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Hinque

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(54) **COMPACT VALVE SYSTEM FOR SELF-INFLATING TIRE**

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This patent is subject to a terminal disclaimer.

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B60C 23/12 (2006.01)
B60C 29/04 (2006.01)

(52) **U.S. Cl.**
CPC ***B60C 23/12*** (2013.01); ***B60C 29/04*** (2013.01); *Y10T 152/10495* (2015.01)

(58) **Field of Classification Search**
CPC B60C 23/12; B60C 29/04
USPC 152/419, 423, 424, 425, 426, 429
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,050,886 A *	1/1913	Wetherell	....	152/426
1,250,476 A	12/1917	Hammersmith		
1,413,531 A	4/1922	Harris		
2,634,785 A *	4/1953	Tubbs	....	152/427
3,247,882 A *	4/1966	Pratt	....	152/429
3,304,981 A *	2/1967	Sheppard	....	152/426
4,103,549 A	8/1978	Schmidt		

(Continued)

FOREIGN PATENT DOCUMENTS

GB 2255850 B 11/1994

OTHER PUBLICATIONS

European Search Report, (Jul. 31, 2014).

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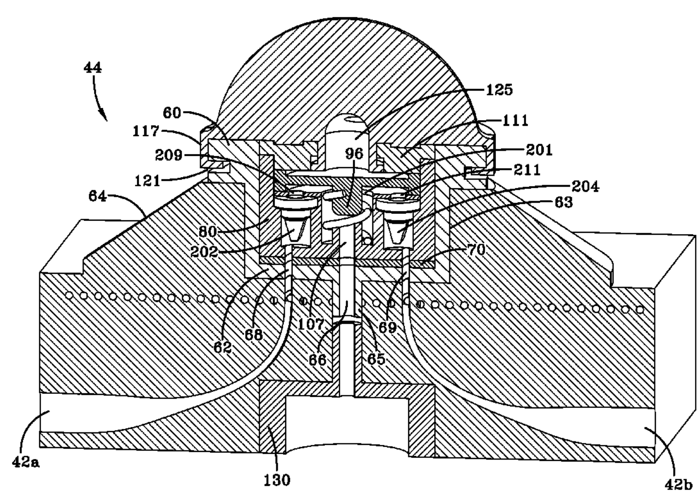
(74) *Attorney, Agent, or Firm* — June E. Rickey

(57) **ABSTRACT**

A self-inflating tire assembly includes an air passageway in the tire that is operable to be sequentially flattened by the tire footprint in a direction opposite to a tire direction of rotation to pump air from an inlet device through the passageway to an outlet device for direction into the tire cavity. A valve device for a tire is also disclosed. The valve device includes an insert mounted in the tire, a valve body mounted within the valve insert; wherein the valve body has a first, second and third chamber, wherein a first and second check valve is positioned in the first and second chamber. A pressure membrane is received within the valve body, and positioned to open and close the third chamber. The pressure membrane is in fluid communication with the tire cavity and the third chamber of the valve body. A spring is received within the third chamber and is positioned to exert force upon the pressure membrane to bias the pressure membrane position relative to the channel in the open position.

18 Claims, 14 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,601,254	A	7/1986	Huang et al.	
5,856,619	A	1/1999	Wang	
5,957,151	A *	9/1999	Dalcourt et al.	137/225
6,525,655	B2	2/2003	Huang	
6,531,960	B1	3/2003	Gladstone et al.	
6,595,046	B2	7/2003	Lemberger et al.	
6,911,903	B2	6/2005	Gladstone et al.	
7,131,632	B2	11/2006	Kish, Jr.	
7,421,889	B2	9/2008	Lin	
7,493,808	B2	2/2009	Milanovich et al.	
7,667,583	B2	2/2010	Petrucelli	
7,764,168	B1	7/2010	Huang	
8,573,270	B2	11/2013	Hinque	
2004/0112495	A1*	6/2004	Weise	152/331.1
2005/0072349	A1	4/2005	Perlin et al.	
2006/0118224	A1*	6/2006	Ellmann	152/415
2011/0146868	A1*	6/2011	Losey et al.	152/426
2013/0048176	A1	2/2013	Hinque	
2013/0048178	A1	2/2013	Hinque	
2014/0000778	A1*	1/2014	Gobinath	152/450
2014/0020805	A1*	1/2014	Gobinath et al.	152/450
2014/0174619	A1	6/2014	Hinque	

