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**Hegemier**(10) **Pub. No.: US 2017/0167316 A1**(43) **Pub. Date: Jun. 15, 2017**(54) **END REINFORCED VALVE STEM SEAL ASSEMBLY**(52) **U.S. Cl.**CPC ..... **F01L 3/08** (2013.01)(71) Applicant: **Dana Automotive Systems Group, LLC, Maumee, OH (US)**

(57)

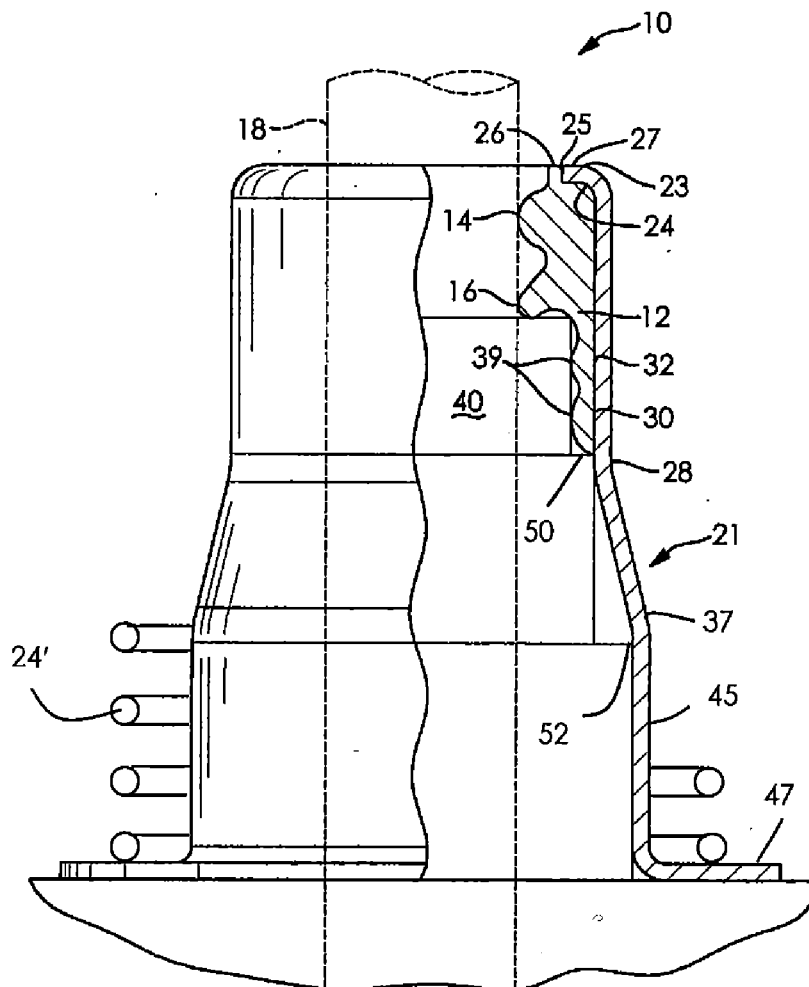
**ABSTRACT**(72) Inventor: **Timothy A. Hegemier, Avilla, IN (US)**(21) Appl. No.: **15/380,365**(22) Filed: **Dec. 15, 2016****Related U.S. Application Data**

