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(54) **SEAT-LOWER GUIDE COMBINATION**

UNTERE FÜHRUNGSKOMBINATION FÜR SITZ

COMBINAISON DE GUIDES D'ABAISSEMENT DE SIEGE

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Description

Cross Reference to Co-Pending Applications

[0001] This application claims the benefit of the earlier filing date of U.S. Provisional Application No. 60/551,304, filed March 8, 2004.

Field Of The Invention

[0002] The invention relates generally to a fuel injector for an internal combustion engine, and more particularly to a fuel injector in which atomization and precision targeting of fuel can be altered so as to meet particular requirements for different engine configurations.

Background Of The Invention

[0003] Most modem automotive fuel systems utilize fuel injectors to provide precise metering of fuel for introduction into each combustion chamber of an internal combustion engine. The fuel injectors atomize the fuel during injection, breaking the fuel into a large number of very small particles, increasing the surface area of the fuel being injected, and allowing an oxidizer, typically ambient air, to thoroughly mix with the fuel prior to combustion. The metering and atomization of the fuel reduces combustion emissions and increases the fuel efficiency of the engine. Thus, as a general rule, the greater the precision in metering and targeting of the fuel, and the greater the atomization of the fuel, the lower the emissions and the greater the fuel efficiency.

[0004] The fuel injector is typically mounted upstream of the intake valve in the intake manifold proximate a cylinder head. As the intake valve opens on an intake port of the cylinder, fuel is sprayed towards the intake port. In one situation, it may be desirable to target the fuel spray at the intake valve head or stem while in another situation, it may be desirable to target the fuel spray at the intake port instead of at the intake valve. In both situations, the targeting of the fuel spray can be affected by the spray pattern. Where the spray pattern has a large divergent cone shape, the sprayed fuel may impact on a surface of the intake port rather than towards its intended target. Conversely, where the spray pattern has a narrow divergent cone shape, the fuel may not atomize and may even recombine into a liquid stream. In either case, incomplete combustion may result, leading to an increase in undesirable exhaust emissions.

Complicating the requirements for targeting and spray pattern are cylinder head configuration and intake geometry specific to different engine designs. As a result, a fuel injector designed for a specified cone pattern and targeting of the fuel spray may work extremely well in one type of engine configuration but may present emissions problems upon installation in a different type of engine configuration.

An electro-magnetic fuel injector typically utilizes a solenoid assembly to supply an actuating force to a fuel metering assembly. Typically, the fuel metering assembly is a plunger-style closure member which reciprocates between a closed position, where the closure member is positioned in a seat to prevent fuel from escaping through a metering orifice into the combustion chamber, and an open position, where the closure member is lifted from the seat, allowing fuel to discharge through the metering orifice for introduction into the combustion chamber. In reciprocating between the open and closed position, the closure member is positioned by a lower guide member that facilitates a proper contact with the seat. In known fuel injectors the lower guide member and the seat are two separate parts that need to be properly aligned during assembly of the fuel injector. A misalignment of the two parts may cause leakage of the fuel injector that will adversely affect precision metering and targeting of the fuel. To prevent such misalignment, the lower guide member and the seat have been formed as one homogeneous member. However, in known homogeneous lower guide and seat members, atomization and precision targeting of fuel can not be altered so as to meet particular requirements for different engine configurations.

It would be beneficial to develop a fuel injector having a lower guide member and a seat member in precise alignment, and in which atomization and precision targeting of fuel can be altered so as to meet particular requirements for different engine configurations.

US617394 describes a valve in which the orifice disk is formed from a multilayer laminate of sheet metal which has been deflected to form a fixed valve seat.

