(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 294 790 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **88109148.2**

(51) Int. Cl.4: **F02F 1/38**

(22) Date of filing: **08.06.88**

(30) Priority: **09.06.87 IT 5339087 U**

(43) Date of publication of application:
14.12.88 Bulletin 88/50

(84) Designated Contracting States:
DE ES FR GB SE

(71) Applicant: **IVECO FIAT S.p.A.**
Via Puglia 35
I-10156 Torino(IT)

(72) Inventor: **Masuelli, Gianguglielmo**
Via Tonco, 21
I-10100 Torino(IT)
Inventor: **Tardi', Riccardo**
Via Breglio, 87
I-10100 Torino(IT)

(74) Representative: **Bongiovanni, Guido et al**
c/o Ing. Carlo e Mario Torta Via Viotti 9
I-10121 Torino(IT)

(54) Diesel engine cylinder head.

(57) The cylinder head comprises a plurality of precombustion chambers (2) the surfaces (3, 4) of which are formed partly in said cylinder head and partly on plugs (5) each of which is inserted into a corresponding seat formed in the cylinder head, and a plurality of pairs of air intake ducts (13) extending to and exhaust gas discharge ducts (14) extending from the engine combustion chamber, the ports of which are controlled by corresponding intake and exhaust valves; in the flat surface (18) which lowerly delimits the cylinder head there being provided a plurality of cavities (20) each of which extends from the lower edge of one of said plugs to the corresponding intake and discharge ducts, so that the cavity is at least partly delimited by the lower edge of the corresponding plug.

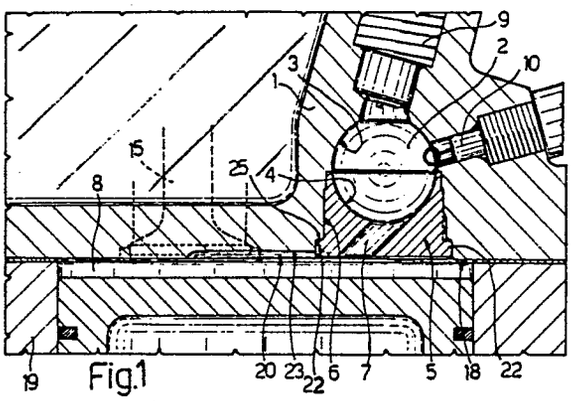


Fig.1

EP 0 294 790 A1

DIESEL ENGINE CYLINDER HEAD

This invention relates to a diesel engine cylinder head particularly suitable for use in high-speed diesel engines with high specific power, in which very high temperatures are encountered in certain cylinder head regions.

A diesel engine cylinder head is known to comprise a plurality of precombustion chambers, the surfaces of which are formed partly in the head and partly on plugs, each of which is inserted into a corresponding seat provided in the head and is provided with a discharge bore to the corresponding engine combustion chamber. In the cylinder head there is also provided a plurality of air intake and exhaust gas discharge ducts to and from said combustion chamber, the ports of which are controlled by corresponding intake and exhaust valves. The cylinder head is delimited lowerly by a flat surface arranged to rest on a corresponding flat surface of the engine block, the bores in the precombustion chamber plugs and the intake and discharge ducts opening into the flat surface which lowerly delimits the cylinder head.

Drawbacks arise in cylinder heads of this briefly described type. Small cracks form in the cylinder head region delimited by said flat surface and lying between the edge of each precombustion chamber and the edges of the corresponding air intake and exhaust gas discharge ducts, and these tend to increase in size during the engine life until they penetrate to the outside of the cylinder head with the result that they allow water and foreign substances to enter the combustion chamber and compressed gas to escape.

These cracks are the result of the high stresses induced by the temperature changes which the operating engine undergoes. In addition, in said region local deformations are encountered which modify the shape of the surface which lowerly delimits the cylinder head, these being in the form of actual local swellings with simultaneous formation of small craters. This drawback is caused by the high thermal excursions produced at high temperature resulting in local plastic deformation of the cylinder head material.

