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(54) **EGR valve for an internal combustion engine and valve seat therefor**

(57) An annular valve seat 2 for an EGR valve having a tapered or conical valve head 4, the valve seat 2 having a cooperating conical contact face 8, said contact face having a plurality of radially spaced regions 12 having a width in a substantially axial direction greater than the width of regions 10 of the valve seat therebetween, such that the contact area between the valve seat 2 and valve head 4 in said spaced regions is greater than the contact area between the valve seat 2 and the valve head 4 in the regions between said spaced regions.

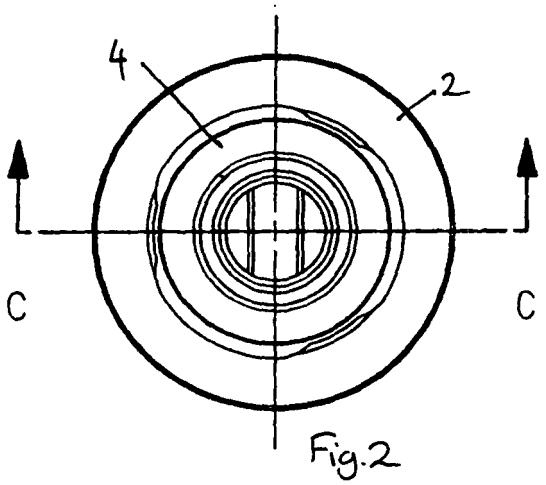

Fig.2

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Description

[0001] The present invention relates to an exhaust gas recirculation (EGR) valve for an internal combustion engine, and in particular to a valve seat for an EGR valve to prevent valve sticking.

[0002] The exhaust gas of an internal combustion engine contains various amounts of unburnt hydrocarbons, carbon monoxide (CO) and nitrous oxides (NOx). Emission of these materials to the atmosphere is undesirable. The problem is more acute in urban areas having a high concentration of motor vehicles.

[0003] There are several methods for reducing these harmful exhaust emissions. One such method is exhaust gas recirculation (EGR) systems. These systems are typically employed in automotive vehicles in order to help reduce nitrous oxide (NOx) emissions. EGR systems typically employ an EGR passage disposed between the engine exhaust manifold and the air intake manifold and operable to recirculate exhaust gas from the exhaust side of the engine back to the intake side. An EGR valve is typically provided to selectively control the recirculation of exhaust gas.

[0004] Unfortunately, components left in the exhaust gas due to incomplete combustion may condense within the exhaust and EGR system and stick to and deposit on surfaces exposed to the exhaust gases. This undesired accumulation can result in reduced engine life and performance and can lead to the failure of components exposed to the exhausts gases, such as the EGR valve.

[0005] A typical known EGR valve is shown in Fig 1. The valve comprises a valve body (not shown) having a valve seat 2 positioned in a passageway between an inlet for communication with an exhaust duct of an internal combustion engine and an outlet for communication with an intake manifold of the internal combustion engine. A valve head 4 is attached to one end of a valve shaft 6, the other end of the valve shaft 6 being connected to an actuating means (not shown) wherein the valve head 4 can be moved between a closed position, wherein the valve head 4 abuts the valve seat 2 to close communication between the inlet and the outlet of the valve body, and an open position, wherein the valve head 4 is spaced from the valve seat 2 to permit the passage of exhaust gases from the inlet to the outlet.

[0006] In order to prevent leakage between the valve seat 2 and the valve head 4 when the valve head 4 is in its closed position, the valve seat 2 defines a conical contact surface having a taper angle corresponding to a cooperating conical contact surface of the valve head 4. This arrangement ensures optimum alignment between the valve head 4 and valve seat 2 when the valve head 4 is in its closed position by providing a degree of self centring of the valve head 4 on the valve seat 2.

[0007] However, the large contact area between the valve head 4 and valve seat 2 has been found to result in sticking problems wherein the valve head 4 becomes "wedged" or "corked" within the valve seat 2, particularly when deposits occur on the contact surfaces of the valve seat 2 and valve head 4. In order to reduce this sticking problem it is desirable to reduce the contact area between the valve head and valve seat. However, this in turn reduces the self alignment properties of the valve and can lead to leakages between the valve seat and valve head when the valve head is in its closed position.

[0008] According to a first aspect of the present invention there is provided an annular valve seat for an EGR valve having a tapered or conical valve head, the valve seat having a cooperating tapered or conical contact face, said contact face having a plurality of radially spaced regions having a width in a substantially axial direction greater than the width of regions of the valve seat therebetween, such that the contact area between the valve seat and valve head in said spaced regions is greater than the contact area between the valve seat and the valve head in the regions between said spaced regions.