Summary Of The Invention

[0005] A preferred embodiment provides a fuel injector for an internal combustion engine, including a housing, a homogeneous member defining a continuous wall having a seat portion and a guide portion, a closure member, and a metering disk. The housing includes an inlet and an outlet disposed along a longitudinal axis. The homogeneous member is disposed proximate the outlet. The seat portion includes a sealing surface and a seat orifice. The closure member is disposed in the housing and positioned by the guide portion for reciprocal motion along the longitudinal axis between a first position such that the closure member is displaced from the seat, allowing fuel flow past the closure member, and a second position such that the closure member is contiguous the seat, precluding fuel flow past the closure member. The metering disk is proximate the seat orifice.

[0006] Another preferred embodiment provides a method of manufacturing a fuel injector for an internal combustion engine. The fuel injector includes a housing having an inlet and an outlet disposed along a longitudinal axis, and a closure member disposed in the housing. The method includes providing a homogeneous member disposed proximate the outlet and defining a continuous wall having a seat portion and a guide portion. The seat por-

tion includes a sealing surface and a seat orifice. The closure member is positioned by the guide portion and contiguous the seat portion. The method includes providing a metering disk proximate the seat orifice, the metering disk having a plurality of metering orifices configured to form a spray pattern particular to the internal combustion engine.

Brief Description Of The Drawings

[0007] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate the presently preferred embodiments of the invention, and together with the general description given above and the detailed description given below, serve to explain features of the invention.

[0008] Fig. 1 is a cross-sectional view of a fuel injector including a seat-lower guide combination, according to an embodiment of the invention.

[0009] Fig. 2 is an enlarged view of the seat-lower guide combination of Fig. 1.

[0010] Fig. 3 is a perspective view of the seat-lower guide combination, according to an embodiment of the invention.

[0011] Fig. 4 is cut-away view of the seat-lower guide combination of Fig. 3.

Detailed Description Of The Preferred Embodiments

[0012] A preferred embodiment of a fuel injector having a seat-lower guide combination 110 is illustrated in Fig. 1. Fig. 2 is an enlarged view of the seat-lower guide combination 110 fixed to an outlet of the fuel injector. The fuel injector includes: a fuel inlet tube 50, a stator 52, a non-magnetic shell 54, a valve body 56, a metering disc 112, an adjustment tube 58, a filter assembly 60, a coil spring 62, an armature 64, a closure member 66, an overmold 68, a coil assembly 70 and a coil assembly housing 72.

[0013] Fuel inlet tube 50, stator 52, non-magnetic shell 54, and valve body 56 are joined preferably by hermetic laser welds to form a fluid-tight flow path between the fuel injector inlet and the fuel injector outlet. The seat-lower guide 110 is coupled at the outlet end of valve body 56 by a suitable coupling technique, such as, crimping, welding, bonding or riveting.

[0014] In the calibrated fuel injector, adjustment tube 58 has been positioned along longitudinal axis A-A within stator 52 to compress coil spring 62 to a desired bias force that urges the armature 64 and closure member 66 such that the rounded tip end of closure member 66 can be seated on a seat portion 114 of the seat-lower guide 110 to close an orifice 118. Filter assembly 60 can be fitted proximate an open upper end of adjustment tube 58 to filter particulate matter from fuel passing through the fuel injector.

[0015] After passing through adjustment tube 58, fuel enters a volume 73 that is cooperatively defined by adjustment tube 58, stator 52 and armature 64 and that contains coil spring 62. Armature 64 includes a passageway 74 that communicates volume 73 with a passageway 75 in valve body 56. Thus fuel may flow from volume 73, through passageways 74, 75, through passage holes 120 in the seat-lower guide 110, to the seat portion 114 of the deep drawn seat-lower guide 110.

[0016] Coil assembly 70 includes a plastic bobbin 76 on which an electromagnetic coil 78 is wound. Respective terminations of the coil 78 connect to respective terminals 80 that are shaped and, in cooperation with a surround 82 formed as an integral part of overmold 68, form an electrical connector for connecting the fuel injector to an electronic control circuit (not shown) that operates the fuel injector.