Various solutions have been proposed to the aforesaid problems, such as avoiding sharp corners at the various seats provided in the cylinder head, particularly in correspondence with each of the seats for the said plugs which define the precombustion chambers. In other cases undercuts are formed in the lower surface of the cylinder head to allow the cylinder head material to expand in predetermined regions and to reduce the volume of said material. These expedients have proved totally insufficient when said cylinder heads are used on high-speed diesel engines with high specific power, in which in certain regions of the cylinder head the operating temperature is between 265 and 280 °C.

The object of the present invention is to provide a diesel engine cylinder head which is able to operate correctly without the aforesaid drawbacks, even when used on high-speed diesel engines of high specific power in which temperatures of the aforesaid order are attained.

The present invention therefore provides a diesel engine cylinder head comprising a plurality of precombustion chambers the surfaces of which are formed partly in said cylinder head and partly on plugs, each of which is inserted into a corresponding seat provided in the cylinder head and is provided with a discharge bore to the corresponding engine combustion chamber, and further comprising a plurality of pairs of air intake and exhaust gas discharge ducts to and from said combustion chamber, the ports of which are controlled by corresponding intake and exhaust valves, said cylinder head being delimited lowerly by a flat surface arranged to rest on a corresponding flat surface on the engine block, said bores in the precombustion chamber plugs and said intake and discharge ducts opening into said flat surface of the cylinder head, characterised in that in said cylinder head there is provided a plurality of cavities each of which extends from the lower edge of one of said plugs to the corresponding intake and discharge ducts, so that said cavity is at least partly delimited by said lower edge of the corresponding plug.

The present invention will be more apparent from the detailed description thereof given hereinafter by way of example, with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic part section through the cylinder head of the present invention;

Figure 2 is a plan view of said cylinder head;

Figure 3 is a diagrammatic part section through a second embodiment of the cylinder head of the invention;

Figure 4 is a plan view of the cylinder head of Figure 3.

With reference to Figures 1 and 2, the cylinder head according to the invention, indicated by the reference numeral 1, comprises a plurality of precombustion chambers 2, each of which is delimited by a surface portion 3 provided on the cylinder head itself, and surface portions 4 provided on corresponding plugs 5, each of which is inserted into a seat 6 in the cylinder head and is provided with a discharge bore 7 towards the corresponding combustion chamber 8 of the engine. Said surface portions are conveniently portions of a

spherical surface, so as to generate a turbulence in the flow of fuel injected into said chamber by a corresponding injector 9. In known manner, the fuel which commences its combustion in the precombustion chamber is projected into the combustion chamber 8 through the bores 7 in the plugs 5, where combustion is completed. Conveniently, a preheating heater plug 10 is arranged to heat the inner region of the precombustion chamber during the engine cold start stage.

In the cylinder head 1 there is also provided a plurality of pairs of air intake ducts 13 and exhaust gas discharge ducts 14 the ports of which are controlled by corresponding intake and exhaust valves 15 and 16 respectively. As can be clearly seen in Figure 2, the axes of the intake and discharge ducts are on opposite sides of the axis of the relative precombustion chamber, with respect to the cylinder axis, and said ducts are separated by a bridge of the same material as the cylinder head.

The cylinder head 1 is delimited lowerly by a flat surface 18 arranged to rest on a corresponding flat surface of the engine block 10. The bores 7 of the plugs 4 and the intake and discharge ducts open into said flat surface of the cylinder head.

According to the invention, in the cylinder head there is provided a plurality of cavities 20, each of which extends from the lower edge 22 of one of the plugs 4 to the corresponding intake and discharge ducts 13 and 14 respectively, so that the cavity is at least partly delimited by the lower edge 22, as clearly shown in Figures 1 and 2. Conveniently, each cavity 20 extends from the lower edge 22 of one of the plugs 4 to the interior of the corresponding intake and discharge ducts 13 and 14, as can be seen from Figures 2 and 4. In this case the cavity extends into the material of the bridge 17 between the ducts 13 and 14.

Each of the cavities 20 is delimited lowerly by a flat surface 23 (Figure 1) parallel to the surface 18 which lowerly delimits the cylinder head 1.