[0009] Preferably the radial extent of said spaced regions is less than the radial extent of the regions therebetween. Thus the spaced regions of greater contact area ensure good centring of the valve to ensure correct seating of the valve head in the valve seat while the overall contact area between the valve head and valve seat is minimised to reduce the risk of sticking.

[0010] According to a second aspect of the present invention there is provided a valve for an EGR passage of an internal combustion engine comprising a valve body having a valve seat according to the first aspect of the invention positioned in a passageway between an inlet for communication with an exhaust duct of an internal combustion engine and an outlet for communication with an intake manifold of the internal combustion engine, a valve head attached to one end of a valve shaft, the other end of the valve shaft being connected to an actuating means wherein the valve head can be moved between a closed position, wherein the valve head abuts the valve seat to close communication between the inlet and the outlet of the valve body, and an open position, wherein the valve head is spaced from the valve seat to permit the passage of exhaust gases from the inlet to the outlet.

[0011] According to a further aspect of the present invention there is provided a method of manufacturing a valve seat for an EGR valve, said method comprising the steps of providing an annular valve seat having a tapered or conical contact face for cooperating with a conical contact face of a valve head of the EGR valve, machining a plurality of equal spaced regions of the inner face of the valve seat to a diameter greater than that of the remainder of the inner face of the valve seat to reduce the width of the contact face of the valve seat in said regions.

[0012] Preferably the radial extent of said machined regions is greater than the radial extent of said remainder of the inner face of the valve seat. In a preferred embodiment three equal spaced regions are machined to a diameter less than that of the remainder of the inner face of the valve seat.

[0013] An embodiment of the present invention will now be described with reference to the accompanying drawings, in which:-

Fig 2 is a plan view of an EGR valve having a valve seat according to an embodiment of the present invention;

Fig 3 is sectional view on line C-C of Fig 2;

Fig 4 is a plan view of the valve seat of Fig 2;

Fig 5 is a sectional view on line D-D of Fig 4;

Fig 6 is a perspective view from above of the valve seat of Fig 4;

Fig 7 is a perspective view from below of the valve seat of Fig 4.

[0014] As shown in the drawings, the EGR valve comprises a valve body (not shown) having a valve seat 2 positioned in a passageway between an inlet for communication with an exhaust duct of an internal combustion engine and an outlet for communication with an intake manifold of the internal combustion engine. A valve head 4 is attached to one end of a valve shaft 6, the other end of the valve shaft 6 being connected to an actuating means (not shown) wherein the valve head 4 can be moved between a closed position (as shown in Fig 3), wherein the valve head 4 abuts the valve seat 2 to close communication between the inlet and the outlet of the valve body, and an open position, wherein the valve head 4 is spaced from the valve seat 2 to permit the passage of exhaust gases from the inlet to the outlet.

[0015] The valve seat 2 comprises an annular ring having a conical contact face 8. In order to reduce the contact area between the valve seat 2 and the valve head 4 (see region 8' in Fig 3), three equal spaced regions 10 of the inner face of the valve seat 2 are cut away to a diameter greater than that of the remainder of the valve seat to reduce the width of the contact face in said regions. Thus three equal spaced regions 12 of the valve seat having a greater contact area remain between the three cut away regions whereby such regions of greater contact area guide the valve head 4 to centralise the valve head 4 in the valve seat 2, ensuring reliable sealing of the valve while minimising the likelihood of the valve sticking in its closed position.

[0016] While the present invention is described in relation to a valve seat for a valve for closing an exhaust gas recirculation passage of an internal combustion engine, it is envisaged that the valve seat according to the invention may also be applicable in other applications, such as inlet and outlet valves of an internal combustion engine or poppet valves in other applications wherein sticking of the valve head in the valve seat might be a problem.

Claims

1. An annular valve seat for an EGR valve having a tapered or conical valve head, the valve seat having a cooperating tapered or conical contact face, said contact face having a plurality of radially spaced regions having a width in a substantially axial direction greater than the width of regions of the valve seat therebetween, such that the contact area between the valve seat and valve head in said spaced regions is greater than the contact area between the valve seat and the valve head in the regions between said spaced regions.

2. An annular valve seat as claimed in claim 1, wherein the radial extent of said spaced regions is less than the radial extent of the regions therebetween.

3. An annular valve seat as claimed in any preceding claim, wherein the diameter of the innermost face of the valve seat in said spaced regions is smaller than the diameter of the innermost face of the valve seat in said regions therebetween.

4. An annular valve seat as claimed in any preceding claim comprises at least three radially spaced regions having a width in a substantially axial direction greater than the width of regions of the valve seat therebetween, said radially spaced regions being equally spaced around the circumference of the valve seat.