[0017] In operation, the fuel injector is initially at the non-injecting position shown in Fig. 1. In this position, a working gap 84 exists between the annular end face of stator 52 and the confronting annular end face of armature 64. Non-magnetic shell 54 assures that when electromagnetic coil 78 is energized, the magnetic flux will follow a path that includes armature 64. Starting at the lower axial end of housing 72, the magnetic circuit extends through valve body 56 to armature 64, and from armature 64 across the working gap 84 to stator 52, and back to housing 72. When electromagnetic coil 78 is energized, the spring force on armature 64 is overcome and armature 64 is attracted toward stator 52 reducing the working gap 84. This unseats closure member 66 from seat portion 114 to open the fuel injector so that pressurized fuel in the valve body 56 flows through passage holes 120 in the seat-lower guide 110, through orifice 118, into a chamber 126 and through the orifices 128 patterned on a metering disc 112. When the coil 78 ceases to be energized, coil spring 62 pushes the armature/closure member closed on seat portion 114.

[0018] Fig. 3 illustrates a preferred embodiment of the seat-lower guide combination 110. Fig. 4 is a cut-away view of the seat-lower guide combination 110. In the preferred embodiment, seat-lower guide combination 110 is a homogeneous member formed as a continuous wall. Preferably the continuous wall is formed of metal by a deep drawn manufacturing process. However, the continuous wall may be formed of other materials and by other processes so long as a seat portion 114 and a guide portion 116 of the seat-lower guide combination 110 are properly aligned with respect to each other. Guide portion 116 defines a cylinder disposed along the longitudinal axis A-A. Seat portion 114 generally defines a conic frustum disposed along the longitudinal axis A-A, and having its base integrally formed with one end of guide portion 116, and its apex forming an orifice 118. Passage holes 120 radially spaced about longitudinal axis A-A by equal intervals penetrate the seat-lower guide combination at a wall portion intermediate the guide portion and seat portion. As illustrated in Fig. 2, guide portion 116 properly positions the closure member 66 on seat portion 114 to form a fluid-tight seal between closure member 66 and

seat portion 114. Guide portion 116 and seat portion 114 being formed as a homogeneous member precludes misalignment between these portions that could occur if the portions were separate parts that needed to be aligned with respect to each other during assembly of the fuel injector.

[0019] In the preferred embodiment, the continuous wall of seat-lower guide combination 110 may further include a metering disk support portion 122 and a retaining portion 124, both being formed integrally with the guide portion and the seat portion. Retaining portion 124 forms a fluid tight connection with an outer surface of valve body 56 proximate the outlet of the fuel injector, as illustrated in Fig. 2. Portion 122 defines an annulus extending between the apex of seat portion 114 and the retaining portion 124, and supports the metering disk 112. As shown in Fig. 2 and Fig. 4, portion 122 extends radially outward at an oblique angle from longitudinal axis A-A and forms a chamber 126 with metering disk 112. Metering disk 112 includes a plurality of orifices 128 to allow fuel to be discharged from the fuel injector. Different metering disks 112 having different size, shape, number and pattern of orifices 128 may be fixed to metering disk support portion 122 so that atomization and precision targeting of fuel can be altered to meet particular requirements for different engine configurations. For example, the seat-lower guide 110 can be used with the fuel injector/metering disk arrangements disclosed in co-pending application nos. 10/183,406 filed June 28, 2002; 10/183,392 filed June 28, 2002; 10/753,378 filed January 9, 2004; 10/753,481 filed January 9, 2004; and 10/753,377 filed January 9, 2004, which are incorporated by reference herein in the entirety.

[0020] While the invention has been disclosed with reference to certain preferred embodiments, numerous modifications, alterations, and changes to the described embodiments are possible without departing from the sphere and scope of the invention, as defined in the appended claims. Accordingly, it is intended that the invention not be limited to the described embodiments, but that it have the full scope defined by the language of the following claims.