* cited by examiner

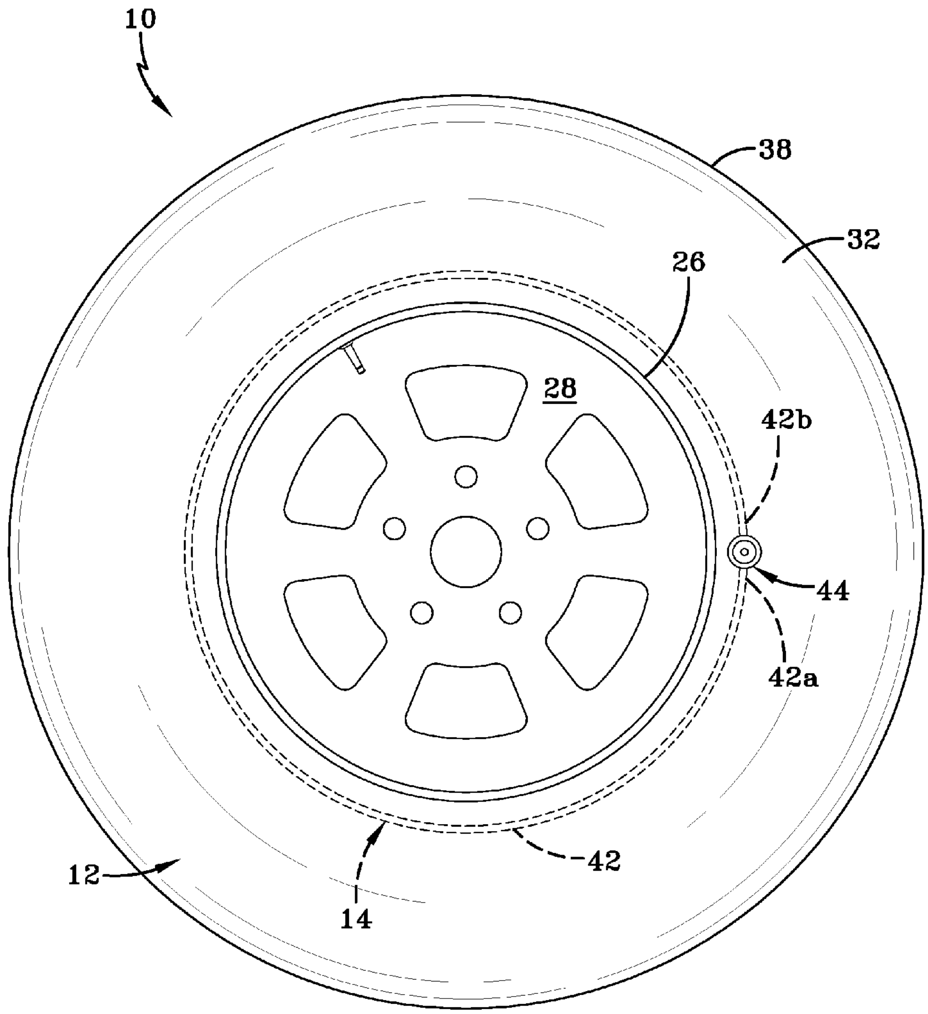


FIG-1

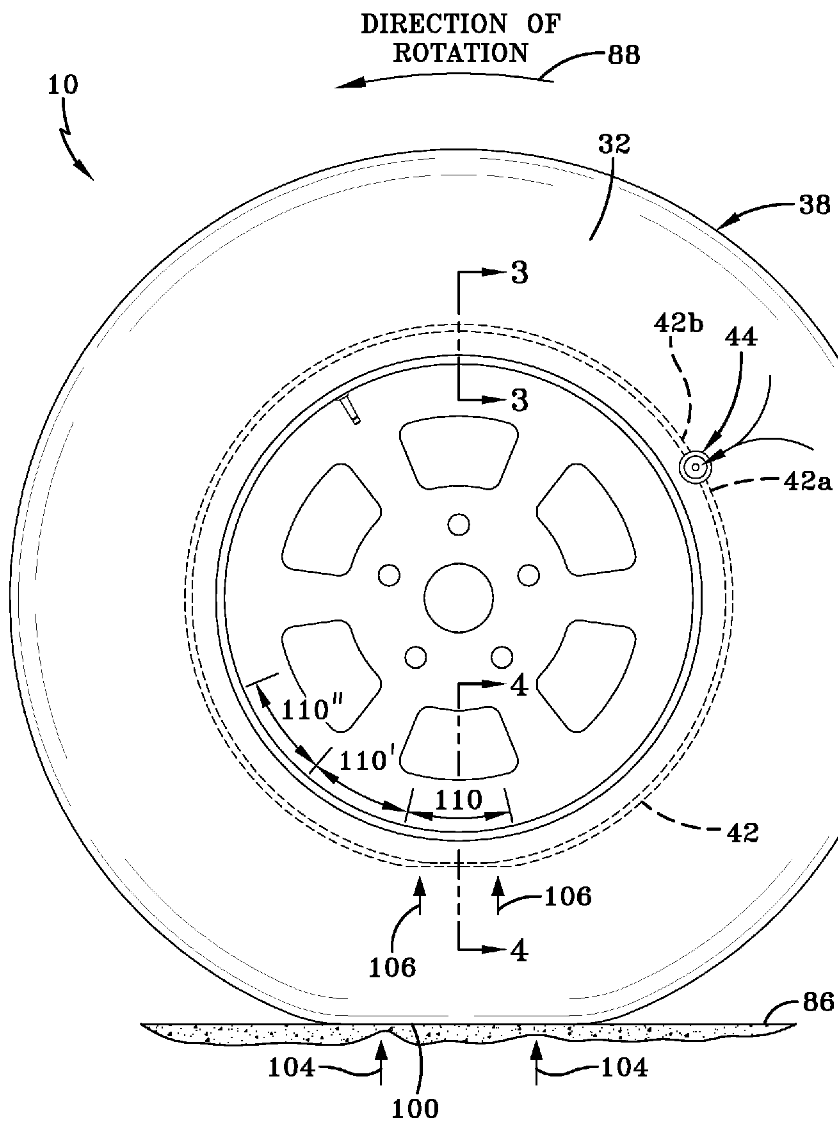

DIRECTION OF
ROTATION
88
10
32
38
3