5. An valve for an EGR passage of an internal combustion engine comprising a valve body having a valve seat as claimed in any preceding claim positioned in a passageway between an inlet for communication with an exhaust duct of an internal combustion engine and an outlet for communication with an intake manifold of the internal combustion engine, a valve head attached to one end of a valve shaft, the other end of the valve shaft being connected to an actuating means wherein the valve head can be moved between a closed position, wherein the valve head abuts the valve seat to close communication between the inlet and the outlet of the valve body, and an open position, wherein the valve head is spaced from the valve seat to permit the passage of exhaust gases from the inlet to the outlet.

6. A method of manufacturing a valve seat for an EGR valve, said method comprising the steps of providing an annular valve seat having a tapered or conical contact face for cooperating with a conical contact face of a valve head of the EGR valve, machining a plurality of equal spaced regions of the inner face of the valve seat to a diameter greater than that of the remainder of the inner face of the valve seat to reduce the width of the contact face of the valve seat

in said regions.

7. A method as claimed in claim 6, wherein the radial extent of said machined regions is greater than the radial extent of said remainder of the inner face of the valve seat.

8. A method as claimed in claim 6 or claim 7, wherein three equal spaced regions are machined to a diameter less than that of the remainder of the inner face of the valve seat.

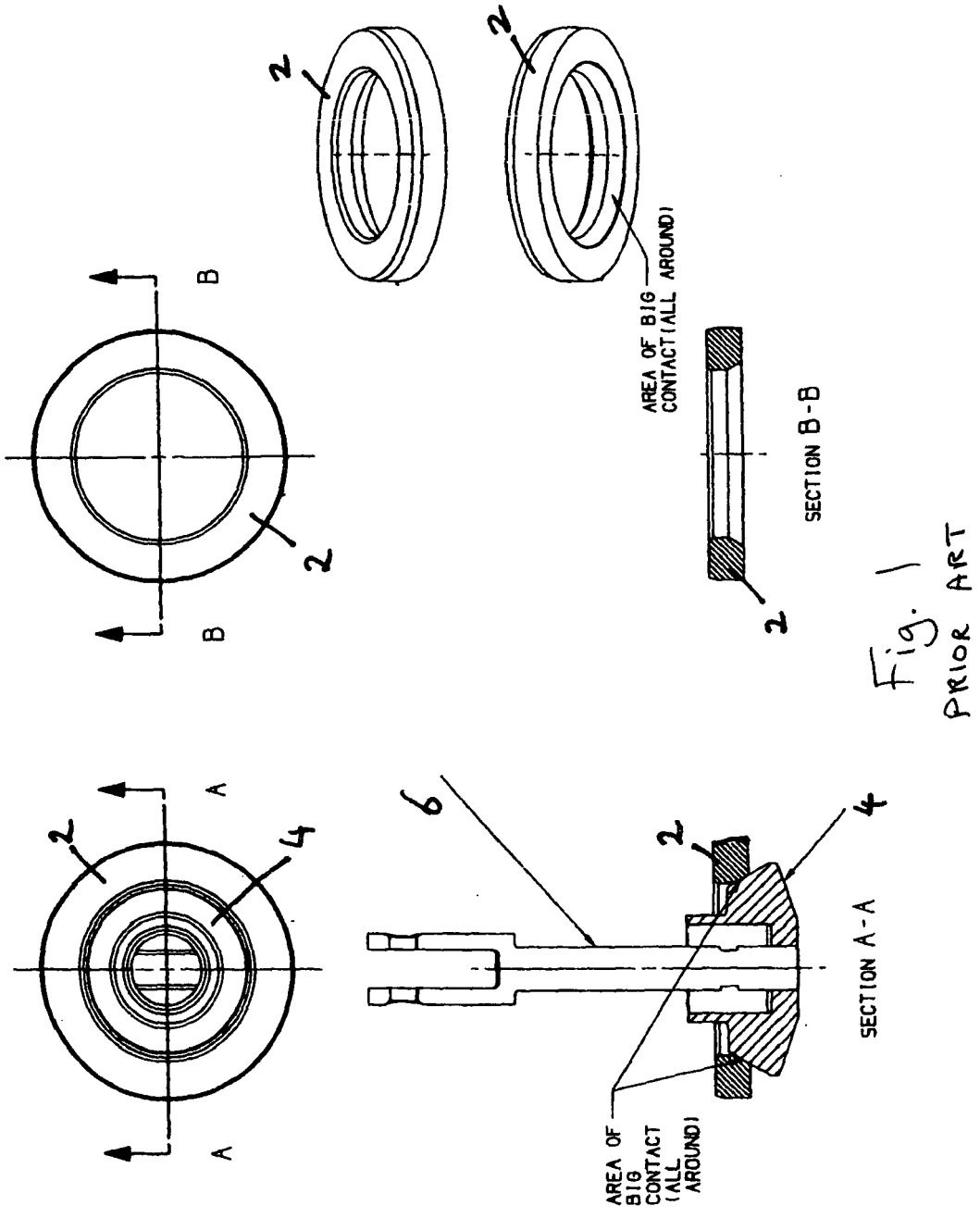

Fig. 1
PRIOR ART

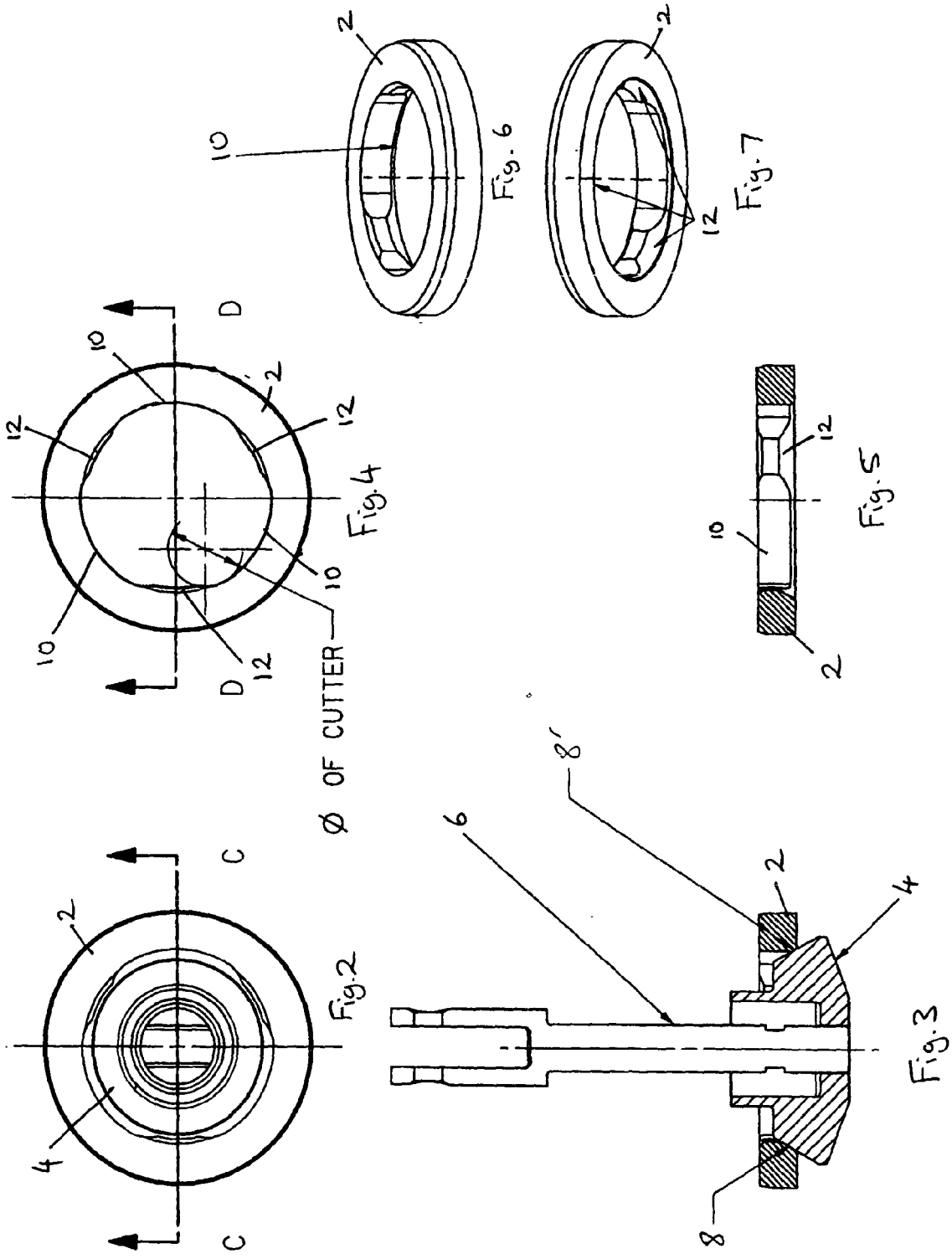
Fig.2
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EUROPEAN SEARCH REPORT

Application Number
EP 05 25 3995

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 40 09 923 A1 (FEV MOTORENTECHNIK GMBH & CO KG, 5100 AACHEN, DE; FEV MOTORENTECHNIK G) 2 October 1991 (1991-10-02) * column 2, line 45 - column 3, line 21; figures 2-8 *	1,6	F02M25/07
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A	US 4 349 003 A (MASUDA ET AL) 14 September 1982 (1982-09-14) * column 6, line 5 - column 6, line 42; figure 18 *	1,6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 October 2005	Marsano, F

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28-10-2005

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