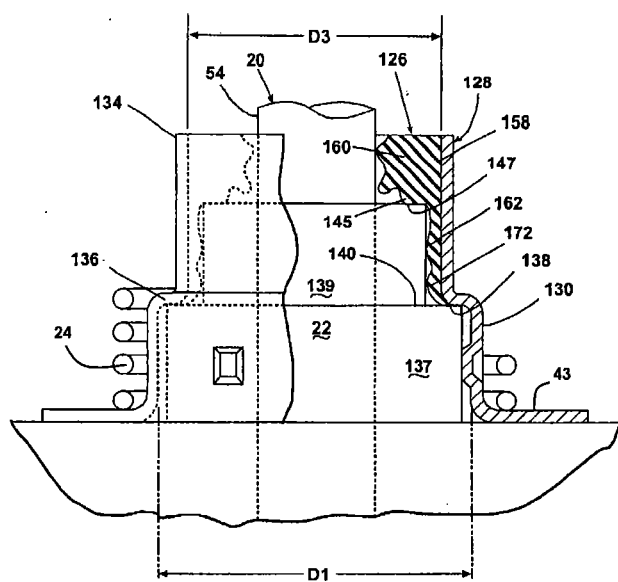
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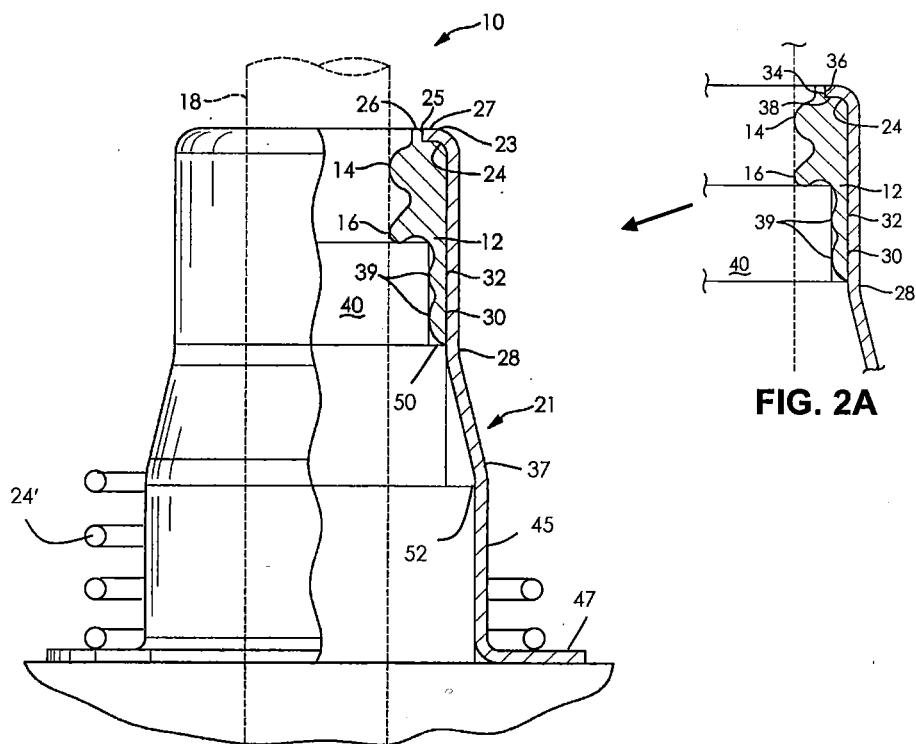
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A valve stem seal assembly comprises an elastomeric seal having first and second radially inwardly directed sealing lips that are in intimate sealing contact with a valve stem. Also, a metal seal retainer has a first metal seal retainer portion disposed on a first top portion of the elastomeric seal. The metal seal retainer radially abuts a second top portion of the elastomeric seal and is bonded thereto, where no portion of the elastomeric seal is axially above the first metal seal retainer portion. A second metal seal retainer portion is continuous and unitary with, and perpendicular to the first metal seal retainer portion. An outer surface of the elastomeric seal is bonded to an inner surface of the second metal seal retainer portion, and no portion of the elastomeric seal is radially outward of the second metal seal retainer portion.



