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(54) An edge filter

(57) An edge filter (1) for a fuel injector, typically provided between the mechanical injection pump (7) and the transfer plate (5) of a mechanical unit injector. The edge filter (1) comprises two opposed and spaced apart annular planar surfaces (3), (11). At least one of the surfaces (3) is provided with an edge (16), typically on the transfer plate (5), such that a gap (2) is defined between the edge (16) and the opposing surface (11), typically on the mechanical injection pump (7). In use, in order for debris to pass through the filter (1) it must pass through the gap (2) between the edge (16) and the opposing surface (11).

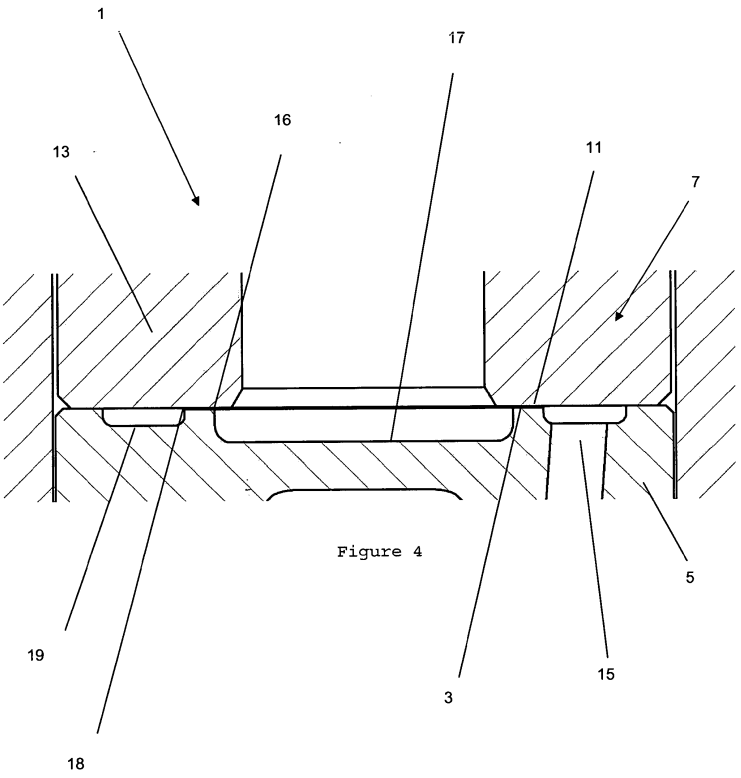

Figure 4

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Description

[0001] The present invention relates to an edge filter. In particular, the present invention relates to an edge filter for a mechanical unit injector for a diesel engine.

[0002] It is necessary to provide a mechanical unit injector with a filter to prevent the nozzle orifices in the fuel injector becoming blocked with debris carried in the fuel that is to be injected.

[0003] Conventional edge filters comprise an elongate cylinder contained within a bore. The outside diameter of the cylinder is smaller than the bore such that an annular space is created between the cylinder and the bore. Fuel flows through the edge filter along separate parallel channels provided on the elongate cylinder and located in a direction parallel to its longitudinal axis. Filtration then occurs in the annular space around the outside of the cylinder between the edge of the channels and the wall of the bore. The width of the annular space is selected so that debris of a size which would block the nozzle orifices is prevented from passing through the edge filter. This debris does not remain within the edge filter but is broken up into a smaller size, which can pass through the filter, by the action of the fuel against the edge filter.

[0004] In order to utilise a conventional edge filter an injector must be of a sufficient length to accommodate it. This is not possible with a conventional mechanical unit injector. A mechanical unit injector comprises a mechanical injection pump and a fuel injector in a generally in line arrangement within a single housing and therefore the amount of space required for a conventional edge filter is not available. Consequently, there is a requirement for an edge filter which is shorter in length that conventional types.

[0005] Accordingly, the present invention provides an edge filter for a fuel injector comprising two opposed and spaced apart planar surfaces, wherein at least one of the surfaces is provided with an edge such that a gap is defined between the edge and the opposing surface, wherein, in use, in order for debris to pass through the filter it must pass through the gap between the edge and the opposing surface.

[0006] Preferably, the size of the gap between the edge and the opposed surface is substantially constant. This enables the size of particles passing through the filter to be controlled.

[0007] Preferably, the two surfaces are substantially parallel. This is advantageous for manufacturing simplicity.

[0008] Preferably, the inner perimeter of the surface provided with an edge is defined by that edge.

[0009] At least one of the surfaces may be annular. However, preferably, both surfaces are annular.

