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54 Exhaust valve for an internal combustion engine.

57 In the stationary and/or the movable valve part (1, 4) of the exhaust valve there is provided an annular chamber (9) formed as a circumferential recess in the surface of the valve part (4) in question facing the other valve part. The annular chamber is located intermediate the seating surfaces (5, 6) of the valve parts and the combustion chamber (10) of the engine cylinder and it communicates with the combustion chamber through a relatively narrow inlet when the valve is closed. During the compression period of the engine cylinder's working cycle the annular chamber is filled by pure and relatively cool air, and if local gaps are present between the seating surfaces, that air acts as a barrier preventing the leakage of substantial amounts of hot and aggressive combustion gases through the gaps during the initial part of the expansion period. This prevents the valve parts from being subjected, adjacent to said gaps, to a high temperature rise and concomitant heavy corrosive attacks which would lead to a rapid enlargement of the gaps. The invention, therefore, prolongs the lifetime of the valve by delaying the moment when a refurbishing of the seating surfaces becomes necessary.

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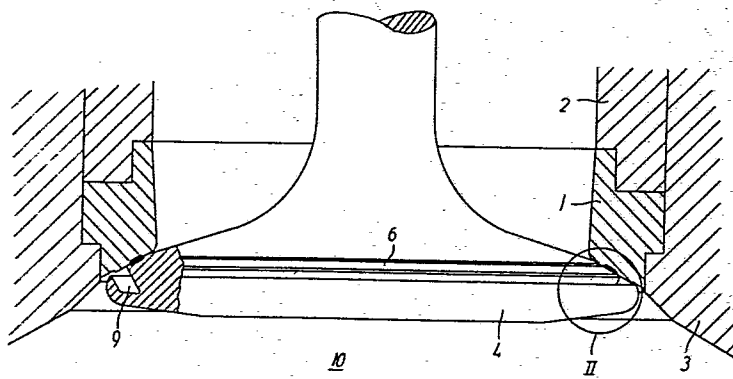


FIG. 1

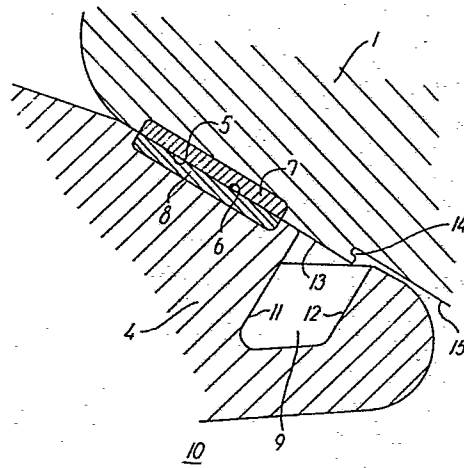


FIG. 2

Exhaust Valve For An Internal Combustion Engine.

The present invention relates to an exhaust valve for an internal combustion engine, comprising a stationary valve part and an axially movable valve part, co-operating seating surfaces on said valve parts and
5 an annular chamber formed in at least one of said valve parts and communicating with the combustion chamber of the engine cylinder when the valve is closed.

An object of the invention is to obtain a
10 prolonged lifetime of the valve by reducing the rate at which the seating surfaces of the valve gradually deteriorate due to corrosive and erosive attacks by aggressive constituents present in the exhaust gases, in particular sodium and vanadium compounds
15 occurring when the engine is running on heavy fuel oil.

It is well-known that the aggressivity of said constituents increases rapidly with increasing temperature, and based on that knowledge it has been
20 proposed to provide a direct or indirect air cooling of the seating surfaces, in some cases as a supplement to a liquid cooling of the stationary valve part.

