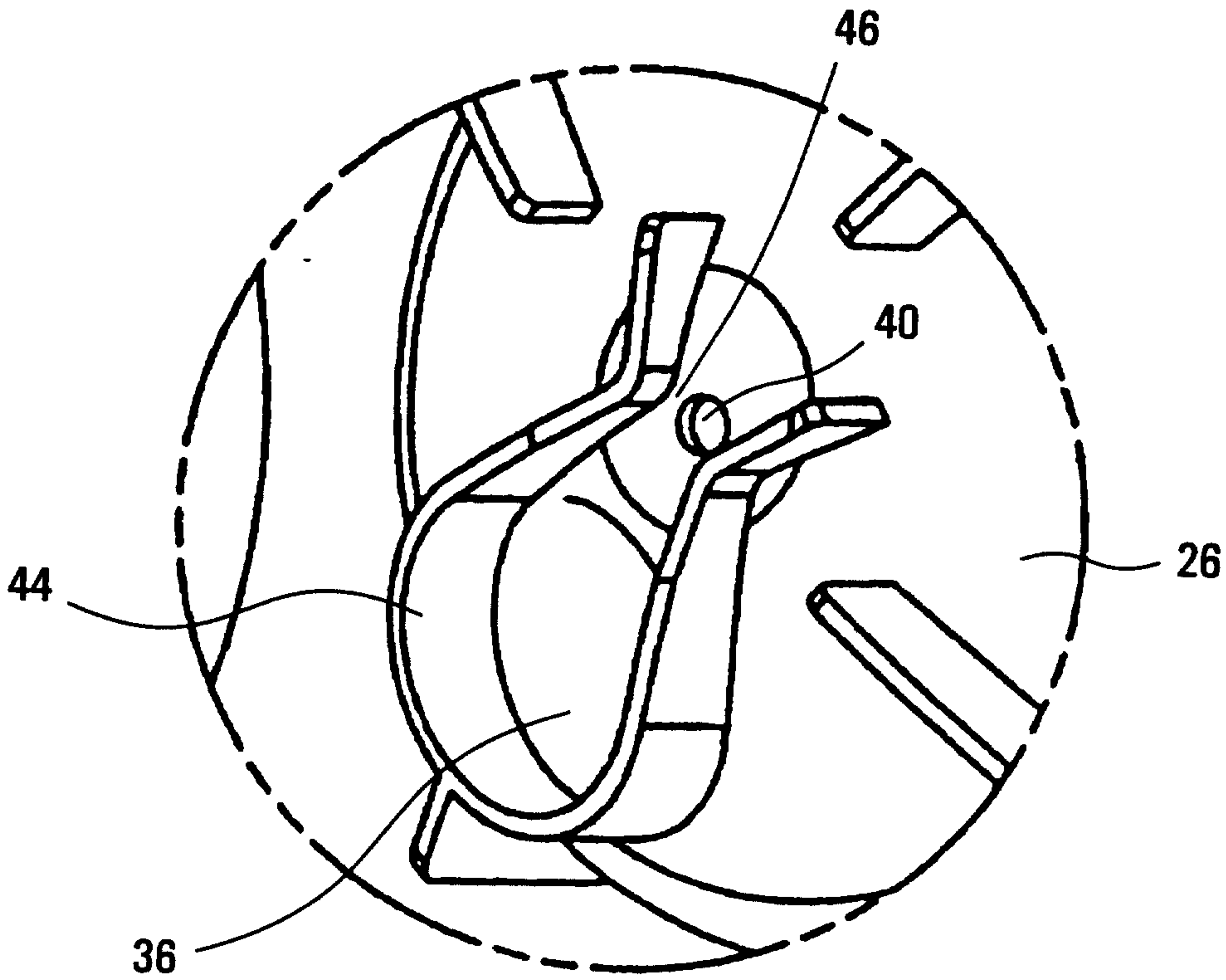

FIG. 3