Claims

1. A fuel injector for an internal combustion engine, comprising:

   a housing having an inlet and an outlet disposed along a longitudinal axis (A-A);
   a homogeneous member (110) disposed proximate the outlet and defining a continuous wall that is formed of metal by a deep-drawn manufacturing process the continuous wall including:
   a guide portion (116) defining a cylinder disposed along the longitudinal axis;
   a seat portion (114) having a sealing surface and a seat orifice, the seat portion defining a conic frustum disposed along the longitudinal axis, the conic frustum having a base and an apex, the base being integrally formed with one end of the cylinder, and the apex forming the seat orifice;
   a retaining portion (124) that fixes the homogeneous member to the housing outlet;
   a support portion (122) that attaches a metering disk thereto, the support portion defining an annulus extending radially between the apex of the seat portion and the retaining portion, at an oblique angle from the longitudinal axis; and
   a plurality of passage holes (120) radially spaced about the longitudinal axis and formed in the continuous wall intermediate the guide portion and the seat portion;
   a closure member (66) in the housing positioned by the guide portion for reciprocal motion along the longitudinal axis between a first position wherein the closure member is displaced from the seat, allowing fuel flow past the closure member, and a second position wherein the closure member is contiguous the seat, precluding fuel flow past the closure member; and
   a metering disk (112) fixed to the support portion proximate the seat orifice, the metering disk having a plurality of metering orifices configured to form a spray pattern particular to the internal combustion engine.

2. The fuel injector of claim 1, wherein the support portion (122) and the metering disk (112) define a chamber (126).

Patentansprüche

1. Kraftstoffeinspritzventil für einen Verbrennungsmotor, das Folgendes umfasst:

   ein Gehäuse mit einem Einlass und einem Auslass, die auf einer Längsachse (A-A) liegen,
   ein homogenes Element (110), das in der Nähe des Auslasses angeordnet ist und eine durchgehende Wand definiert, die durch ein Tiefziehfertigungsverfahren aus Metall gebildet wird, wobei die durchgehende Wand Folgendes umfasst:
   einen Führungsabschnitt (116), der einen in Längsachsenrichtung liegenden Zylinder definiert,
   einen Sitzabschnitt (114) mit einer Abdichtfläche und einer Sitzöffnung, wobei der Sitzabschnitt einen in Längsachsenrichtung liegenden Kegelstumpf definiert, der eine Grundfläche und eine Deckfläche aufweist, wobei die Grundfläche einstükkig mit einem Ende des Zylinders

ausgebildet ist und die Deckfläche die Sitzöffnung bildet,
einen Halteabschnitt (124), der das homogene Element an dem Gehäuseauslass befestigt,
einen Stützabschnitt (122), der eine Dosierscheibe daran anbringt, wobei der Stützabschnitt einen Kreisring definiert, der radial zwischen der Deckfläche des Sitzabschnittes und dem Halteabschnitt in einem schiefen Winkel zur Längsachse verläuft, und
mehrere Durchgangslöcher (120), die in einem radialen Abstand um die Längsachse herum angeordnet und in der durchgehenden Wand zwischen dem Führungsabschnitt und dem Sitzabschnitt ausgebildet sind,
ein Schließelement (66) in dem Gehäuse, das von dem Führungsabschnitt in Position gehalten wird und sich an der Längsachse entlang zwischen einer ersten Position und einer zweiten Position hin- und herbewegen kann, wobei das Schließelement in der ersten Position nicht an dem Sitz anliegt, wodurch Kraftstoff an dem Schließelement vorbeifließen kann, und in der zweiten Position an dem Sitz anliegt, was ein Vorbeifließen von Kraftstoff an dem Schließelement verhindert, und
eine Dosierscheibe (112), die in der Nähe der Sitzöffnung an dem Halteabschnitt befestigt ist, wobei die Dosierscheibe mehrere Dosieröffnungen aufweist, die so konfiguriert sind, dass sie ein für den Verbrennungsmotor typisches Spritzmuster bilden.