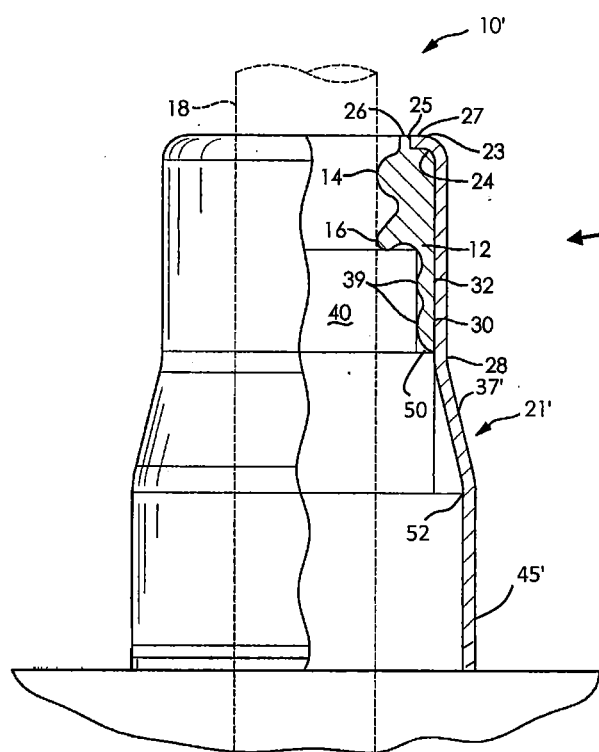


**FIG. 1**  
**Prior Art**

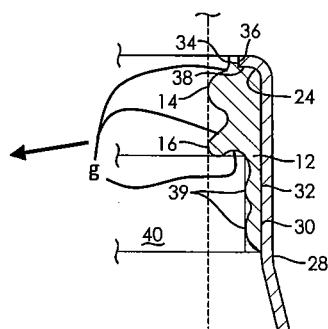


**FIG. 2**

**FIG. 2A**



**FIG. 3**



**FIG. 3A**

## END REINFORCED VALVE STEM SEAL ASSEMBLY

### FIELD

**[0001]** An engine valve stem seal assembly is disclosed. More particularly, an end reinforced engine valve stem seal assembly is disclosed.

### BACKGROUND

**[0002]** For an engine, a valve stem seal assembly cooperates with an engine valve stem to provide lubrication and to contain engine gases within engine inlet and exhaust ports. To accomplish these functions, such an engine valve stem seal assembly typically includes an elastomeric seal that provides an elastomeric-to-metal seal between the engine elastomeric seal and the engine valve stem.

**[0003]** FIG. 1 illustrates a prior art valve stem seal assembly, which is disclosed in U.S. Pat. No. 6,450,143, having a one-piece cylindrical-shaped foundation seal retainer **128** for supporting a valve stem seal **126**. The retainer **128** includes a lower portion **130** and an upper portion **134**. The lower portion **130** is separated from the upper portion **134** by a transition area **136**. The transition area **136** serves to reduce the inner diameter of the retainer **128** between a lower diameter **D1** and an upper diameter **D3**. The transition area **136** is formed as an inwardly extending radial ledge located on a valve guide **22** where the diameter of the valve guide **22** is reduced from a first diameter **137** to a smaller, second diameter **139**.

**[0004]** An inner surface **138** of the transition area **136** engages an upper surface **140** of the first diameter **137** of the valve guide **22**. The valve stem seal **126** engages the outer circumference **54** of the valve stem **20** to provide a seal. An outer circumference **158** of the seal **126** is supported by and engages an inner circumference of the upper retainer portion **134**. The valve stem seal **126** includes an upper seal **160** and a lower seal **162**. The upper seal **160** includes an inner surface **145** that engages an upper surface **147** of the second diameter **139** of the valve guide **22**. The retainer lower portion **130** has a valve spring **24** disposed therearound. The valve spring **24** rests on and cooperates with an integral flange **43** to maintain the seal **126** in position on the valve guide **22**. Under high pressure conditions, the valve spring **24** tends to prevent the guide **22** from being lifted, which can result in seal failure due to bursting.

**[0005]** Unfortunately, the cylindrical-shaped foundation retainer **128** of the '143 patent has a limited sealing effect in an axial direction by allowing the elastomeric seal **126** to partially axially extrude when pressure is applied under the elastomeric seal **126**. Such cylindrical-shaped foundation seal support assemblies only partially solve the problem of leakage in the axial direction into which the elastomeric seal **126** partially extrudes. Consequently, the cylindrical-shaped foundation arrangement has limited strength in the axial direction by allowing the elastomeric seal **126** to shear and partially extrude when pressure is applied under the elastomeric seal **126**.