[0010] In the preferred embodiment the edge may be circular and the gap may be ring-shaped.

[0011] It is advantageous to provide a ring-shaped gap, enabled by an annular edge and annular surfaces, as this encourages uniform flow through the filter and helps to prevent the filter from becoming blocked. However, the gap may be of any suitable configuration.

[0012] Preferably, the gap between the edge and the opposed surface is between 30 and 60 microns. However, the gap may be varied according to the size of debris that it is desired to filter.

[0013] Preferably, the edge has a radius of less than 0.05mm. However, the radius may be of any dimension that is suitable for the application in which the filter is being used. It is advantageous to provide a sharp edge to aid with the break down of any debris collected by the filter.

[0014] According to a preferred embodiment, the surface provided with an edge is formed on one end surface of a substantially cylindrical transfer plate.

[0015] Preferably, the surface provided with an edge is formed between a substantially cylindrical recess and a substantially annular recess provided in the end surface of the transfer plate, wherein the maximum diameter of the annular recess is less than the diameter of the transfer plate and the maximum diameter of the cylindrical recess is smaller than the minimum diameter of the annular recess. This arrangement is preferred for desired flow characteristics and for simplicity of manufacture. However, alternative arrangements are envisaged within the scope of the present invention.

[0016] Preferably, the transfer plate, the annular recess and the cylindrical recess are substantially co-axial.

[0017] Preferably, the annular recess is provided with a bore. The bore allows onwards passage of fuel passing through the filter.

[0018] In the preferred embodiment, the opposing surface is provided on a housing of a mechanical injector pump.

[0019] According to a third aspect, the present invention provides a mechanical unit injector comprising an edge filter and a transfer plate according to the first and second aspects of the present invention, wherein one surface of the edge filter is provided on a housing of a mechanical injection pump and the other surface of the edge filter is provided on the transfer plate.

[0020] A preferred embodiment of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a MUI provided with an edge filter according to a preferred embodiment of the present invention;

Figure 2 is a perspective view of the annular edge filter of Figure 1;

Figure 3 is a plan view of the annular edge filter of Figure 1; and

Figure 4 is a close-up cross-sectional view of the annular edge filter of Figure 1.

[0021] The edge filter 1, as shown in place in a mechanical unit injector in Figure 1, is provided by a gap 2 formed between opposed, parallel and spaced apart planar surfaces 3 and 11. Surface 3 is provided on an upper surface of a cylindrical transfer plate 5. Surface 11 is provided on a lower surface of a housing 13 of a mechanical injection pump 7. The transfer plate 5 and the mechanical injection pump 7 are axially aligned.

[0022] The surface 3, best shown in Figures 2 and 3, is a planar annulus, which is relatively narrow in comparison to surface 11, formed between two concentric circular edges 16,18. The axes of the circular edges 16,18 are co-axial with the axis of the transfer plate 5. The circular edge 16 is relatively sharp and is the perimeter edge of a cylindrical recess 17 at the centre of the transfer plate 5. The circular edge 18 is the internal perimeter of an annular recess 19 located between the recess 17 and the circumference of the transfer plate 5. The circular recess 17, the annular surface 3 and the annular recess 19 are thus concentric.

[0023] The surface 11, best shown in Figure 4, is a planar annulus, relatively wide in comparison to surface 3, formed between the external circumference 21 of the housing 13 and the internal circumference 23 of the bore 25 provided in the housing 13. The axis of the bore 25 is aligned with the axis of the housing 13.

[0024] The gap 2 between the transfer plate surface 3 and the housing surface 11 acts as a filter by preventing debris that is larger than the gap from passing through it. In use, fuel is pumped by the mechanical injection pump 7 into the recess 17 and flows out of the recess 17, through the gap 2 into the annular recess 19. The fuel then flows out from the annular recess 19 via the bore 15, from where it passes to the injector orifices (not shown) .

[0025] Typically, the distance between the surface 3 and the surface 11, will be between 30 and 60 microns. Any debris that is unable to pass through the gap 2 will be retained within the recess 17. However, this debris will not remain permanently within the recess 17 but will be broken up into a size that can pass through the gap 2, as a result of the high pressure fuel forcing them against the relatively sharp edge 16 of the recess 17. The pressure waves in the fuel, created by the pulsating action of the mechanical injection pump 7 aid with the break up of any such debris.

[0026] The preferred embodiment utilises the edge filter of the present invention in a mechanical unit injector. However, the present invention is equally applicable to other types of fuel injector and to completely separate applications where there is a requirement for a shallow filter.