3
42b
44
42a
110''
4
110'
110
42
106
106
4
86
104
104
100

FIG-2

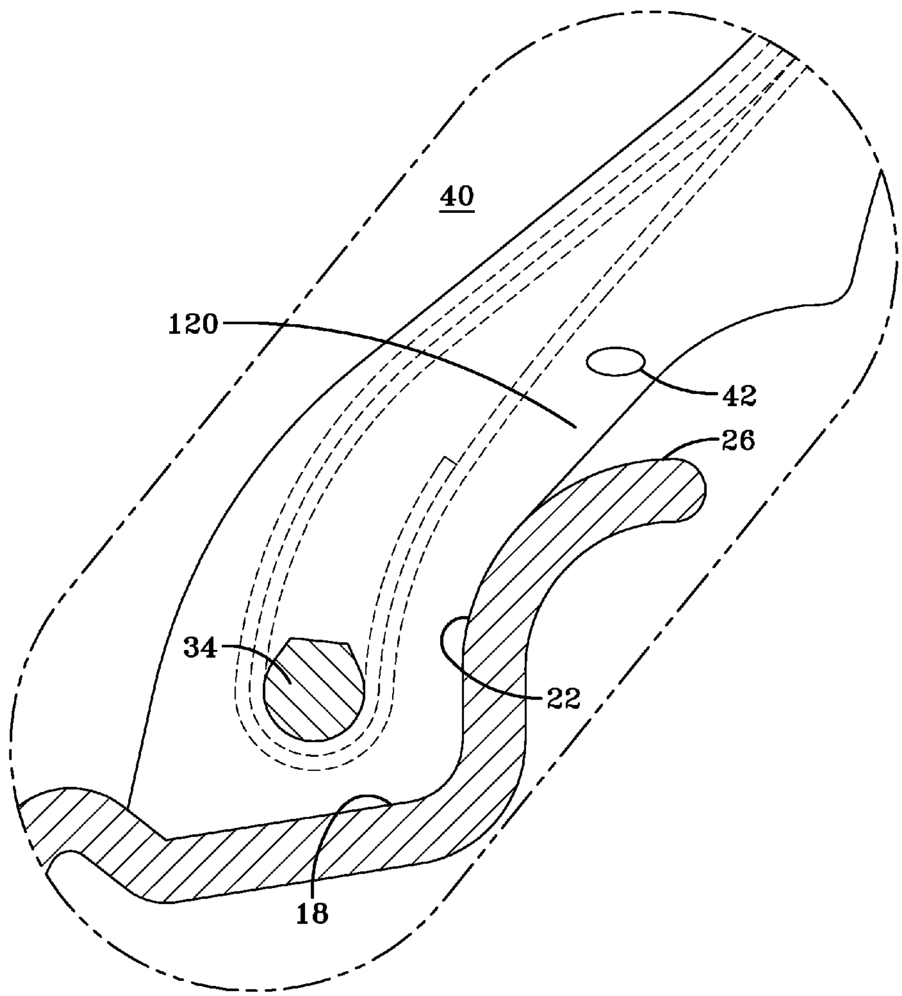
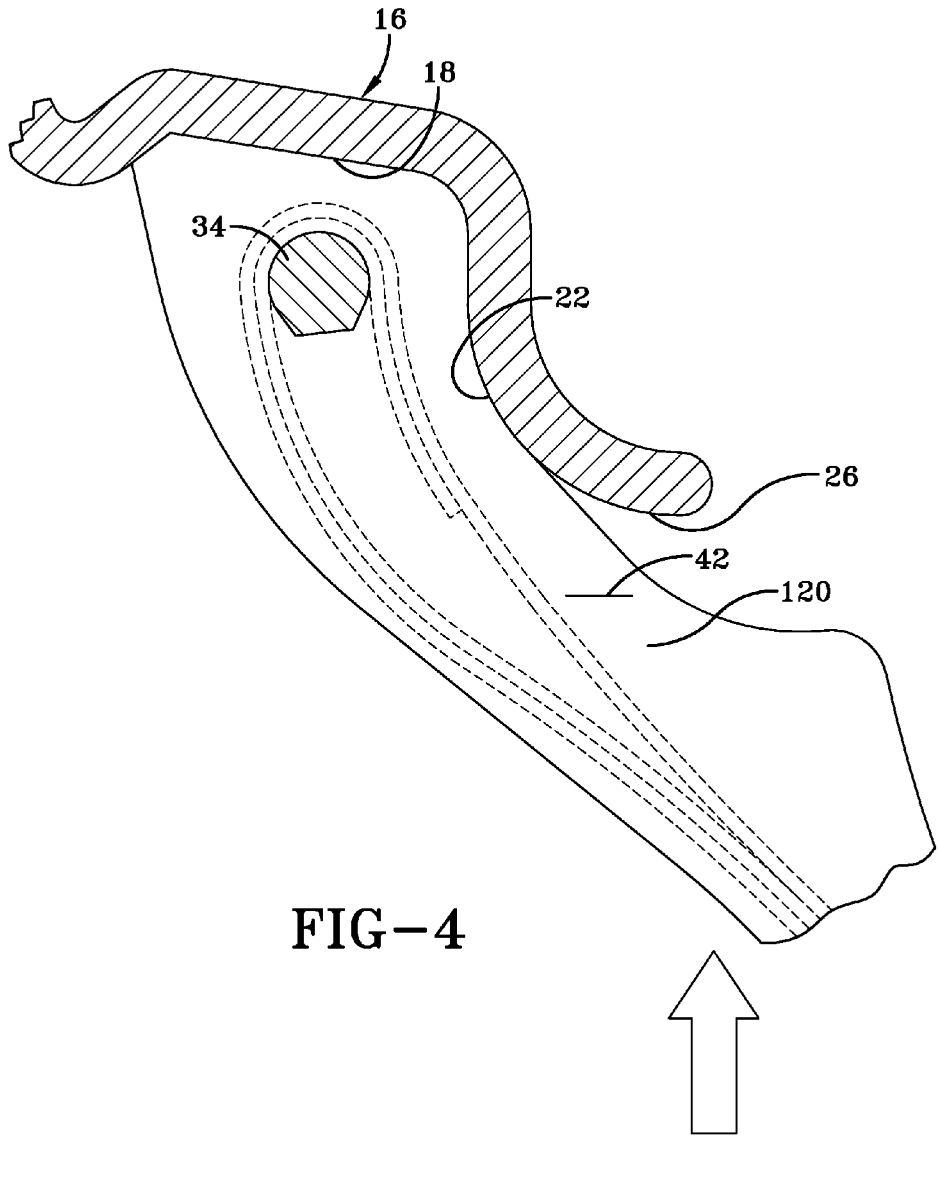