Thus, US Patent Specification No. 1 873 119
25 discloses a valve of the kind referred to above in which an annular chamber in the stationary valve part and a chamber centrally located within the movable valve part both communicate with the combustion chamber through bores opening adjacent the
30 edges of the seating surfaces oriented towards the combustion chamber. Through non-return valves said two chambers within the valve parts communicate with a

source of pressurized air and when the exhaust valve opens, the outflowing exhaust gases entrain, by ejector action, the relatively cool air from the chambers, which air thus effects a certain cooling of the seating surfaces during the exhaust period.

An indirect cooling of the seating surfaces has been described in French Patent Specification No. 1 481 241 according to which cool air continually flows from an annular chamber within the stationary valve part through bores directed towards the surface of the movable valve part downstream of the seating surfaces.

An exhaust valve according to the present invention differs from the valve known from US Patent Specification No. 1 873 119 by the feature that the annular chamber is formed as a recess in a surface of one or both valve parts, which recess is open towards the opposed surface of the other valve part along its entire circumference.

With this construction and location of the annular chamber it constitutes a reservoir in the flow path from the combustion chamber to the seating surfaces of the valve parts, and when during the compression stroke the annular chamber has been filled by pure and relatively cool air, either from the engine cylinder or from a connected external source of pressurized air, that amount of air will after ignition of the fuel and until the exhaust valve opens function as a barrier between the hot combustion gases and the seating surfaces. As a consequence, the combustion gases cannot, as in the previously known valves, flow directly out through leaks formed by local gaps

between the seating surfaces. Instead it will be only the reservoir air or, at most, a mixture of that air with a relatively small percentage of combustion gases which penetrates through the
5 leaks.

The invention is based on the recognition that the above mentioned attacks, by the aggressive constituents present in the combustion gases, on the seating surfaces occur predominantly during
10 the period in which the valve is closed without, however, providing a perfect seal due to said local leaks which occur sooner or later, e.g. because deposits previously formed on the seating surfaces by corrosion peel off or
15 because particles of slag, cinder or coke squeezed between the surfaces when the valve closes, have left small indentations in the surfaces. Measurements of the surface temperature of the stationary valve part have shown that around such a
20 local leak there can occur a temperature rise of approximately 200°C immediately after top dead centre and an increase of the mean temperature amounting to approximately 100°C . On the other hand, the temperature rise at the beginning of
25 the exhaust period immediately after opening of the valve amounted to only approximately 20 to 25°C . Therefore, an additional cooling of the seating surfaces during the exhaust period exerts only a marginal influence on the corrosion
30 phenomena and on the resulting gradual enlargement of the initially very small leaks to larger burned regions. These phenomena are delayed to a far greater extent when, by means of the characteristic features of the present invention,

both the temperature of the gas leaking out between the seating surfaces when the valve is closed, and the content of aggressive constituents in that gas are reduced. Since with the materials normally employed for the seating surfaces, the corrosion rate can double at a temperature rise of approximately 70°C, it will be understood that the invention materially extends the time which a small local leak needs to grow into a regular burn-through of such size that it becomes necessary to refurbish the seating surfaces by regrinding them. The result is therefore, as mentioned above, that the lifetime of the valve is prolonged.

The critical period of each working cycle, during which the temperature and the pressure in the combustion chamber are at so high values that combustion gases leaking out therefrom can cause perceptible attacks on the seating surfaces, is rather short and ends approximately 20° after top dead centre, both with two stroke and four stroke engines. The desired effect of the invention can, therefore, be obtained with an annular chamber of relatively small volume which does not necessitate any inconvenient increase of the dimensions of the valve parts or of the so-called dead space of the engine cylinder. The chamber volume can be chosen somewhat larger than the volume of gas which during said period can flow through a gap having a cross-section of about 0.2 by 3 mm, e.g. 2 to 3 times that gas volume.

In order to obtain the desired barrier action of the air within the annular chamber combined with a minimum mixing of that air with combustion gases flowing into the chamber from the combustion chamber it is advantageous to

shape the annular chamber such that the width of an axial cross-section therethrough has a maximum value at the surface of the valve part in which the recess is formed.