Claims

1. An edge filter (1) for a fuel injector comprising two opposed and spaced apart planar surfaces (3), (11), wherein at least one of the surfaces (3) is provided with an edge (16) such that a gap (2) is defined between the edge (16) and the opposing surface (11), wherein, in use, in order for debris to pass through the filter (1) it must pass through the gap (2) between the edge (16) and the opposing surface (11).

2. An edge filter (1) as claimed in claim 1, wherein the size of the gap (2) between the edge (16) and the opposing surface (11) is substantially constant.

3. An edge filter (1) as claimed in claim 1 or claim 2, wherein the two surfaces (3), (11) are substantially parallel.

4. An edge filter (1) as claimed in any one of claims 1, 2 or 3, wherein the inner perimeter of the surface (3) provided with an edge (16) is defined by that edge (16).

5. An edge filter (1) as claimed in any preceding claim, wherein one of the surfaces (3), (11) is annular.

6. An edge filter (1) as claimed in any preceding claim, wherein both surfaces (3), (11) are annular.

7. An edge filter (1) as claimed in any preceding claim wherein the edge (16) is circular.

8. An edge filter (1) as claimed in any preceding claim, wherein the gap (2) is ring-shaped.

9. An edge filter (1) as claimed in any preceding claim wherein the gap (2) between the edge (16) and the opposing surface (11) is between 30 and 60 microns.

10. An edge filter (1) as claimed in any preceding claim wherein the edge (16) has a radius that is less than 0.05mm.

11. An edge filter (1) as claimed in any preceding claim wherein the surface (3) provided with an edge (16) is formed on one end surface of a substantially cylindrical transfer plate (5).

12. An edge filter (1) as claimed in claim 11, wherein the surface (3) provided with an edge (16) is formed between a substantially cylindrical recess (17) and a substantially annular recess (19), provided in the end surface of the transfer plate (5), wherein the maximum diameter of the annular recess (19) is less than the diameter of the transfer plate (5) and the maximum diameter of the cylindrical recess (17) is smaller than the minimum diameter of the annular recess (19).

13. An edge filter (1) as claimed in claim 12, wherein the transfer plate (5), the cylindrical recess (17) and the

annular recess (19) are substantially co-axial.

14. An edge filter (1) as claimed in claim 10, wherein the annular recess (19) is provided with a bore (15).

15. An edge filter (1) as claimed in any preceding claim, wherein the opposing surface (11) is provided on a housing of a mechanical injection pump (7).