FIG-3



FIG–4

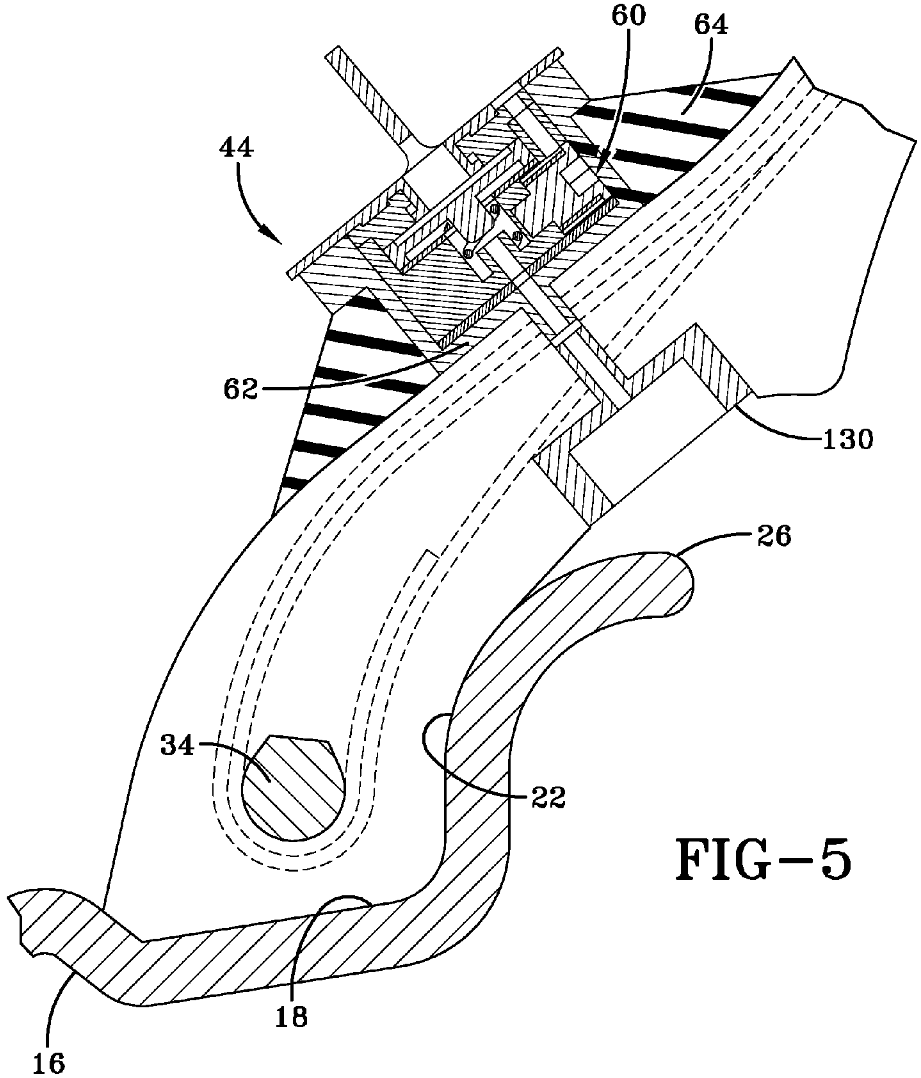


FIG-5

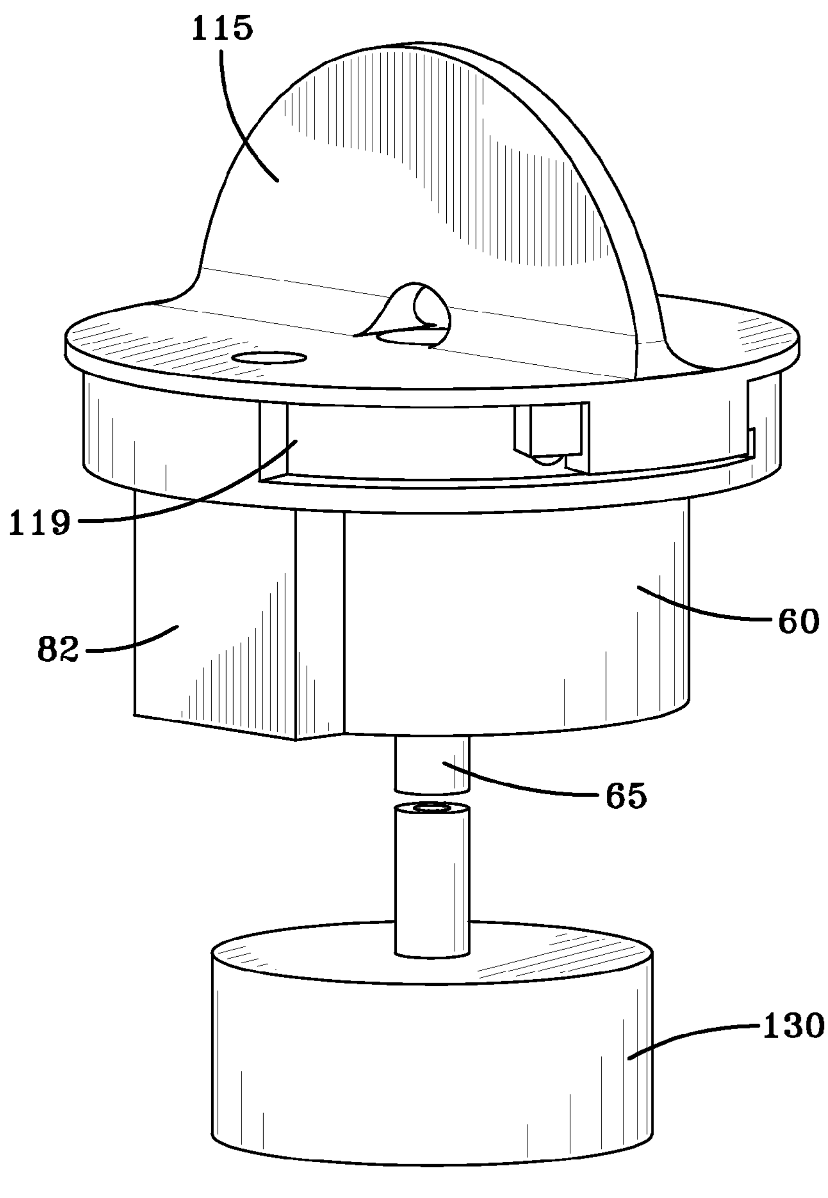
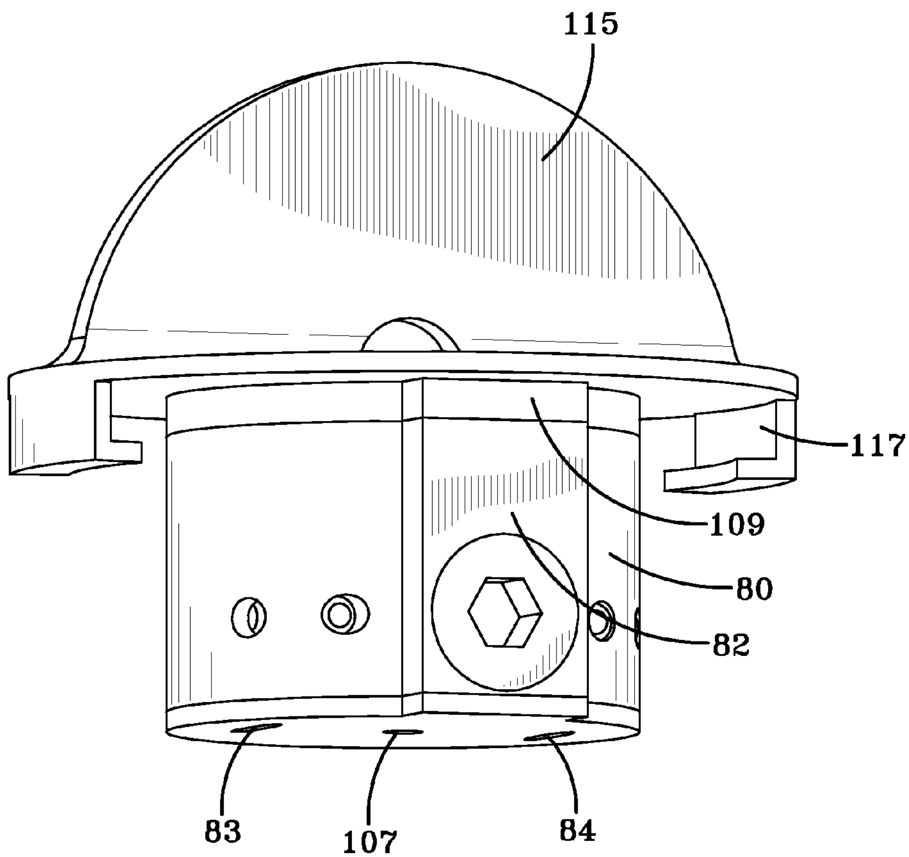
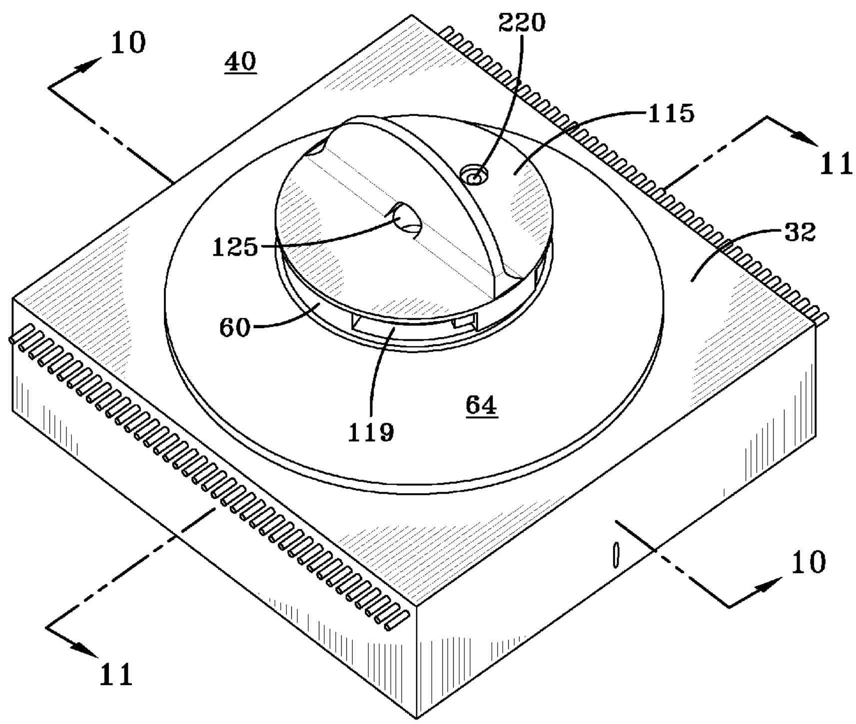