The cylinder head is provided with annular shoulders 25 each of which is arranged to form a stop for a corresponding annular projection on one of the plugs 4. Conveniently, the distance between the surfaces 18 and 23 is less than the height of said projection measured in the direction of the axis of the plug 4. For the reasons indicated hereinafter, it has been found that the distance between said two surfaces is preferably less than 3 mm. Each of the cavities 20 can be formed by chip-forming machining, such as milling. In the embodiment shown in Figures 1 and 2 this cavity is delimited laterally by portions 26 of a curved surface of revolution having its axis parallel to the axis of the engine cylinder. In the case of the embodiment illustrated, this axis coincides with the cylinder axis. A cavity having such a form can be obtained by a cylindrical miller rotated about an axis coinciding with said cylinder axis.

In the embodiment shown in Figures 3 and 4 each cavity is formed by a cylindrical miller which is rotated about an axis parallel to the surface 18 which lowerly delimits the cylinder head 1. In this case each cavity is delimited laterally by flat surface portions 27 (Figure 4) and cylindrical surface portions 28 having the same axis as the miller.

The operation of the described cylinder head is as follows. During the explosion stage, combustion originates in the precombustion chamber 2 when, at the end of the compression stroke, atomised fuel is injected into said chamber by the injector 9. Part of the fuel burns in the precombustion chamber to produce a sudden pressure increase with the result that the as yet unburnt fuel is projected into the combustion chamber 8 through the bore 7. Combustion is completed in this second chamber.

Thus a flame emerges through each of the bores 7 which have their axis inclined to the cylinder axis, and this would tend to graze the surface 18 lowerly delimiting the cylinder head 1 if this were not provided with the cavities 20, and as it does in the case of cylinder heads of the prior art. The lower surface 23 of each cavity 20 is at a certain distance from the surface 18 which lowerly delimits the cylinder head 1 and thus the flame leaving the bores 7 does not make direct contact with the surface 23, so substantially reducing the heat transfer from the flame to the cylinder head in the region lying between the precombustion chamber and the intake and discharge ducts 13 and 14. In addition that part of the edge 22 of the plug 5 which delimits the cavity 20 generates an actual shield for the base surface 23 of the cavity so as to deviate the flow of incandescent fuel and prevent it grazing the surface. Finally, because of the layer of air which is created in this manner between the flow of such fuel and the surface 23, the coefficient of heat transfer between the flame and head is substantially lower than that which would be obtained in the absence of said air layer.

It has been found that in those regions of the cylinder head lying between the each precombustion chamber 2 and the corresponding intake and discharge ducts 13 and 14, there is no generation of the cracks which are produced in cylinder heads of prior type. In these regions there has also been noted no substantial swelling of the surface 23 of the cavities 20 or surface 18 of the cylinder head 1, and no generation of craters in the same regions. These favourable results, which have also been obtained on cylinder heads used on high-speed diesels in which temperatures of between 267 and 270 °C have been encountered in said regions, are the result of reduced heat transfer

between the incandescent fuel emerging from the bores 7 and the cylinder head.

It has also been found the the dimensions of each of the cavities 20 should be sufficiently large to include at least part of the bridges 17 between the intake and discharge ducts 13 and 14. In this respect, these regions are also critical and therefore only if the size of each cavity 20 is chosen so as to include the said regions can cracking and abnormal deformation be prevented in them.

It is apparent that modifications can be made to the embodiment of the present invention in terms both of the form and arrangement of the various parts, but without leaving the scope of the invention itself.

Claims

1. A diesel engine cylinder head comprising a plurality of precombustion chambers (2) the surfaces (3, 4) of which are formed partly in said cylinder head and partly on plugs (5), each of which is inserted into a corresponding seat formed in the cylinder head and is provided with a discharge bore (7) to the corresponding engine combustion chamber (8), and further comprising a plurality of pairs of air intake ducts (13) extending to and exhaust gas discharge ducts (14) extending from said combustion chamber, the ports of which are controlled by corresponding intake and exhaust valves, said cylinder head being delimited lowerly by a flat surface (18) arranged to rest on a corresponding flat surface of the engine block (19), said bores in the precombustion chamber plugs and said intake and discharge ducts opening into said flat surface of the cylinder head, characterised in that in said cylinder head there is provided a plurality of cavities (20) each of which extends from the lower edge (22) of one of said plugs to the corresponding intake and discharge ducts, so that said cavity is at least partly delimited by said lower edge of the corresponding plug.