**[0006]** Therefore, what is sought is a valve stem seal assembly whose elastomeric seal does not extrude, thereby providing a low oil metering rate performance and better containment of engine gases in the axial direction, than existing one-piece cylindrical-shaped foundation valve stem seal assemblies.

### SUMMARY

**[0007]** A valve stem seal assembly has an elastomeric seal with first and second radially inwardly directed sealing lips that are in intimate sealing contact with a valve stem. The valve stem seal assembly has a metal seal retainer with a first metal seal retainer portion disposed on a first top portion of the elastomeric seal. The first metal seal retainer portion radially abuts a second top portion of the elastomeric seal and is bonded thereto, wherein no portion of the elastomeric seal is axially above the first metal seal retainer portion. Also, the valve stem seal assembly has a second metal seal retainer portion that is unitary with and perpendicular to the first metal seal retainer portion, wherein an outer surface of the elastomeric seal is bonded to an inner surface of the second metal seal retainer portion. No portion of the elastomeric seal is radially outward of the second metal seal retainer portion.

**[0008]** Further objects and advantages of the present invention will be apparent from the following description and appended claims, reference being made to the accompanying drawings forming a part of a specification, wherein like reference characters designate corresponding parts of several views.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0009]** FIG. 1 is a side cross-sectional plan view of a prior art valve stem seal assembly with a retainer having a cylindrical-shaped foundation;

**[0010]** FIG. 2 is a side cross-sectional plan view of a first valve stem seal assembly having an end reinforced metal seal retainer;

**[0011]** FIG. 2A is an inset view of a portion of FIG. 2;

**[0012]** FIG. 3 is a side cross-sectional plan view of a second valve stem seal assembly having an end reinforced metal seal retainer; and

**[0013]** FIG. 3A is an inset of the side cross-sectional plan view of the second valve stem seal assembly having an end reinforced metal seal retainer of FIG. 3.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0014]** It is to be understood that the invention may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions, directions or other physical characteristics relating to the embodiments disclosed are not to be considered as limiting, unless the claims expressly state otherwise.

**[0015]** FIGS. 2 and 2A depict a first valve stem seal assembly **10** that has an elastomeric seal **12** with first and second radially inwardly directed sealing lips **14**, **16** that are in intimate sealing contact with a valve stem **18**. Further, the first valve stem seal assembly **10** has a first metal seal retainer portion **23** disposed axially on a first top portion **24** of the elastomeric seal **12**, and radially abutting a second top portion **26** of the elastomeric seal **12**. The first metal seal retainer portion **23** is bonded to both first and second elastomeric seal top portions **24**, **26**, wherein no portion of the elastomeric seal **12** is axially above the first metal seal

retainer portion 23. The top surface 25 of the second top portion 26 of the elastomeric seal 12 and the top surface 27 of the first metal seal retainer portion 23 are in the same horizontal plane.

[0016] The valve stem seal assembly 10 has a second metal seal retainer portion 28 that is continuous and unitary with, and perpendicular to, the first metal seal retainer portion 23. As shown, the metal seal retainer 21 is essentially of the same thickness throughout, but could vary in thickness depending on the application. The metal seal retainer 21 further comprises the first and second metal seal retainer portions 23, 28, wherein the metal seal retainer 21 extends up the full vertical height of the valve stem seal assembly 10 and over the top of the first top portion 24 of the elastomeric seal 12. Thereby, the metal seal retainer 21 supports the elastomeric seal 12 and prevents axial extrusion thereof. The prior art valve stem seal assembly of the '143 patent, which is illustrated in FIG. 1, does not provide such support.