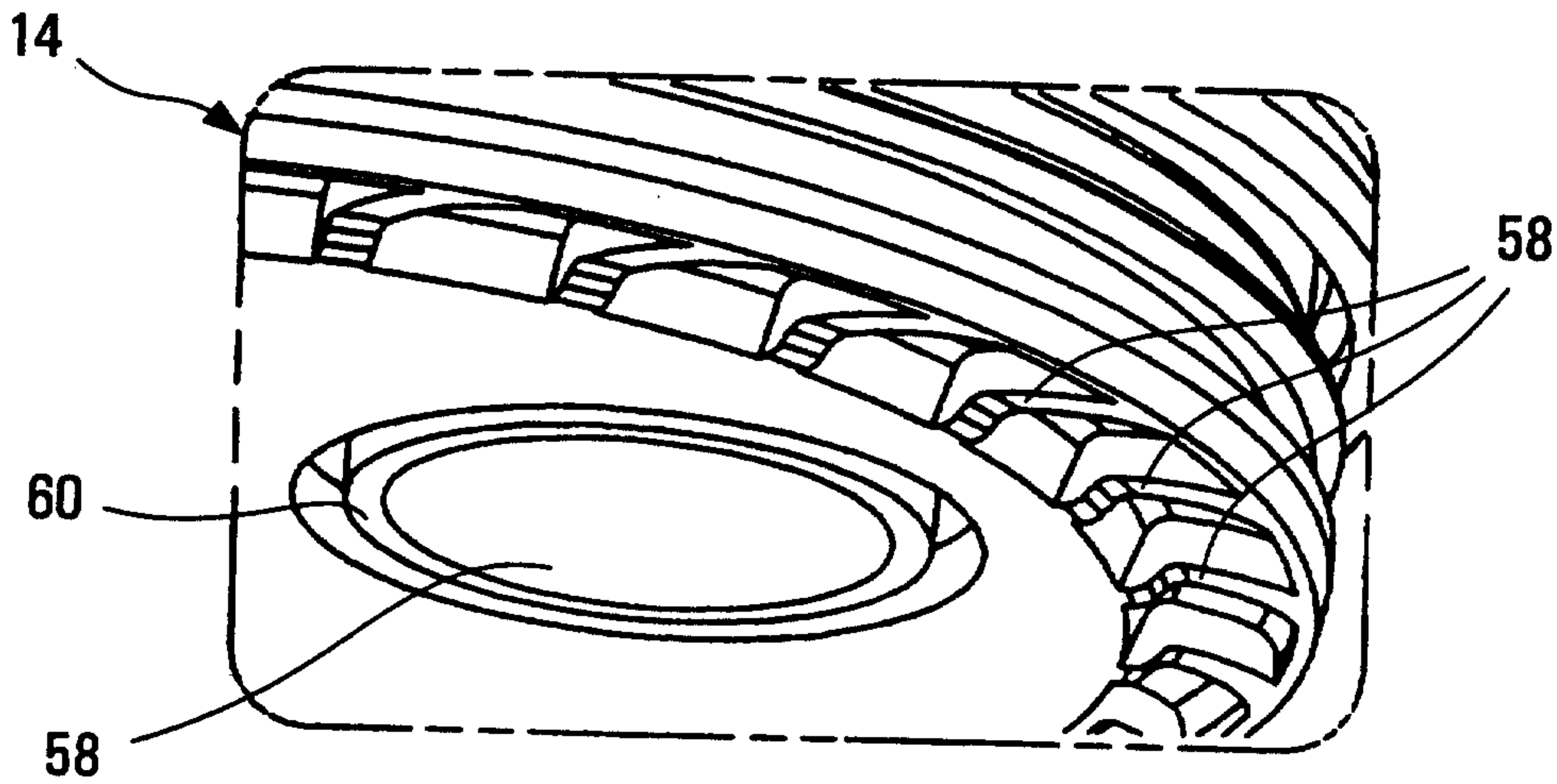

FIG. 4