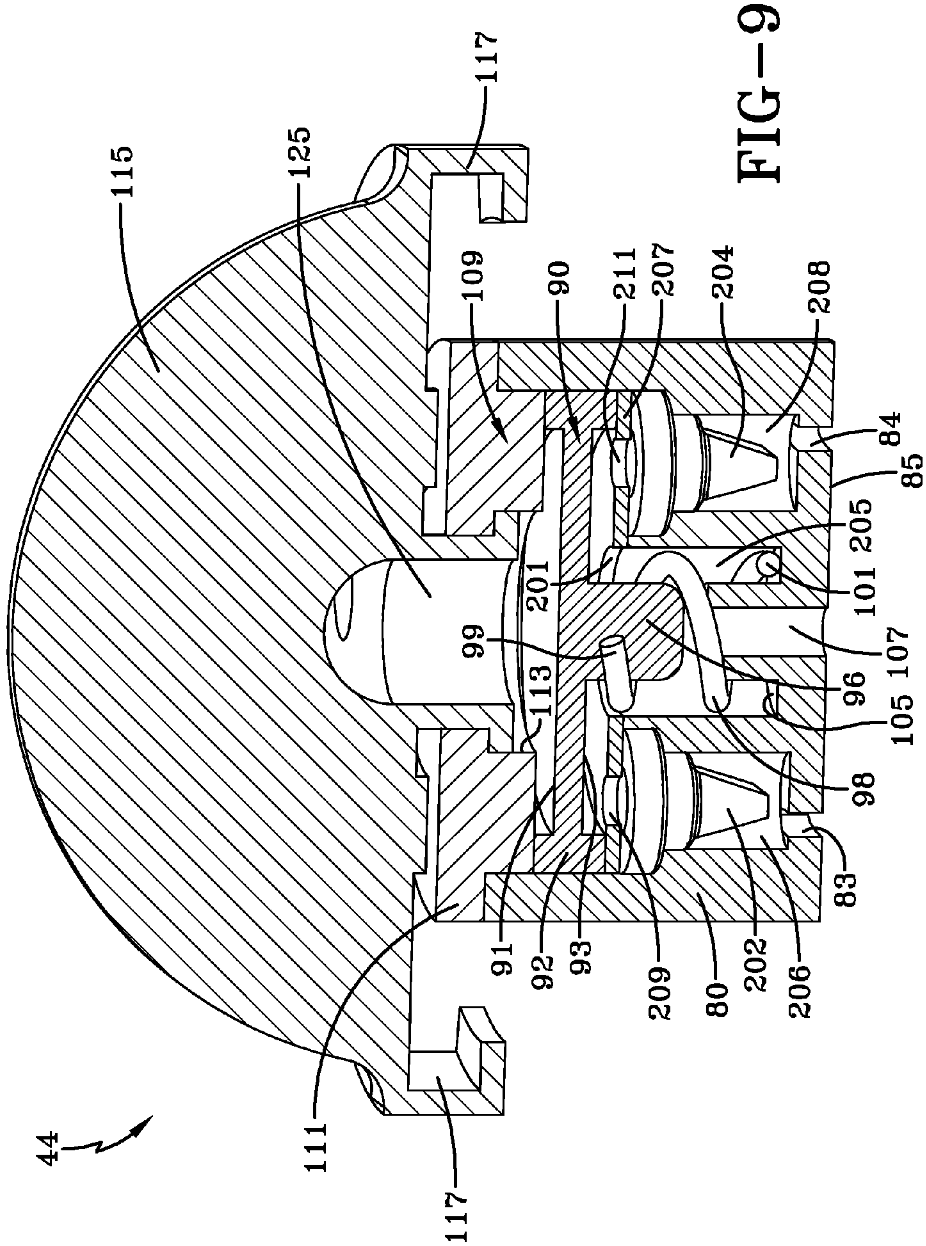
FIG-6



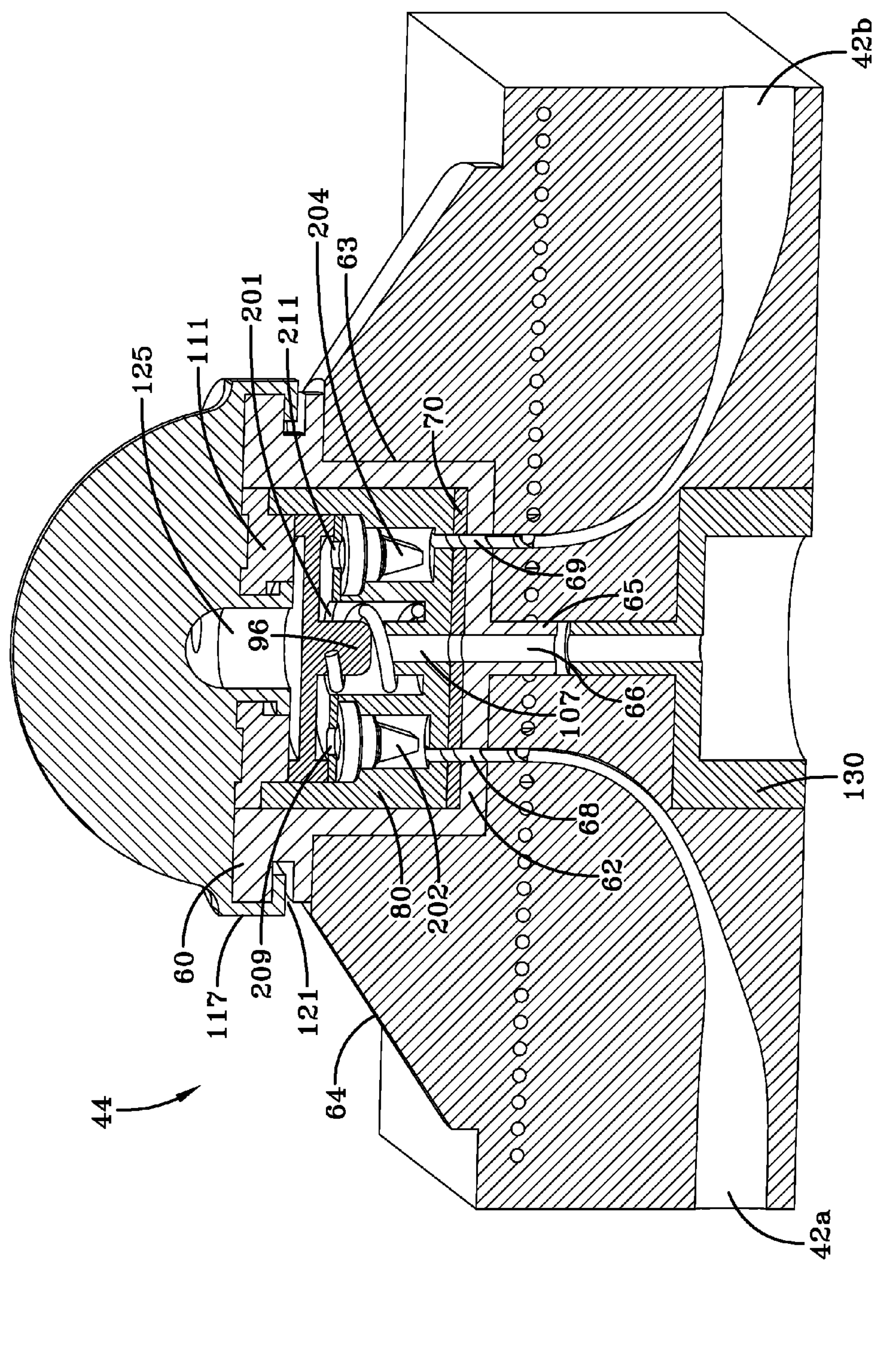
FIG–7



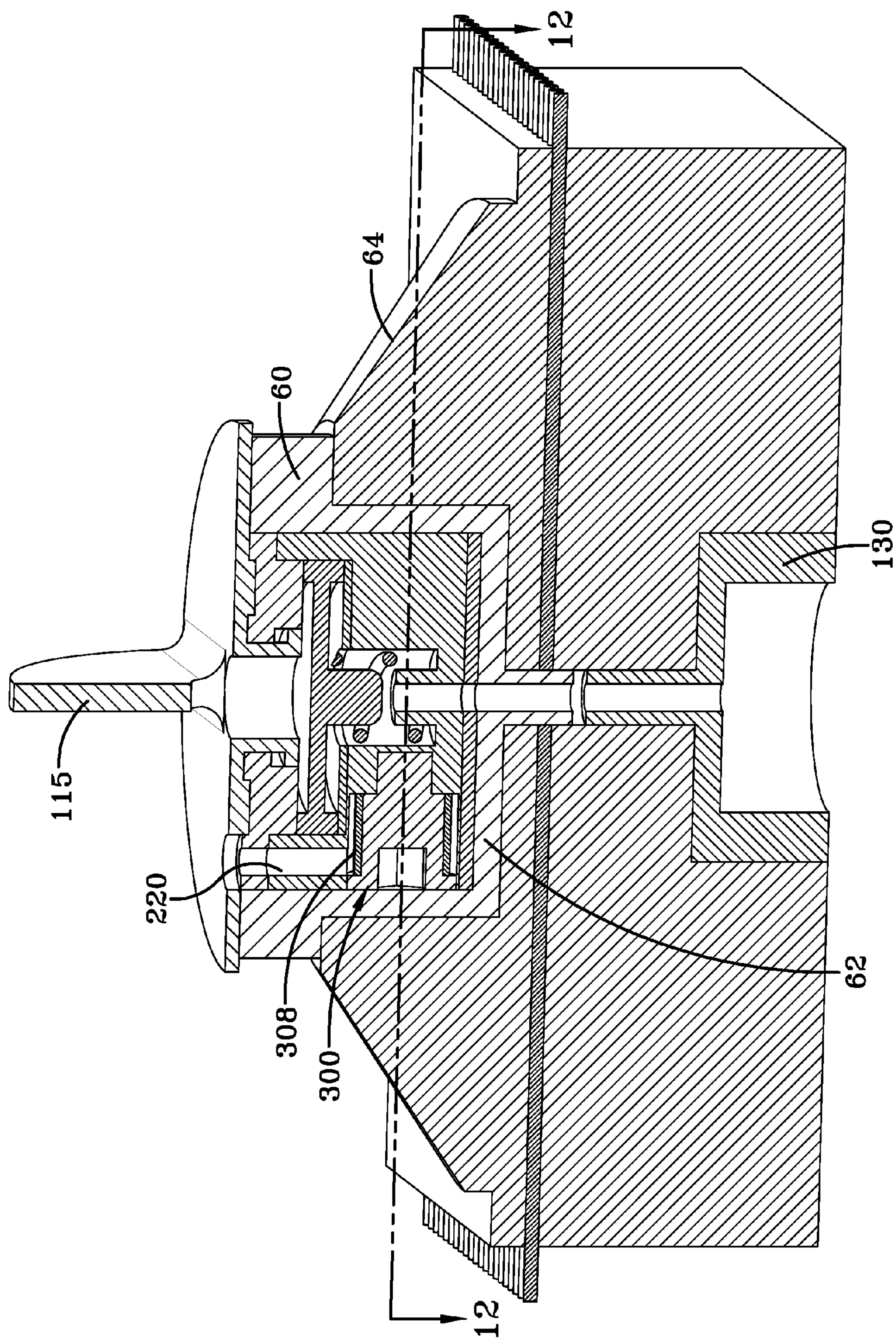
FIG–8


115
125
117
109
90
211
207
204
208
84
85
205
201
101
107
99
96
113
105
98
83
91
92
93
209
80
202
206
111
117
44

FIG—9


44
64
121
117
209
60
80
202
62
68
130
42a
42b
125
111
201
211
204
63
70
96
69
65
107
66