2. A cylinder head as claimed in claim 1, characterised in that each of said cavities extends from the lower edge (22) of one of said plugs to the interior of the corresponding intake and discharge ducts (13, 14).

3. A cylinder head as claimed in claim 1 or 2, characterised in that each of said cavities extends into the bridge (17) formed from the cylinder head material and separating said intake and discharge ducts.

4. A cylinder head as claimed in one of the preceding claims, characterised in that each of said cavities is delimited lowerly by a flat surface (23) parallel to said surface (18) which lowerly delimits said cylinder head.

5. A cylinder head as claimed in claim 4 in which said head is provided with annular shoulders (25) each of which is arranged to form a stop for a corresponding annular projection on one of said plugs, characterised in that the distance between said flat surface (23) which lowerly delimits said cavity and said flat surface (18) which lowerly delimits said cylinder head is less than the height of said projection on the plug.

6. A cylinder head as claimed in claim 5, characterised in that the distance between said two surfaces is less than 3 mm.

7. A cylinder head as claimed in one of the preceding claims, characterised in that said cavity is delimited laterally by portions (26) of a curved surface of revolution having its axis parallel to the axis of the corresponding engine cylinder.

8. A cylinder head as claimed in one of the preceding claims, characterised in that each cavity is delimited laterally by flat surface portions (27).

9. A cylinder head as claimed in one of the preceding claims, characterised in that each of said cavities is obtained by a milling operation by which the material of said cylinder head is removed below said surface which lowerly delimits said head.