2. Kraftstoffeinspritzventil nach Anspruch 1, bei dem der Halteabschnitt (122) und die Dosierscheibe (112) eine Kammer (126) definieren.

Revendications

1. Injecteur de carburant pour un moteur à combustion interne, comprenant :

un logement ayant une entrée et une sortie disposées le long d'un axe (A-A) longitudinal ;
un élément (110) homogène disposé à proximité de la sortie et définissant une paroi continue qui est formée de métal par une opération de fabrication à embouti profond, la paroi continue comprenant :
une partie (116) de guidage définissant un cylindre disposé le long de l'axe longitudinal ;
une partie (114) de siège ayant une surface d'étanchéité et un orifice de siège, la partie de siège définissant un tronc de cône disposé le long de l'axe longitudinal, le tronc de cône ayant une base et un sommet, la base étant d'un seul tenant avec une extrémité du cylindre, le sommet formant l'orifice du siège ;
une partie (124) de retenue qui fixe l'élément homogène à la sortie du logement ;
une partie (122) de support qui attache un disque de mesure, la partie de support définissant un espace annulaire s'étendant radialement entre le sommet de la partie de siège et la partie de retenue en faisant un angle oblique avec l'axe longitudinal ; et
une pluralité de trous (120) de passage espacés radialement autour de l'axe longitudinal et formés dans la paroi continue entre la partie de guidage et la partie de siège ;
un élément (66) de fermeture dans le logement mis en position par la partie de guidage en vue d'un mouvement en aller et retour le long de l'axe longitudinal entre une première position dans laquelle l'élément de fermeture est écarté du siège, en permettant à un courant de carburant de passer devant l'élément de fermeture et une deuxième position dans laquelle l'élément de fermeture est contiguë au siège en empêchant un courant de carburant de passer devant l'élément de fermeture ; et
un disque (112) de mesure fixé à la partie de support à proximité de l'orifice du siège, le disque de mesure ayant une pluralité d'orifices de mesure configurés pour former un motif de pulvérisation particulier au moteur à combustion interne.

2. Injecteur de carburant suivant la revendication 1, dans lequel la partie (122) de support et le disque (112) de mesure définissent une chambre (126).