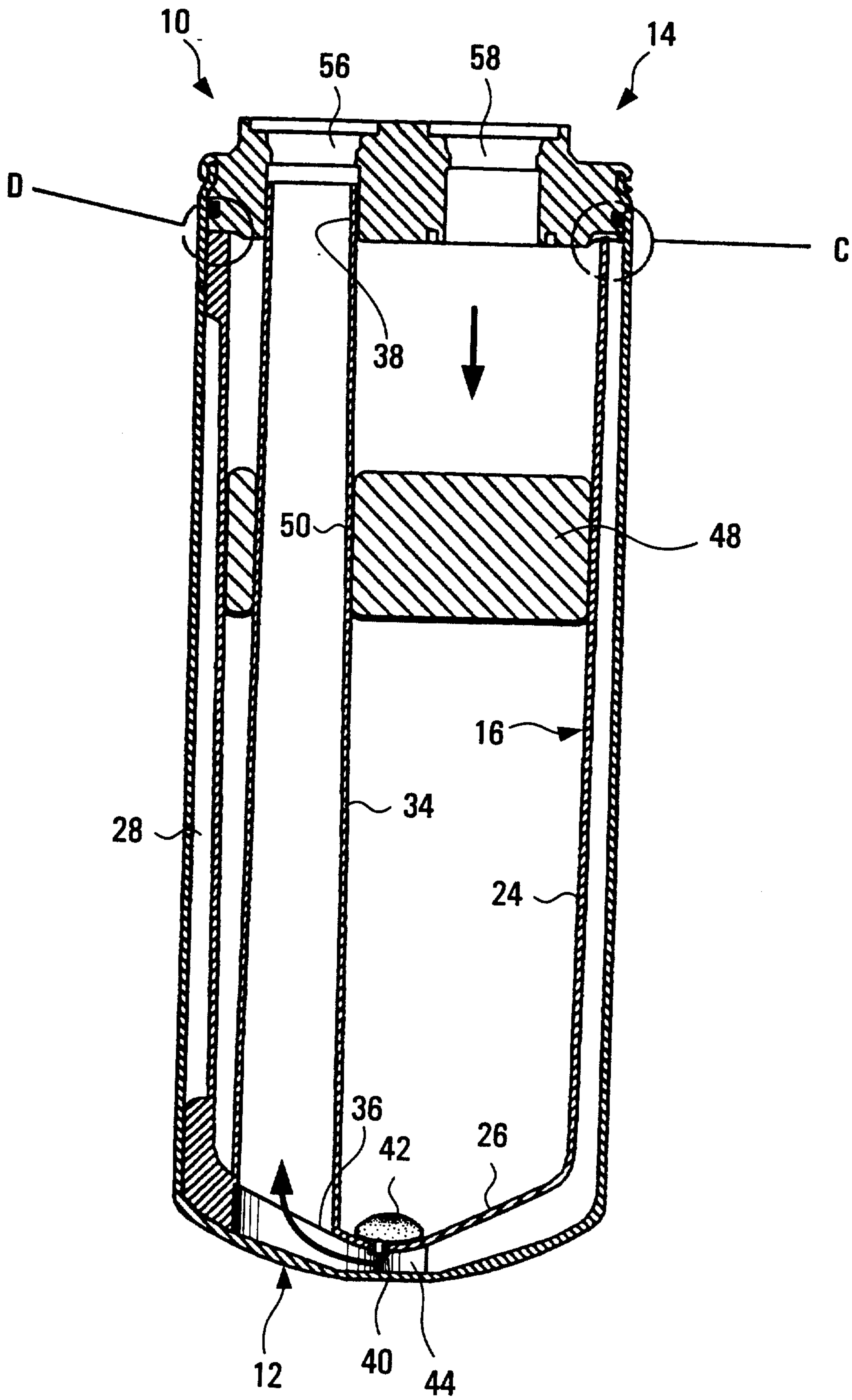

FIG. 5

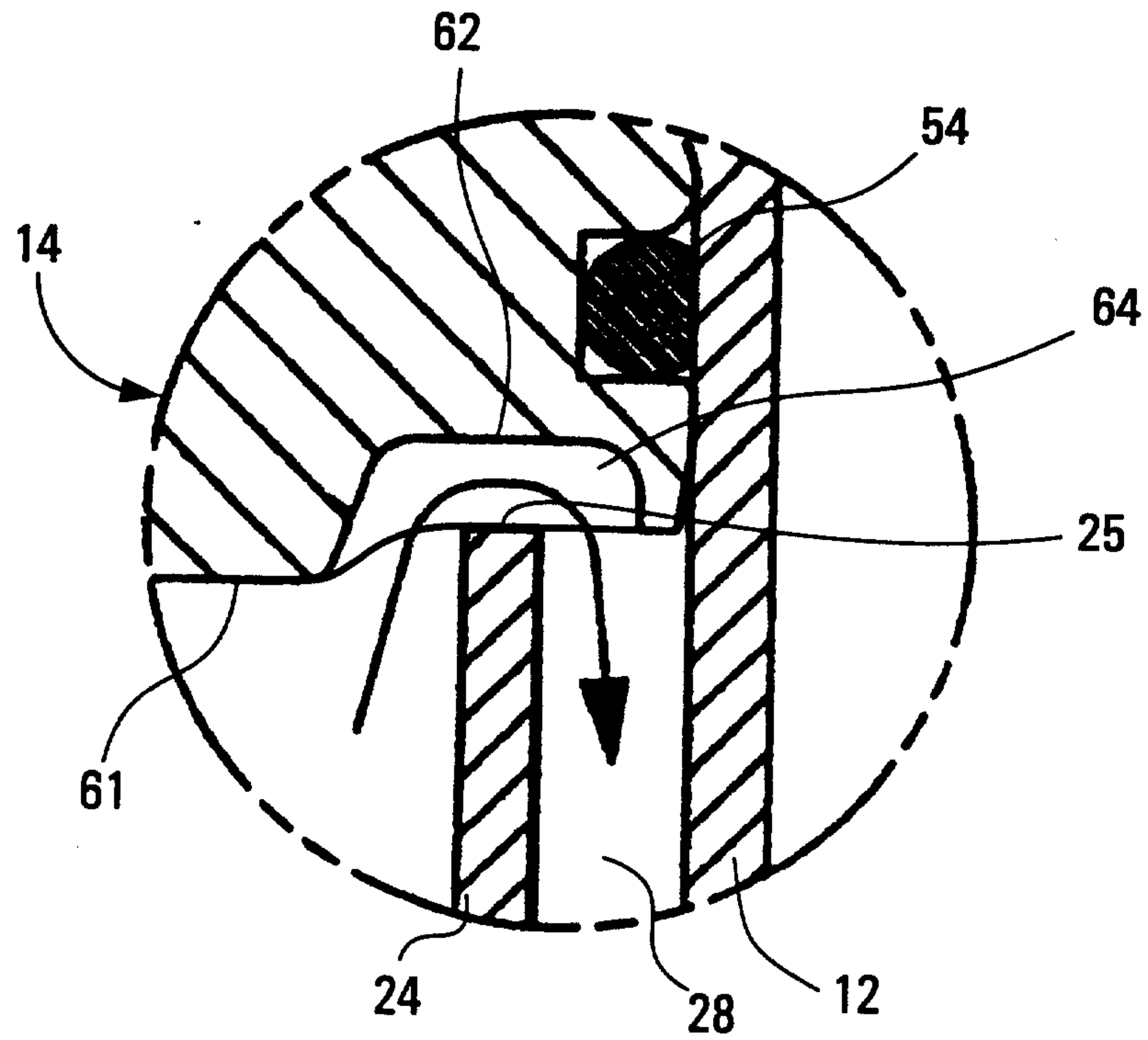