[0017] Further, an outer surface 30 of the elastomeric seal 12 is bonded to an inner surface 32 of the second metal seal retainer portion 28, and, except for a retainer flang 47, no portion of the elastomeric seal 12 is radially outward of the metal seal retainer 21. As FIG. 2A further shows, an outward vertical surface 34 of the elastomeric seal 12 is abutted by an inward vertical surface 36 of the first metal seal retainer portion 23. The top surface 27 of the first metal seal retainer portion 23 is essentially parallel with the bottom surface 38 of the first metal seal retainer portion 23. Although not uniquely necessary to seal a valve guide 40, ribs 39 shown in FIG. 2A make intimate sealing contact with the valve guide 40. Similar to the '143 patent, the metal seal retainer 21 is located on the valve guide 40 at two valve guide contact points 50, 52.

[0018] In relationship to the second metal seal retainer portion 28, the first metal seal retainer portion 23 extends radially inward. Also, the first metal seal retainer portion 23 extends horizontally at least halfway inward of the horizontal width of the elastomeric seal 12, just above the first radially inwardly directed sealing lip 14.

[0019] The first metal seal retainer portion 23, in conjunction with a much smaller exposed width of the second top portion 26 of the elastomeric seal 12 (as compared to the fully exposed width of the top of seal 126 of the '143 patent that is illustrated in FIG. 1), functions to prevent the elastomeric seal 12 from extruding axially/vertically up above the top surface 27 of the first metal seal retainer portion 23. Functionally, the first metal seal retainer portion 23 axially blocks axial stress exerted on the elastomeric seal 12 from gas pressure exerted on engine ports (not shown) from below the gas lip 16. Consequently, the valve stem seal assembly 10 of the present invention at least overcomes the shortcomings of the prior art of the '143 valve stem seal assembly that has a one-piece cylindrical-shaped foundation seal retainer 128, which experiences extrusion of the seal 126 at its top.

[0020] It is much more common to have a valve guide step 50 machined in the valve guide 40 that extends outward a bit

further under the lowest extent of the seal 12, as the first valve stem assembly 10 is structured. However, a second valve stem seal assembly 10', as illustrated in FIG. 3. In this embodiment 10', the three lowest axial elements 37, 45, and 47 of the retainer 21 illustrated in FIG. 2, are replaced by a lower vertical retainer portions 37', 45' that extend to the bottom of the second valve stem seal assembly 10'. Consequently, the second valve stem seal assembly 10' can be applied to an engine arrangement (not shown) that does not have the lateral space available for the three lowest retainer elements 37, 45, 47 and the valve spring 24' of the first valve stem seal assembly 10. This extended lower vertical retainer portion 21' allows for an engine application of the second-valve stem seal assembly 10' having all of the above-stated benefits associated with the inventive metal frustoconical foundation 28.

[0021] FIG. 3A illustrates that there are three gaps g associated with the upper sealing lip 14 and the lower sealing lip 16, where one g is above the upper sealing lip 14, one g is between the upper sealing lip 14 and the lower sealing lip 16, and there is one g below the lower sealing lip 16. This arrangement of gaps g also applies to FIGS. 2 and 2A, which are directed to the first valve stem seal assembly 10.

[0022] In accordance with the provisions of the patent statutes, the principles and modes of operation of this invention have been described and illustrated in its preferred embodiments. However, it must be understood that the invention may be practiced otherwise than specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. A valve stem seal assembly 10, comprising:

an elastomeric seal 12 having first and second radially inwardly directed sealing lips 14, 16 in intimate sealing contact with a valve stem 18;

a metal seal retainer 21 having a first metal seal retainer portion 23 disposed on a first top portion 24 of the elastomeric seal 12, radially abutting a second top portion 26 of the elastomeric seal 12, and bonded to both elastomeric seal top portions 24, 26, wherein no portion of the elastomeric seal 12 is axially above the first metal seal retainer portion 23; and

a second metal seal retainer portion 28 unitary with and perpendicular to the first metal seal retainer portion 23, wherein an outer surface 30 of the elastomeric seal 12 is bonded to an inner surface 32 of the second metal seal retainer portion 28, and no portion of the elastomeric seal 12 is radially outward of the second metal seal retainer portion 28;

wherein the metal seal retainer 21 extends up the full vertical height of a valve stem seal assembly 10 and over the top of the seal 12, to support the elastomeric seal 12 and prevent extrusion thereof.

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