FIG—10



FIG—11

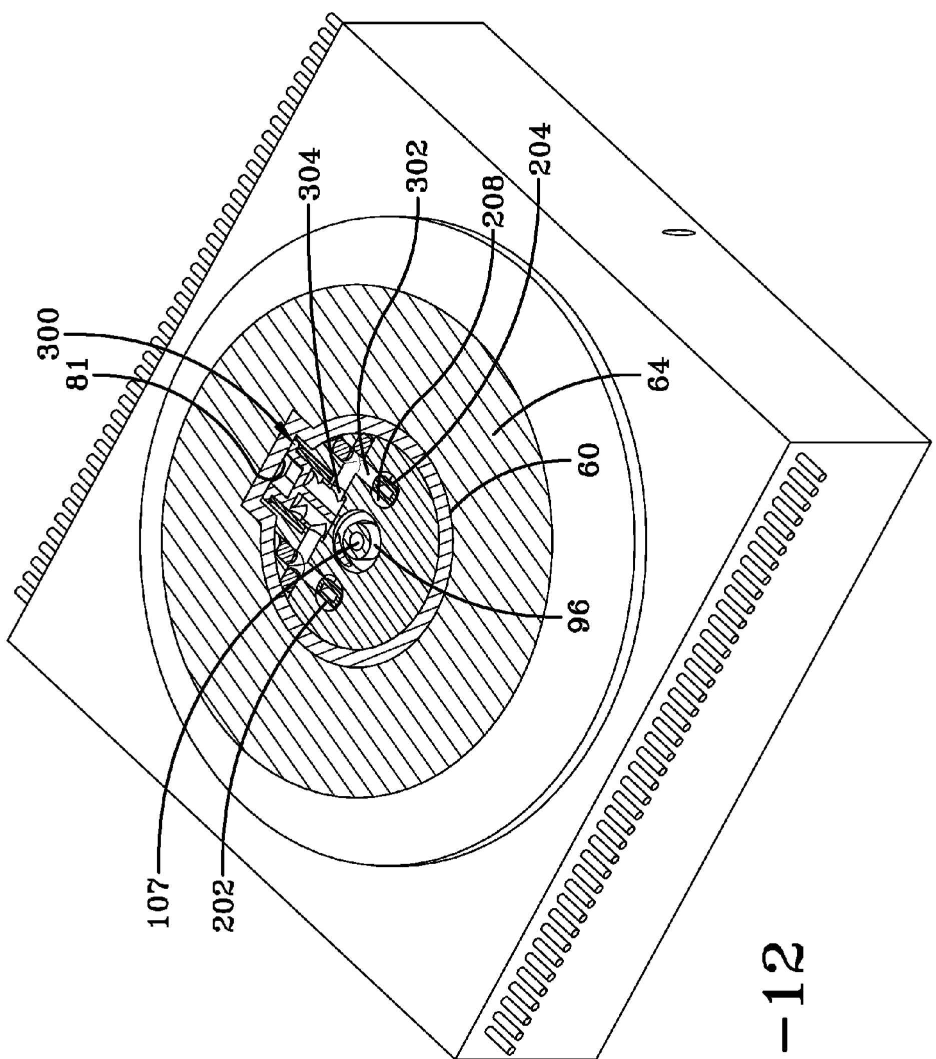


FIG-12

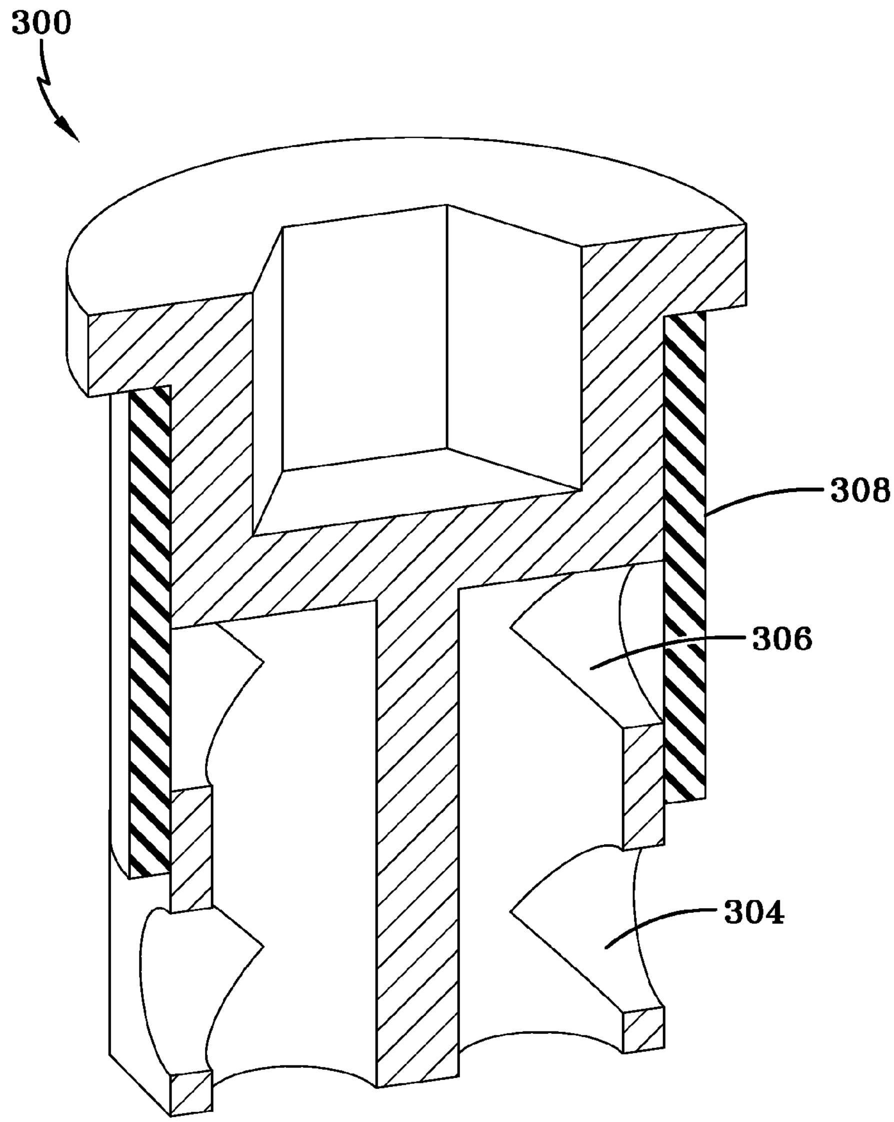


FIG-13

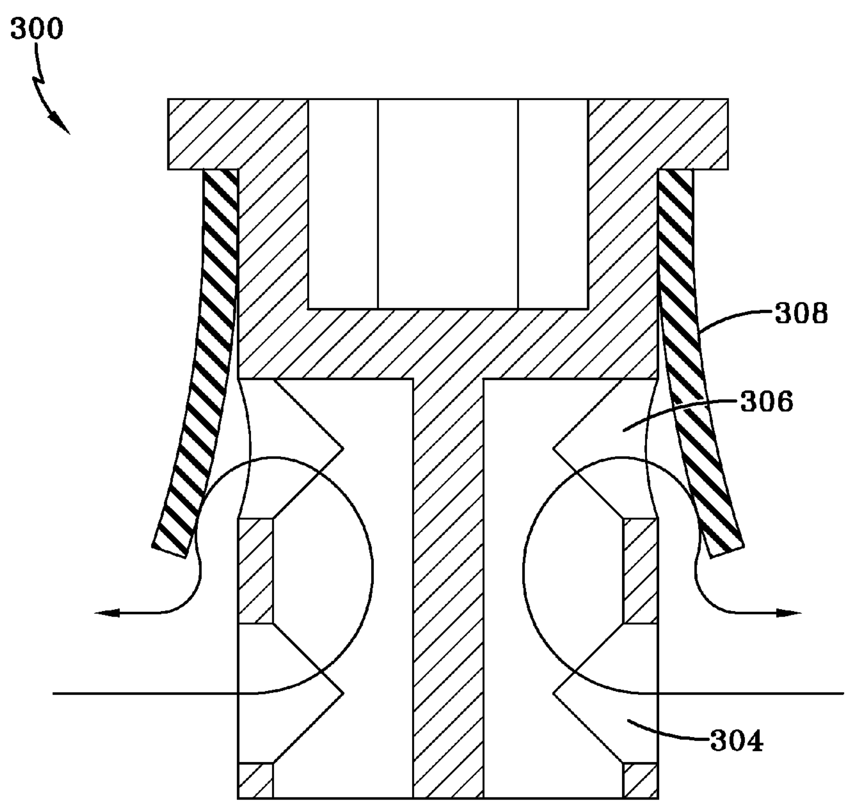

300
308
306
304

FIG-14

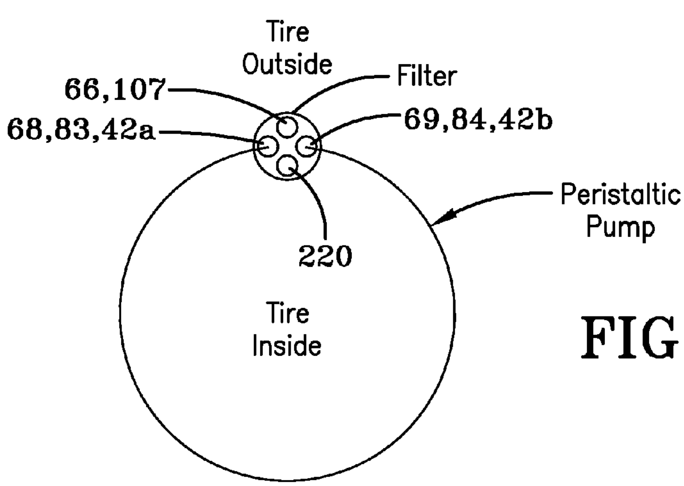

Tire
Outside
Filter
66,107
68,83,42a
69,84,42b
Peristaltic
Pump
220
Tire
Inside

FIG-15

COMPACT VALVE SYSTEM FOR SELF-INFLATING TIRE

FIELD OF THE INVENTION

The invention relates generally to self-inflating tires and, more specifically, to a pump mechanism for such tires.

BACKGROUND OF THE INVENTION

Normal air diffusion reduces tire pressure over time. The natural state of tires is under inflated. Accordingly, drivers must repeatedly act to maintain tire pressures or they will see reduced fuel economy, tire life and reduced vehicle braking and handling performance. Tire Pressure Monitoring Systems have been proposed to warn drivers when tire pressure is significantly low. Such systems, however, remain dependant upon the driver taking remedial action when warned to re-inflate a tire to recommended pressure. It is a desirable, therefore, to incorporate a self-inflating feature within a tire that will self-inflate the tire in order to compensate for any reduction in tire pressure over time without the need for driver intervention.

DEFINITIONS

"Aspect ratio" of the tire means the ratio of its section height (SH) to its section width (SW) multiplied by 100 percent for expression as a percentage.

"Asymmetric tread" means a tread that has a tread pattern not symmetrical about the center plane or equatorial plane EP of the tire.

"Axial" and "axially" means lines or directions that are parallel to the axis of rotation of the tire.

"Chafer" is a narrow strip of material placed around the outside of a tire bead to protect the cord plies from wearing and cutting against the rim and distribute the flexing above the rim.

"Circumferential" means lines or directions extending along the perimeter of the surface of the annular tread perpendicular to the axial direction.

"Equatorial Centerplane (CP)" means the plane perpendicular to the tire's axis of rotation and passing through the center of the tread.

"Footprint" means the contact patch or area of contact of the tire tread with a flat surface at zero speed and under normal load and pressure.

"Inboard side" means the side of the tire nearest the vehicle when the tire is mounted on a wheel and the wheel is mounted on the vehicle.

"Lateral" means an axial direction.

"Lateral edges" means a line tangent to the axially outermost tread contact patch or footprint as measured under normal load and tire inflation, the lines being parallel to the equatorial centerplane.

"Net contact area" means the total area of ground contacting tread elements between the lateral edges around the entire circumference of the tread divided by the gross area of the entire tread between the lateral edges.

"Non-directional tread" means a tread that has no preferred direction of forward travel and is not required to be positioned on a vehicle in a specific wheel position or positions to ensure that the tread pattern is aligned with the preferred direction of travel. Conversely, a directional tread pattern has a preferred direction of travel requiring specific wheel positioning.

"Outboard side" means the side of the tire farthest away from the vehicle when the tire is mounted on a wheel and the wheel is mounted on the vehicle.