FIG. 6

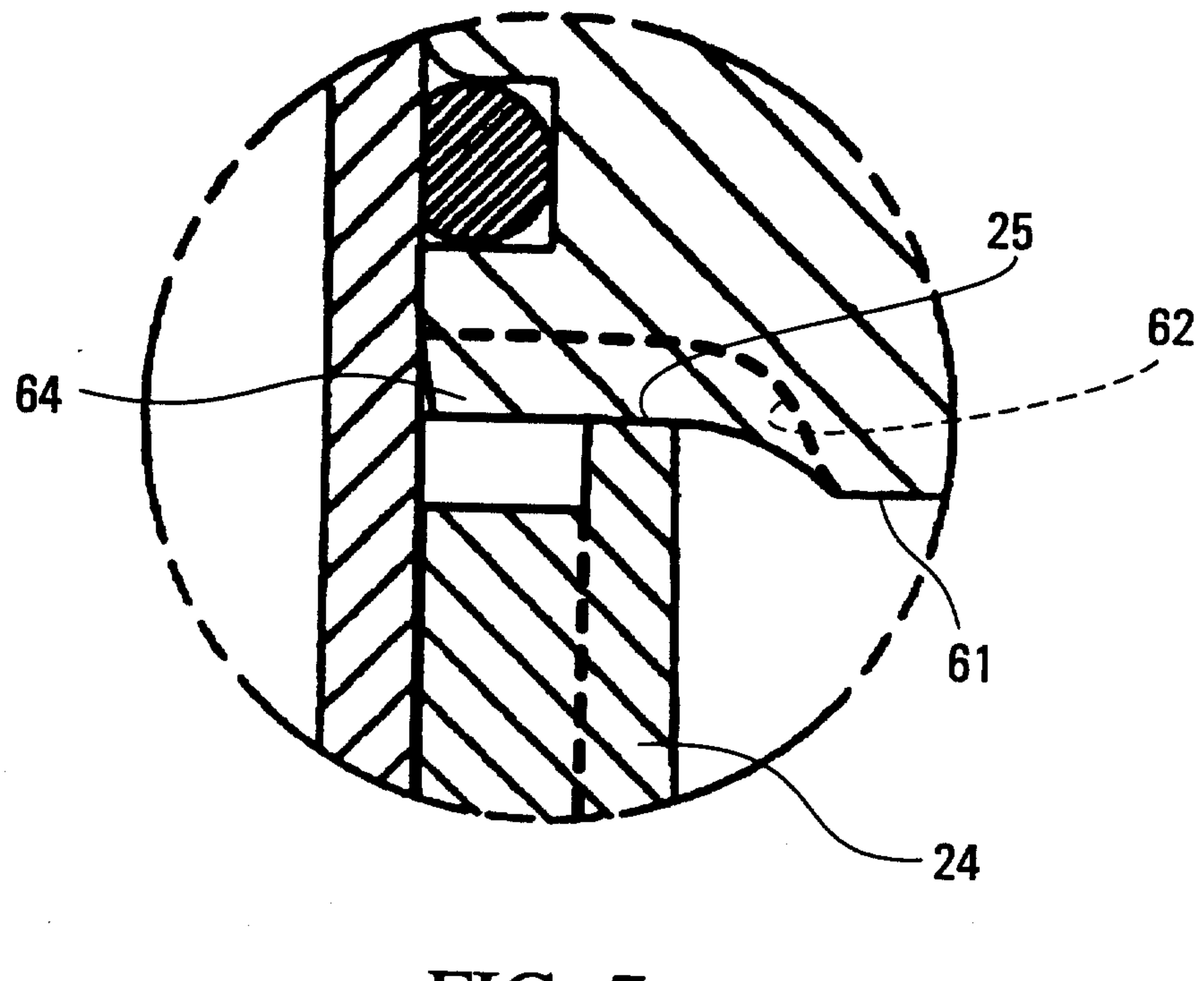