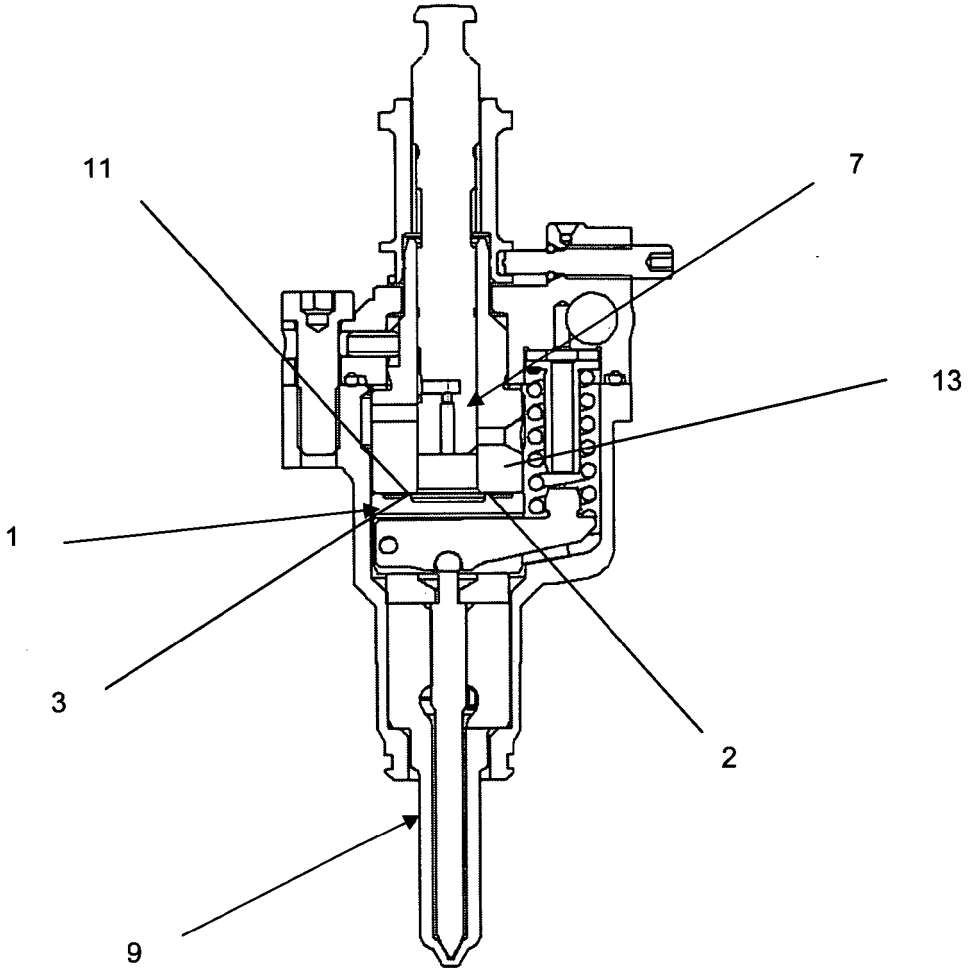
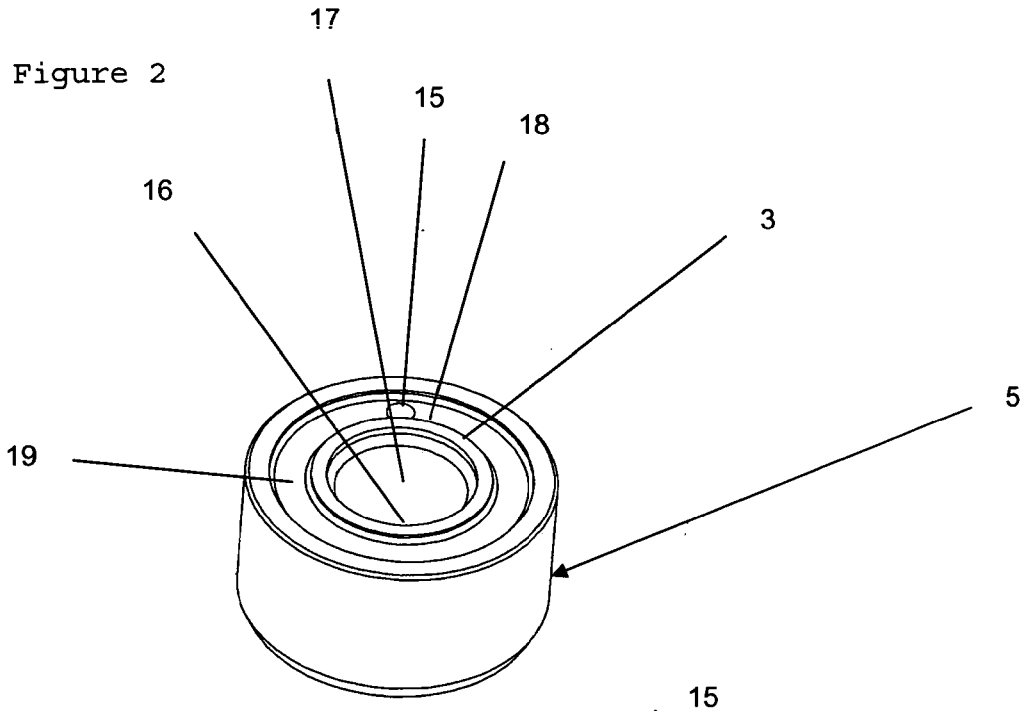