"Passageway" means an integrally formed pathway in the tire or a discrete tube inserted in the tire forming the pump.

"Peristaltic" means operating by means of wave-like contractions that propel contained matter, such as air, along passageways.

"Radial" and "radially" means directions radially toward or away from the axis of rotation of the tire.

"Rib" means a circumferentially extending strip of rubber on the tread which is defined by at least one circumferential groove and either a second such groove or a lateral edge, the strip being laterally undivided by full-depth grooves.

"Sipe" means small slots molded into the tread elements of the tire that subdivide the tread surface and improve traction, sipes are generally narrow in width and close in the tires footprint as opposed to grooves that remain open in the tire's footprint.

"Tread element" or "traction element" means a rib or a block element defined by having shape adjacent grooves.

"Tread Arc Width" means the arc length of the tread as measured between the lateral edges of the tread.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described by way of example and with reference to the accompanying drawings in which:

FIG. **1** is an isometric view of tire and rim assembly showing a single peristaltic pump assembly.

FIG. **2** illustrates a side view of the tire, rim, pump, and valves showing operation of the pump to the tire cavity when the tire rotates.

FIG. **3** is an enlarged cross-sectional view of a pump in the bead area of the tire.

FIG. **4** is an enlarged cross-sectional view illustrating the pump being compressed in the tire bead area.

FIG. **5** is an enlarged cross sectional view of the bead area with the flow controller and filter assembly shown mounted in the tire.

FIG. **6** is a front view of the flow controller and filter assembly.

FIG. **7** is a side view of the valve insert.

FIG. **8** is a top view of the flow controller valve shown mounted in a partial section of the tire.

FIG. **9** is a cross-sectional view of the valve insert of FIG. **7**;

FIG. **10** is a cross-sectional side view of the flow controller valve and filter assembly shown mounted in a tire sidewall;

FIG. **11** is a cross-sectional side view of the inlet control valve and filter assembly shown mounted in a tire sidewall in a direction 90 degrees to that of FIG. **10**;

FIG. **12** is a cross-sectional view of the control valve body in the direction **12-12** of FIG. **11**;

FIG. **13** is a cross-sectional view of a sleeve valve.

FIG. **14** is an illustration showing operation of the sleeve valve; and

FIG. **15** is a schematic of the pump connection.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. **1** and **3**, a tire assembly **10** includes a tire **12**, a peristaltic pump assembly **14**, and a tire rim **16**. The tire mounts in a conventional fashion to a pair of rim mounting surfaces **18** located adjacent outer rim flanges **22**. The outer rim flange **22** has an outer rim surface **26**. An annular rim body **28** joins the rim flanges **22** and supports the tire assembly as shown. The tire is of conventional construction, having a pair of sidewalls **32** extending from opposite bead areas **34** to a crown or tire tread region **38**. The tire and rim enclose an interior tire cavity **40**.

As shown in FIG. **1** the peristaltic pump assembly **14** includes a pump passageway **42** that is mounted or located in the sidewall area of the tire, preferably near the bead region. The pump passageway **42** may be formed of a discrete tube made of a resilient, flexible material such as plastic, elastomer or rubber compounds, and is capable of withstanding repeated deformation cycles when the tube is deformed into a flattened condition subject to external force and, upon removal of such force, returns to an original condition generally circular in cross-section. The tube is of a diameter sufficient to operatively pass a volume of air sufficient for the purposes described herein and allowing a positioning of the tube in an operable location within the tire assembly as will be described. Preferably, the tube has a circular cross-sectional shape, although other shapes such as elliptical may be utilized.

The pump passageway may also be integrally formed into the sidewall of the tire during vulcanization, eliminating the need for an inserted tube. A pump passageway is preferably formed by building into a selected tire component such as a chafer, a removable strip made of wire or silicone, which is them removed post cure to form a molded in pump air passageway. Hereinafter, the term "passageway" refers either to installed tubes or integrally molded passageway.

FIGS. **1** and **2** are illustrations of the pump in the tire, and are not shown in phantom as they should be, in order to facilitate understanding of the system. The location selected for the air passageway within the tire may be within a tire component residing within a high flex region of the tire, sufficient to progressively collapse the peristaltic internal hollow air passageway as the tire rotates under load thereby conveying air along the air passageway from the inlet to the pump outlet.

The pump air passageway **42** has an inlet end **42***a* and an outlet end **42***b* joined together by a flow controller **44**. As shown, the inlet end **42***a* and the outlet end **42***b* are spaced apart approximately 360 degrees forming an annular pump assembly.

A first embodiment of a flow controller **44** is shown in FIGS. **5-15**. The flow controller device **44** functions to regulate the inlet flow and exit flow of the pump passageway **42**. As shown in FIGS. **6** and **10**, the flow controller **44** includes an outer insert **60** that is inserted into a receptacle **64** built in the tire.

As shown in FIG. **8**, the receptacle **64** is a raised hump formed on the tire inner surface and may optionally include a threaded inner hole, wherein the hump is built into the tire sidewall using a series of concentric layers of material, such as uncured elastomer, green rubber. A one piece molded shape may also be used instead of the concentric layers.

Alternatively, the outer insert **60** may be inserted into the receptacle prior to vulcanization. The outer insert may be made of green rubber, elastomer, nylon, ultra high molecular weight polyethylene. The insert is preferably coated with a suitable adhesive such as resorcinol formaldehyde latex (RFL) or commonly referred to as "dip" known to those skilled in the art. The outer surface of the insert may be roughened and coated with the selected RFL. The outer surface of the insert may further include ridges, flanges, extensions, threads or other mechanical means in addition to the selected RFL to retain the insert into the rubber of the tire sidewall.

As shown in FIG. **10**, the outer insert **60** has an interior section formed by an open end facing the tire cavity, a bottom wall **62** opposite the open end and a curved sidewall **63**. The bottom wall has a male portion **65** extending from the bottom wall. The male portion has a hole **66** therethough for communicating filtered air to the interior of the valve. The bottom portion also has two opposed holes **68**, **69** for alignment and fluid communication with the pump inlet and outlet ends, respectively **42***a*, **42***b*. A gasket **70** is positioned on the bottom wall **62** of the insert **60**. The gasket is circular and flat, with three holes aligned with the three holes **66**, **68**, **69** of the insert **60**.

The flow controller device further comprises a valve insert **80** as shown in FIGS. **6**, **7**, **9**, and **10**. The valve insert is generally cylindrical in shape, with an alignment key **82** projecting from the body. The alignment key is seated in mating engagement with an alignment slot **81** formed in the sidewall **63** of the outer insert **60**. They alignment key **82** ensures that holes **83**, **84** on the bottom surface **85** of the valve body aligns with holes **68**, **69** of the insert. The insert **60** is an optional component that may be eliminated, and the outer surface of the valve body **80** may be threaded for reception into the receptacle **64**.

As shown in FIG. **9**, a pressure membrane **90** is received within the valve body inner chamber wherein the outer flanged rim **92** of the pressure membrane **90** is seated on a flow control plate **207**. The pressure membrane **90** is preferably disk shaped and formed of a flexible material such as, but not limited to, rubber, elastomer, plastic or silicone. On the side of the pressure membrane facing the third chamber, a plug **96** protrudes from the membrane. The plug is positioned to plug a channel **107** protruding from the bottom wall of the chamber and prevent flow from the outside air into the third chamber **205**, and hence, airflow into the pump passageway **42**.

A spring **98** has a first end **99** wrapped around the plug **96**, and a second end **101** wrapped around the channel **107** which extends from the bottom wall **105** of the third chamber. The tire cavity pressure overrides the opposing spring force and biases the pressure membrane into the closed position until the tire cavity pressure falls below a threshold value. The channel **107** extends from the chamber **205** through the bottom surface and in alignment with the hole **66** of male portion **65** of the insert **60** as shown in FIG. **10**. Channels **107** and **66** are in fluid communication with a filter assembly **130**. The filter assembly **130** may be mounted on the outside portion of the tire, opposite the flow controller. The filter assembly has filter media (not shown) for filtering the outside air and preventing debris and fluid from entering the pump. The filter assembly may be formed of a hard plastic cup shaped device mounted in the tire sidewall precure or postcure, and have an opening in fluid communication with the internal chamber **205** of the valve body.

As shown in FIGS. **9** through **11**, lid **109** is positioned over the pressure membrane **90**. The lid has a flanged portion **111** which engages the rim of the pressure membrane. The lid **109** further includes a central hole **113**. The lid **109** is secured to the flow controller **44** via a slideable retainer **115**. The retainer **115** has opposed U shaped ends **117** which are first aligned into opposed cutout recesses **119**, and then rotated into engagement with mating grooves **121** of flanged ends **123** of insert **60**. The retainer **115** has a hole **125** aligned with hole **113** of cap to allow fluid communication of the tire cavity with the pressure membrane.