FIG. 7

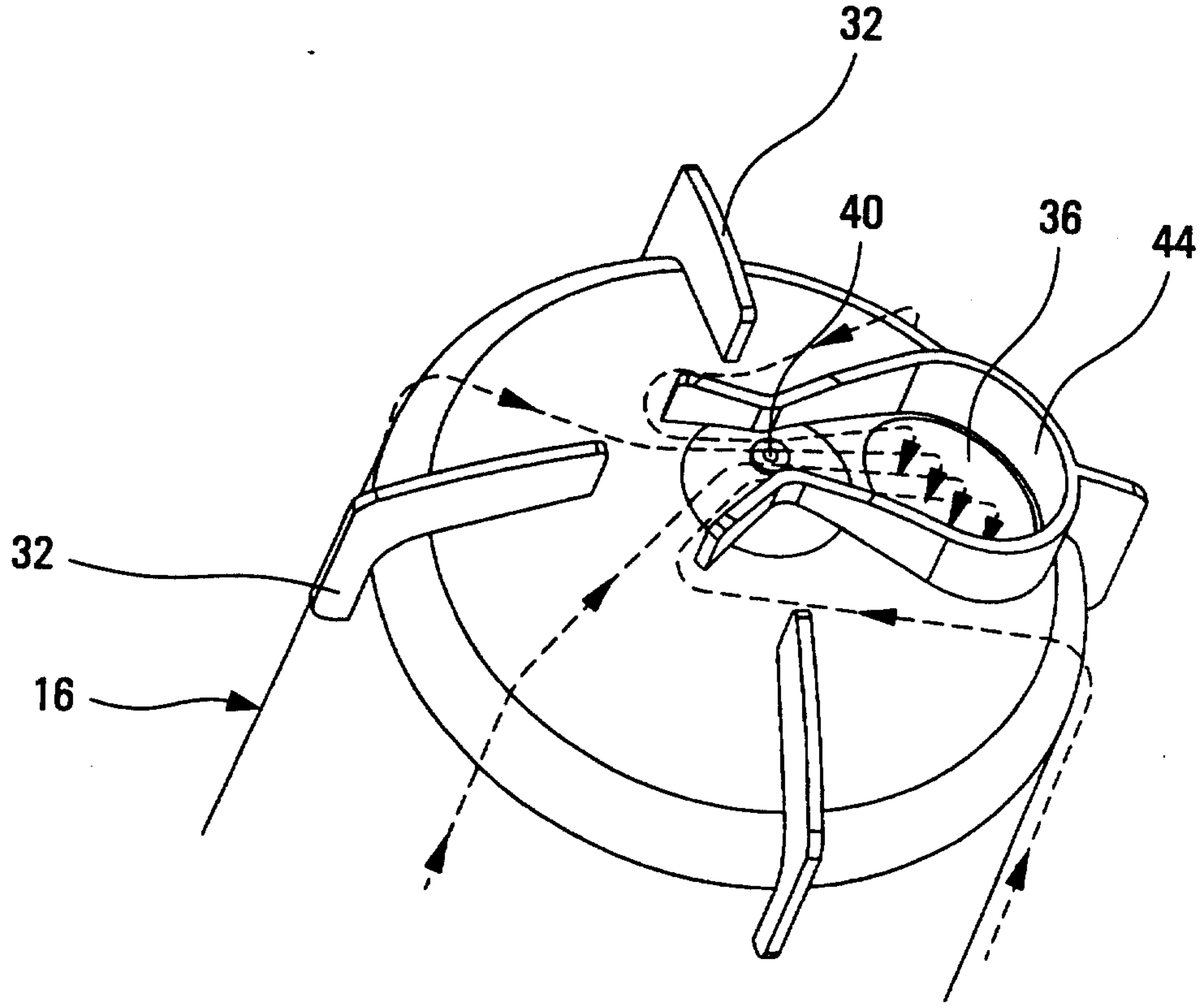

FIG. 8

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