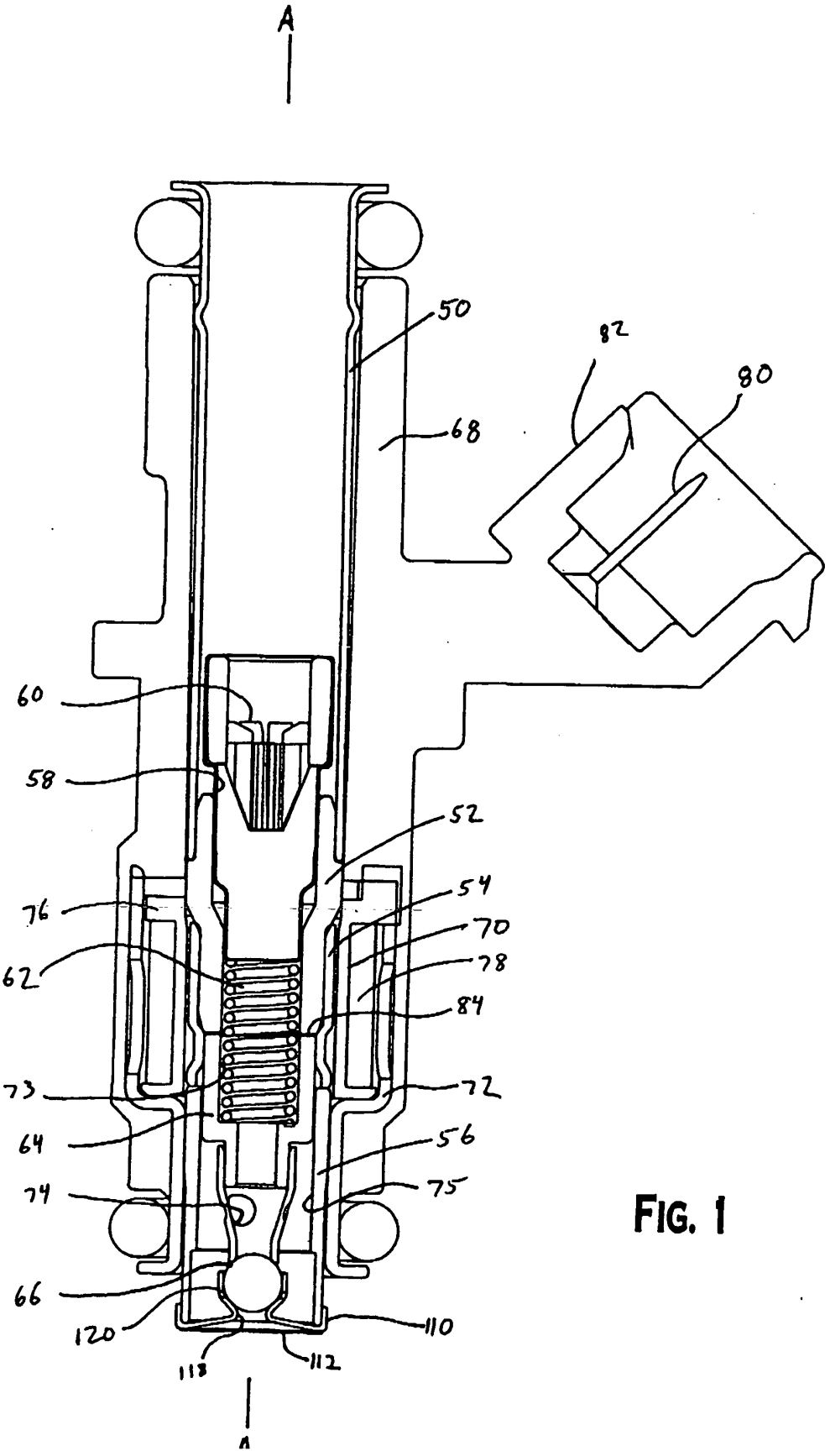

A
50
82
80
68
60
58
52
54
76
70
62
78
84
73
72
64
56
74
75
66
120
110
118
112
A

FIG. 1

FIG. 2

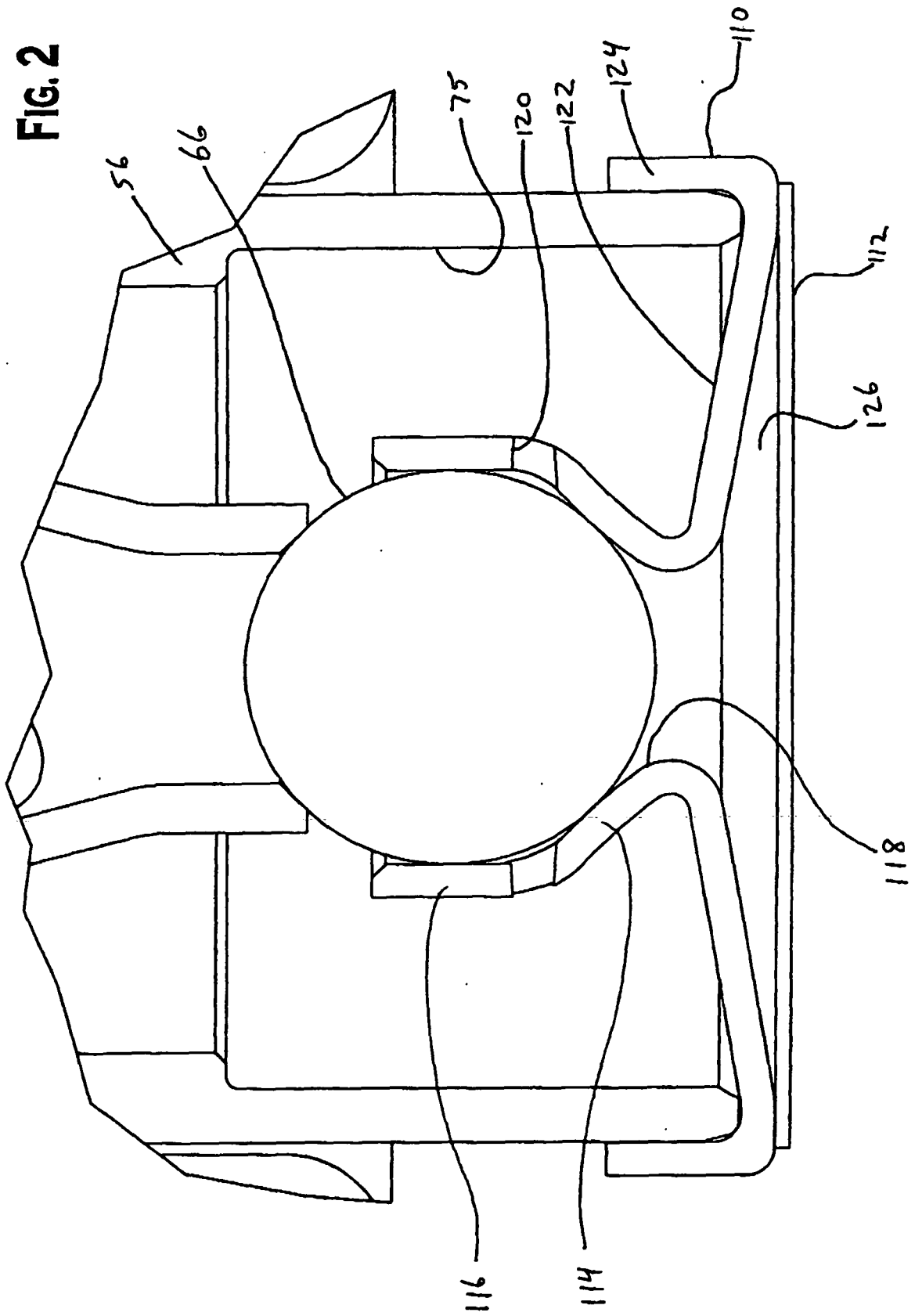