As shown in FIG. **9**, the valve body **80** has three interior chambers **205**, **206**,**208**. A first duckbill or check valve **202** is positioned in first chamber **206**. A second duckbill or check valve **204** is positioned in second chamber **208**. The third chamber **205** has a channel **107** which supplies filtered outside air to the flow controller. The plug of the pressure membrane is positioned in the third channel to close off flow from the channel **107**. A spring **98** is housed within third chamber **205**, and is positioned to bias the pressure membrane in the open position when the tire cavity pressure falls to Pset level, wherein Pset is the tire pressure value at which the control valve opens and allows air into the pump to initiate pumping action.

The third chamber has an open hole **201** (opposite channel **107**) through a flow control plate **207**. The flow control plate **207** has aligned holes **209**, **211** to direct the flow into the duckbill valves **202**, **204** from the third chamber **205**. The duckbill valves **202**/**204** prevent backflow from the pump passageway into the chamber **205**.

The pressure membrane **90** is responsive to the pressure in the interior of the tire cavity **40** on the cavity side **91** of the membrane, and is responsive to the pressure in the inlet chamber on the valve side **93** of the membrane. If the tire pressure is sufficiently high, the tire pressure pushes the plug of the membrane into sealing engagement with the channel **107**, overcoming the spring force, wherein the pressure membrane seals off flow from the channel **107** so that no airflow may enter the pump inlet end **42***a*. As the tire loses air pressure it will reach a set trigger pressure Pset. When the tire pressure is at or below the trigger pressure Pset, the spring force is sufficient to unseat the pressure membrane plug from the channel, opening up the channel **107**. Filtered, outside air may then enter the flow controller through the channel **107** of the valve body, then through the third or central chamber **205**, into the first chamber **206** through hole **209** and out hole **83** into pump inlet **42***a*. As the tire rotates, the air is pumped from the inlet to the pump outlet **42***b*. As shown in FIGS. **11** and **12**, as the flow enters chamber **208**, the fluid exits though a channel **302** and then enters the one way sleeve valve **300** through inlet port **304**. The fluid travels up the sleeve valve and exits through outlet port **306** as shown in FIG. **14**. The sleeve valve **300** has a one way resilient flap **308** which allows the fluid to exit into outlet channel **220**. Outlet channel **220** is in fluid communication with the pump cavity. Thus as the tire rotates air is pumped into the tire cavity.

As will be appreciated from FIG. **2**, air maintenance pump passageway **42** is a bi-directional, 360 degree pump, with the inlet and outlet co-located. If the tire cavity pressure is below the trigger pressure, membrane plug opens the channel **107** allowing filtered outside air to enter the valve body chamber **205** and into the pump tube inlet **42***a*. As the tire rotates in a direction of rotation **88**, a footprint **100** is formed against the ground surface **86**. A compressive force **104** is directed into the tire from the footprint **100** and acts to flatten a segment **110** of the pump passageway **42** a as shown at numeral **106**. Flattening of the segment **110** of the pump passageway **42** forces a portion of air located between the flattened segment **110** and the flow controller **44**, in the direction towards the flow controller **44**. As the tire continues to rotate in direction **88** along the ground surface **86**, the pump passageway **42** will be sequentially flattened or squeezed segment by segment **110**, **110'**, **110"** in a direction opposite to the direction of tire rotation **88**. The sequential flattening of the pump passageway **42** segment by segment causes the column of air located between the flattened segments to be pumped within pump passageway **42** to the pump outlet **42***b*. Flow enters the flow controller chamber **208** and then into channel **302**. The flow then enters inlet port **304** of sleeve valve **300** and then exits outlet port **306** of sleeve valve into outlet channel **220** and into the tire cavity. With the tire rotating in direction **88**, flattened tube segments are sequentially refilled by air **92** flowing into the flow controller **44** along the pump passageway **42** as shown by FIG. **2**. This cycle continues until the tire cavity pressure is sufficient to overcome the spring force **98** and plug the channel, no longer allowing air flow to enter the pump.

The location of the peristaltic pump assembly will be understood from FIGS. **3**-**4**. In one embodiment, the peristaltic pump assembly **14** is positioned in the tire sidewall, radially outward of the rim flange surface **26** in the chafer **120**. So positioned, the pump passageway **42** is radially inward from the tire footprint **100** and is thus positioned to be flattened by forces directed from the tire footprint as described above. The segment that is opposite the footprint **100** will flatten from the compressive force **104** from the footprint **100** pressing the tube segment against the rim flange surface **26**. Although the positioning of the pump passageway **42** is specifically shown as between a chafer **120** of the tire at the bead region **34** and the rim surface **26**, it is not limited to same, and may be located at any region of the tire such as anywhere in the sidewall or tread.

From the forgoing, it will be appreciated that the subject invention may be used with a secondary tire pressure monitoring system (TPMS) (not shown) of conventional configuration that serves as a system fault detector. The TPMS may be used to detect any fault in the self-inflation system of the tire assembly and alert the user of such a condition.

Variations in the present invention are possible in light of the description of it provided herein. While certain representative embodiments and details have been shown for the purpose of illustrating the subject invention, it will be apparent to those skilled in this art that various changes and modifications can be made therein without departing from the scope of the subject invention. It is, therefore, to be understood that changes can be made in the particular embodiments described which will be within the full intended scope of the invention as defined by the following appended claims.

What is claimed is:

1. A self-inflating tire assembly comprising:

a. a tire having a tire cavity, a first and second sidewall extending respectively from first and second tire bead regions to a tire tread region;

b. said tire having a passageway, said passageway having an inlet end and an outlet end,

c. a valve device connected to the inlet end and outlet end of the passageway, wherein the valve device has a valve body having a first, second and third chamber, said first chamber having a first hole in fluid communication with the inlet end of the passageway, said second chamber having a second hole in fluid communication with the outlet end of the passageway, and a third chamber having a channel in fluid communication with the ambient air;

d. wherein a first and second one way valve is positioned in the first and second chamber, respectively; wherein a pressure membrane is received within the valve body, and positioned to open and close the channel;

e. wherein the second chamber is in fluid communication with the tire cavity.

2. The self-inflating tire assembly of claim **1** wherein the second chamber is in fluid communication with an outlet channel, wherein the outlet channel has an outlet to the tire cavity.

3. The self-inflating tire assembly of claim **2** wherein a one way flow valve is positioned in the outlet channel.

4. The self-inflating tire assembly of claim **3** wherein the one way flow valve is a sleeve valve.

5. The self-inflating tire assembly of claim **3** wherein the one way flow valve is a duckbill valve.

6. The self-inflating tire assembly of claim **3** wherein the one way flow valve is a check valve.

7. The self-inflating tire assembly of claim **2** wherein the valve body is mounted within a valve insert.

8. The self-inflating tire assembly of claim **1** wherein the first chamber is in fluid communication with an outlet channel, wherein the outlet channel has an outlet to the tire cavity.

9. The self-inflating tire assembly of claim **1** wherein the valve device including an insert molded in the tire.

10. The self-inflating tire assembly of claim **1** wherein the pressure membrane is in fluid communication with the tire cavity and the third chamber of the valve body.

11. The self-inflating tire assembly of claim **1** wherein a spring is received within the third chamber and is positioned to exert force upon the pressure membrane to bias the pressure membrane position relative to the channel in the open position.

12. The self-inflating tire assembly of claim **11** wherein the pressure membrane has a plug and the spring has a first end mounted about the plug, wherein the plug is positioned to close an end of the channel.

13. The self-inflating tire assembly of claim **1** wherein a control plate is positioned between the pressure membrane and the first and second one way valve, wherein the control plate has a hole aligned for communicating flow from the third chamber into one of the first and second chamber.

14. A valve device for a tire having a tire cavity, the valve device comprising:

a. an insert mounted in the tire, a valve body mounted within the insert; wherein the valve body has a first, second and third chamber, wherein a first and second one way valve is positioned in the first and second chamber, respectively;

b. wherein a pressure membrane is received within the valve body, and positioned to open and close the third chamber;

c. said pressure membrane is in fluid communication with the tire cavity and the third chamber of the valve body;

d. wherein a spring is received within the third chamber and is positioned to exert force upon the pressure membrane to bias the pressure membrane position relative to the third chamber in an open position.

15. The valve device of claim **14** wherein the pressure membrane has a plug and the spring has a first end mounted about the plug.

16. The valve device of claim **14** wherein a control plate is positioned between the pressure membrane and the first and second one way valve, wherein the control plate has a hole aligned for communicating flow from the third chamber into the first chamber.

17. The valve device of claim **16** wherein the control plate has a hole aligned for communicating flow from the third chamber into the second chamber.

18. The valve device of claim **14** wherein the first one way valve is a duck bill type.

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