Figure 1

Figure 2



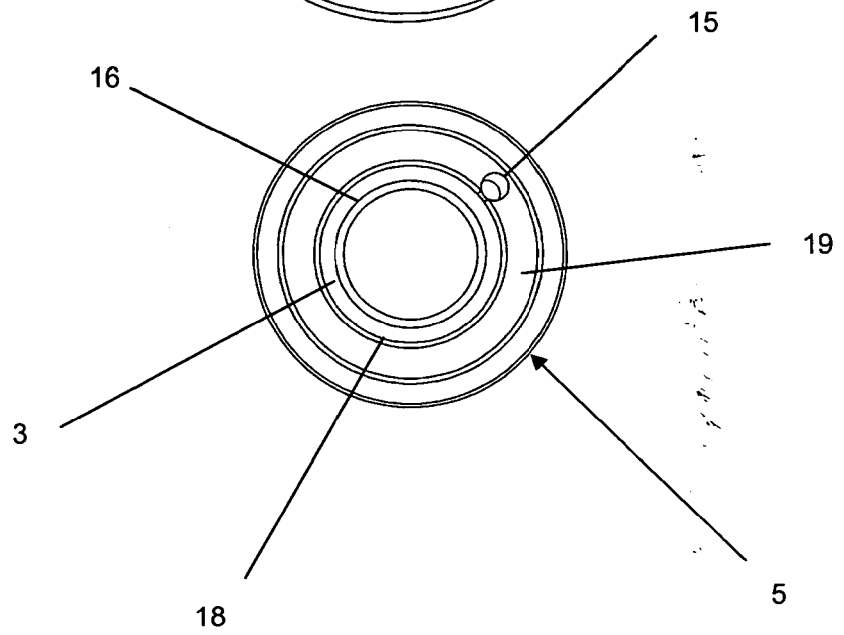


Figure 3

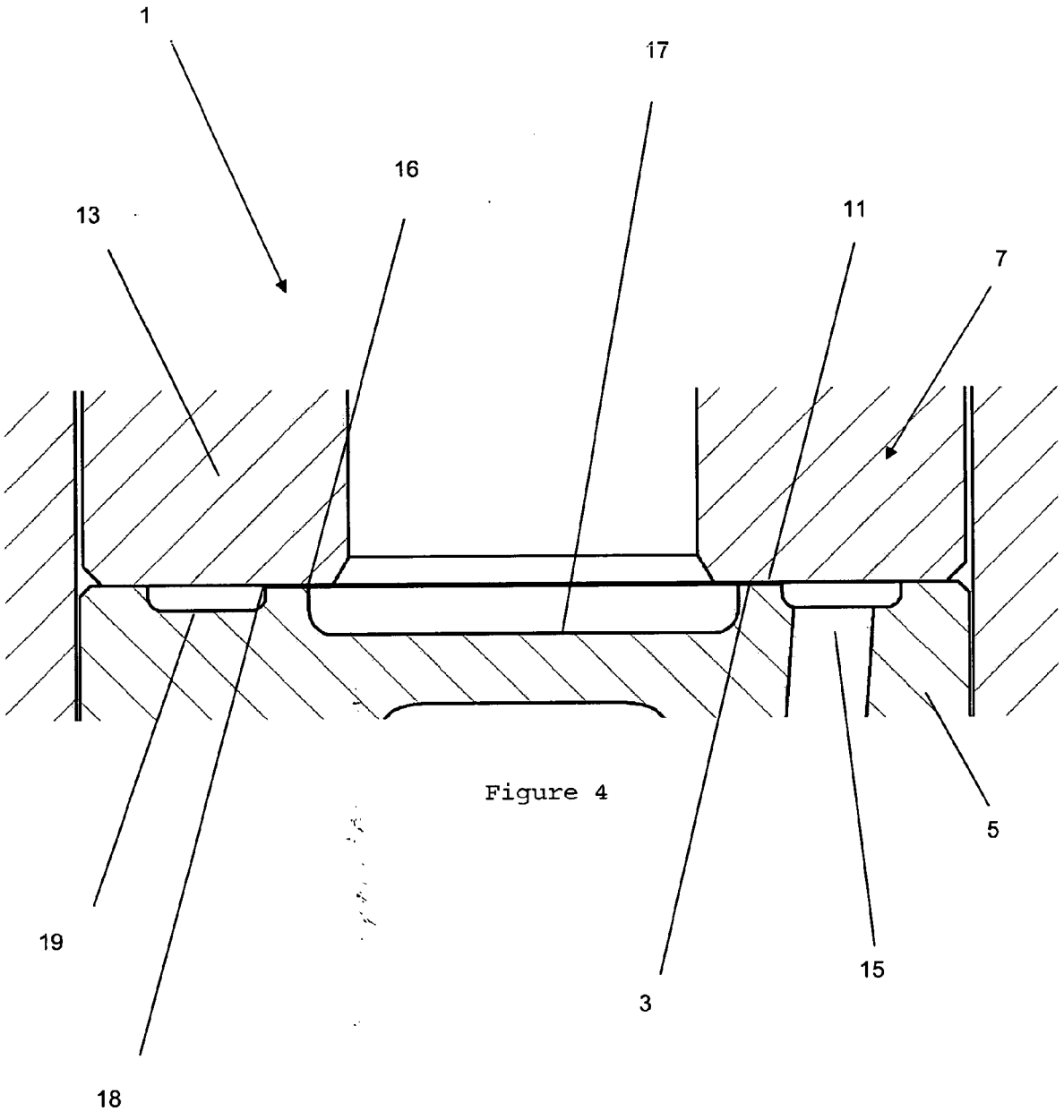


Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 07 25 0555

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC) F02M B01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 May 2007	Etschmann, Georg

CATEGORY OF CITED DOCUMENTS

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