FIG. 3

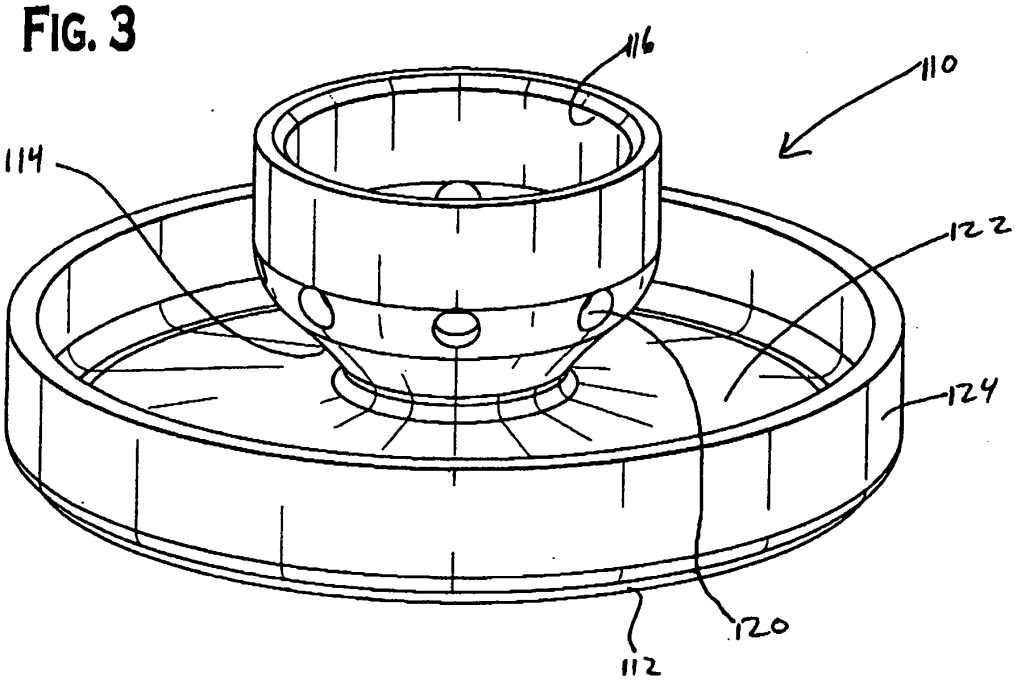
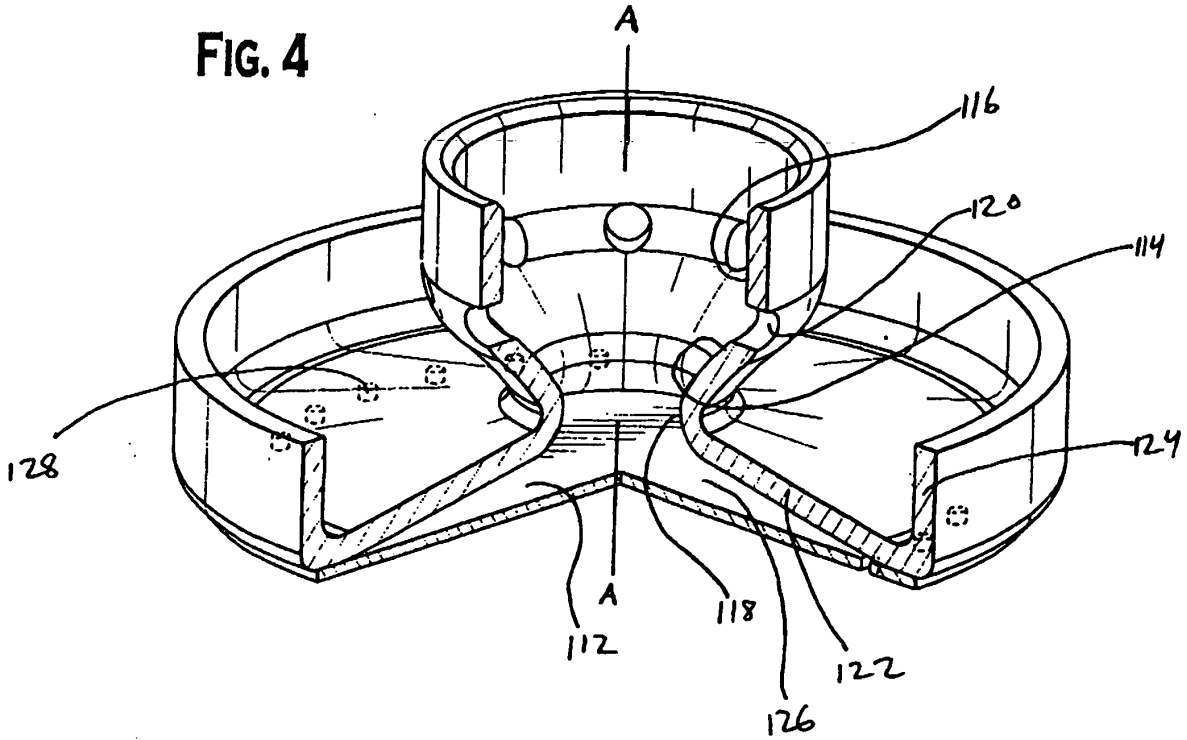

116
110
114
122
124
120
112

FIG. 4


A
116
120
114
128
124
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118
112
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126

REFERENCES CITED IN THE DESCRIPTION

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