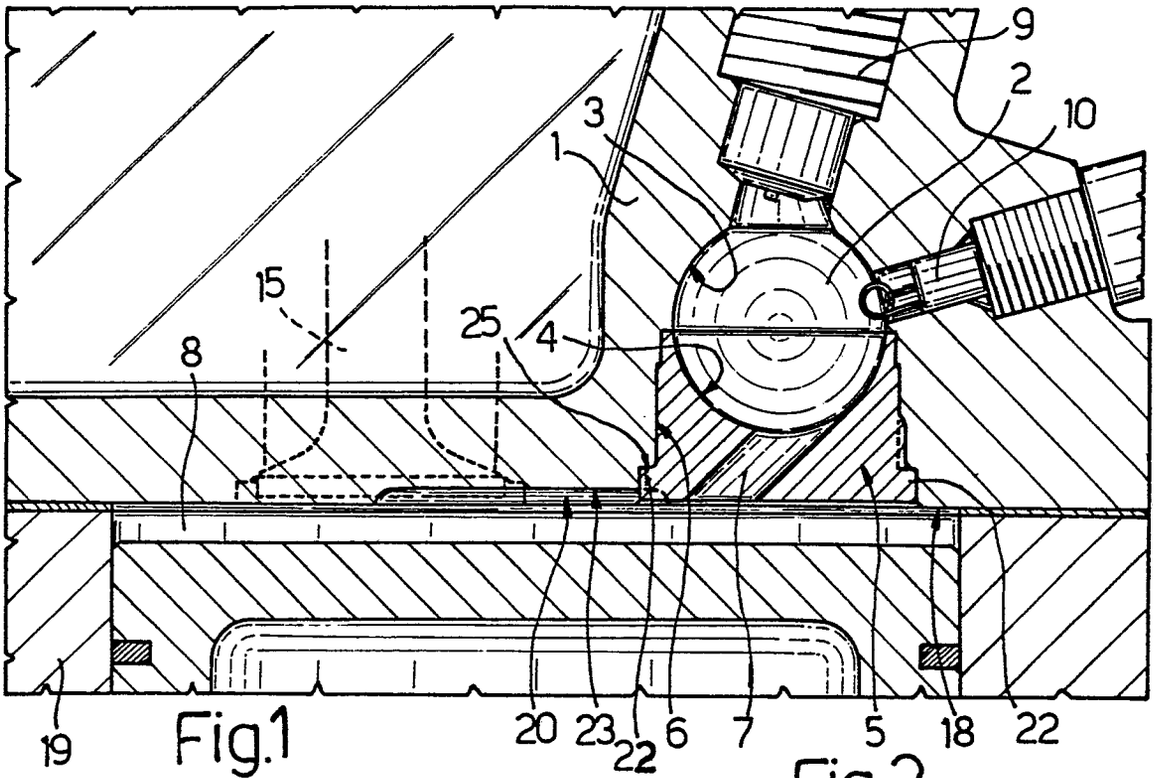
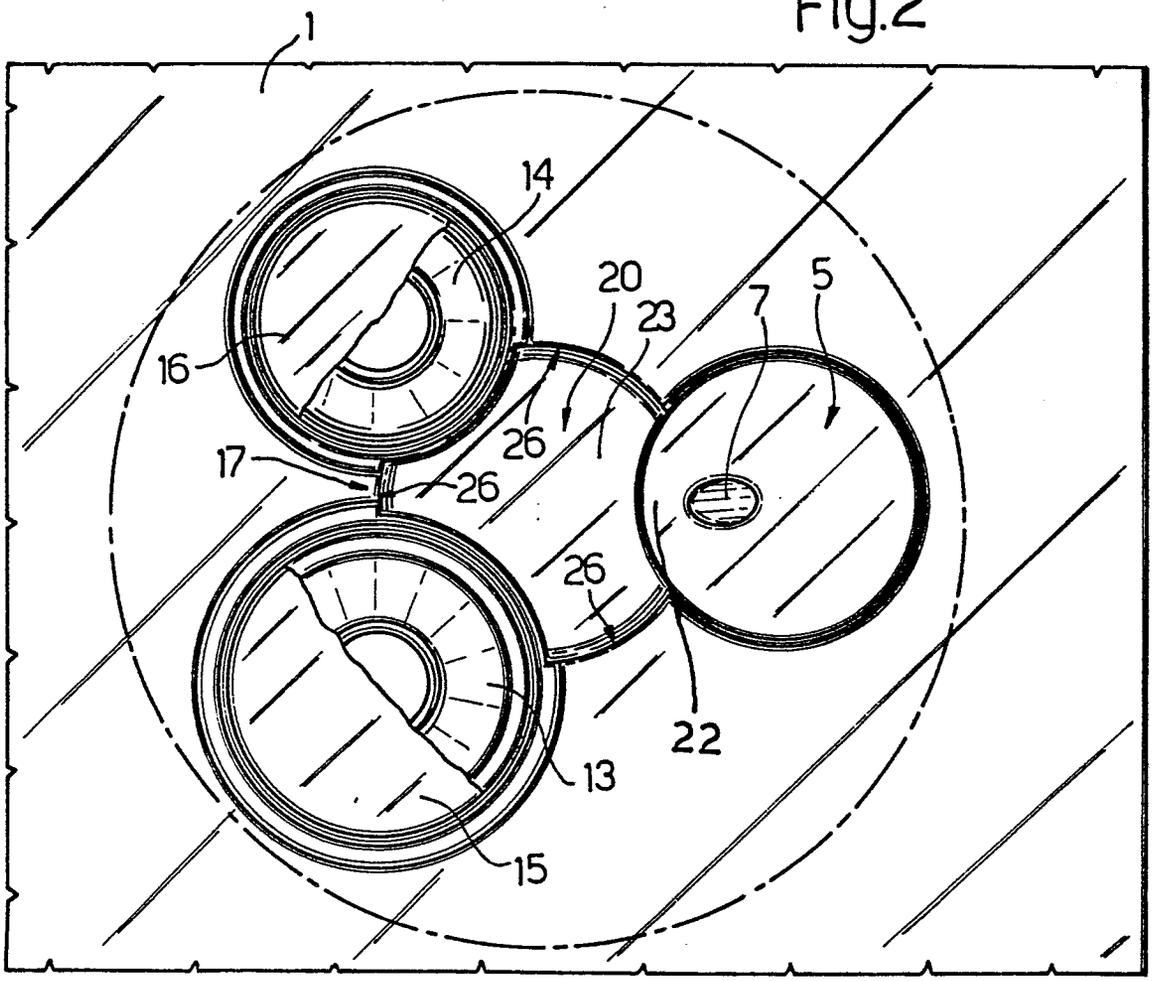

9
2
10
3
1
15
25
4
8
19
20
23
22
6
7
5
18
22

Fig.1

Fig.2


1
14
20
23
7
5
16
26
17
26
26
22
13
15

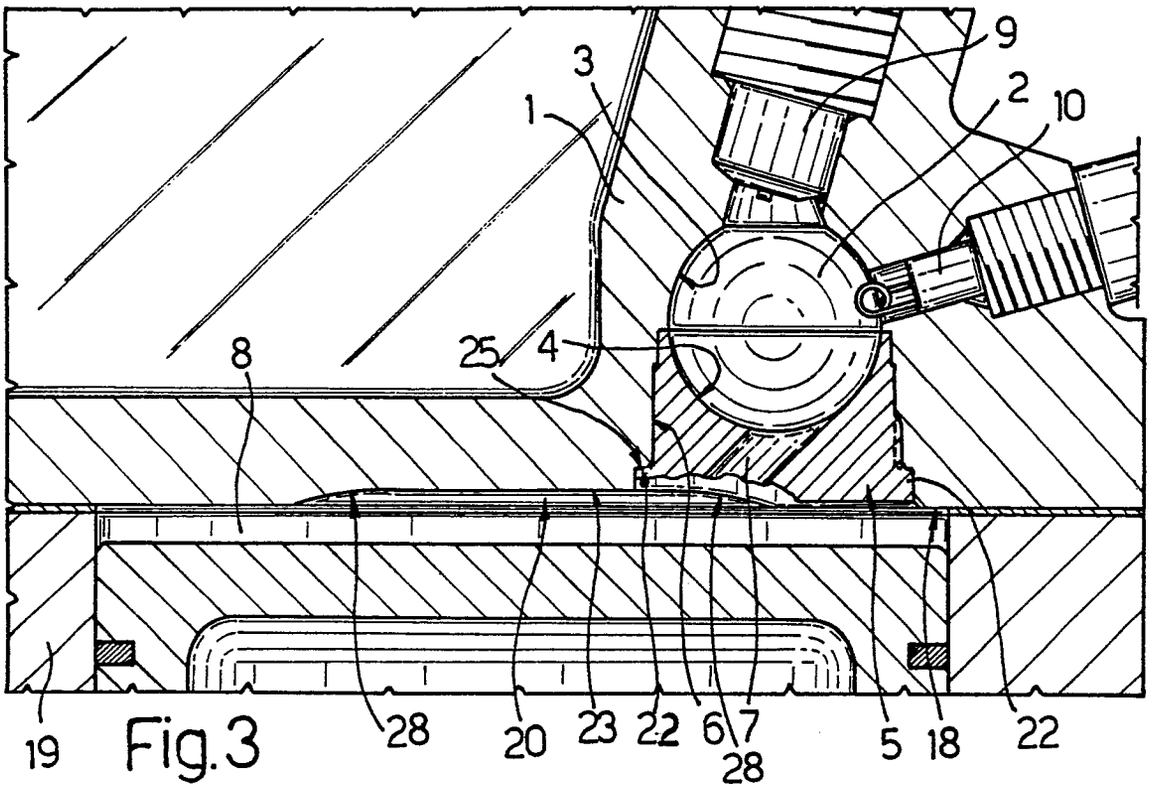
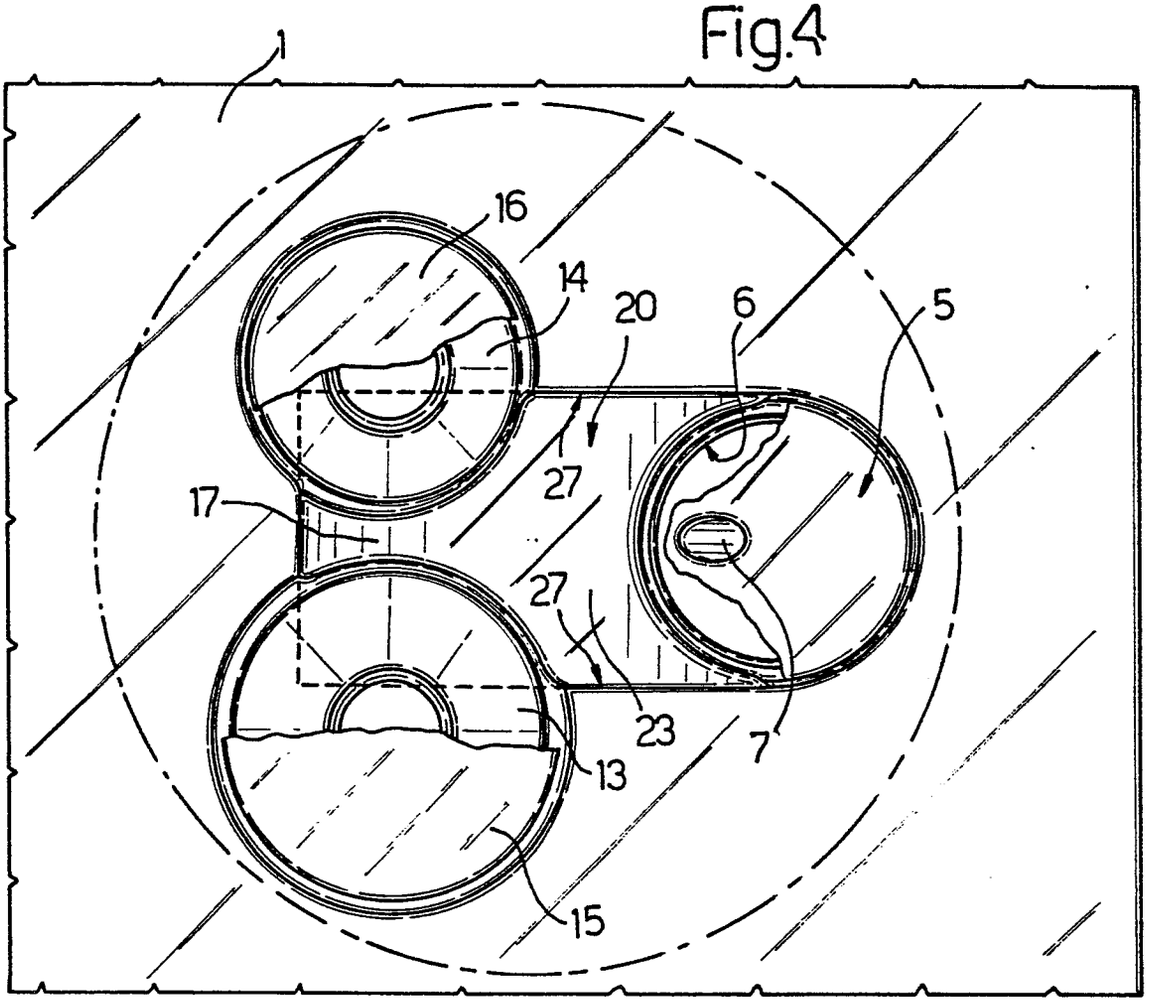

9
3
2
10
1
8
25
4
19
28
20
23
22
6
7
28
5
18
22

Fig.3

Fig.4


1
16
14
20
6
5
27
17
27
23
7
13
15

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 10 9148

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.4)
A	GB-A- 512 823 (CHAPMAN) * Page 4, lines 30-58 *	1	F 02 F 1/38
A	GB-A- 609 261 (SANDERS) * Page 2, lines 78-125 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 02 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12-09-1988	WASSENAAR G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)