5 When the annular chamber is formed solely in one valve part it is expedient to design the opposed surface of the other valve part with a step at the inlet from the combustion chamber to the annular chamber, such that the portion of said
10 surface nearest to the combustion chamber is retracted relative to the surface portion facing the annular chamber. With this feature the gases flowing from the combustion chamber are slowed down and deflected by the step between said surface
15 portions whereby the gases lose a material part of their kinetic energy. Consequently, the pure and relatively cool air from the annular chamber is pushed through the local leaks, if any, between the seating surfaces by the combustion gases solely
20 due to the static pressure drop from the combustion chamber to the downstream side of the valve. A further advantage of the embodiment is that at the moment when the opening of the valve starts, the flow of combustion gases from the cylinder is
25 similarly deflected into the annular chamber, thus contributing to keep the walls of that chamber free of undesired accumulation of deposits during operation of the engine.

 Said effect of the particular shape of the
30 valve parts is obtained optimally in an embodiment in which the transition between the two surface portions is shaped, in an axial cross-section, as a fillet oriented towards the inlet from the combustion chamber.

In a second embodiment the annular chamber is formed in the stationary valve part and defined by a cylindrical or substantially cylindrical first surface coaxial with the movable valve part and a second surface extending perpendicular or substantially perpendicular to the first surface. Compared to an embodiment in which the annular chamber is formed by removal of material from the movable valve part the manufacture of the valve is simplified and there is less risk of high local temperatures of the material surrounding the annular chamber. By providing a coolant duct, as known per se, in the stationary valve part it is possible to further reduce the wall temperatures of the annular chamber and thus obtain a correspondingly lower temperature of the gas accumulated within the annular chamber thereby increasing the advantageous influence of that chamber on the lifetime of the seating surfaces.

The surface of the movable valve part, which faces the annular chamber, may be substantially conical with a rounded outer edge which, together with said first surface of the stationary valve part, defines, in the closed position of the valve, an annular gap, the cross-section of which, as seen from the combustion chamber towards the annular chamber, is first convergent and then divergent. With this configuration of the narrow gap, which in the closed position of the valve provides the communication between the combustion chamber and the annular chamber, particles of slag or coke above a certain size, which are entrained by the exhaust gases, will, from a time during the closing movement when the valve is not fully closed,

be prevented from penetrating through the gap into the annular chamber and onwards to the seating surfaces between which the particles might be squeezed so as to create permanent deformations
5 of the surfaces.

The invention will now be described in more detail with reference to the accompanying schematical drawings, in which

Fig. 1 is an axial section through a valve
10 according to the invention, only those parts thereof which are deemed necessary for understanding the invention being shown,

Fig. 2 is a fractional view, on a substantially larger scale, of the area marked by II in Fig. 1,

15 Fig. 3 is an axial section similar to Fig. 1, through a second embodiment of the exhaust valve according to the invention, and

Fig. 4 is a fractional view, corresponding to Fig. 2, of the area marked by IV in Fig. 3.

20 As shown in Figs. 1 and 2 an exhaust valve for a two-stroke diesel engine comprises a stationary valve part (or bottom piece) 1 which together with a valve housing 2 is releasably secured (in a manner not shown in detail) to the cylinder cover
25 3 of an engine cylinder. The movable part 4 of the exhaust valve is generally formed as a conventional poppet valve which contacts bottom piece 1 on a conical surface. The seating surfaces proper of the two valve parts, which are designated by 5 and 6,
30 respectively, are formed on two coatings or inserts 7 and 8 of a suitable material, such as stellite or hard metal, see Fig. 2.

In that surface of the movable valve part 4, which is oriented towards bottom piece 1, there is

provided an annular chamber 9 located between the combustion chamber 10 of the engine cylinder and the seating surface 6 of valve part 4. As shown, the axial cross-section of chamber 9, i.e. a section
5 located in a plane through the valve axis, is trapezoid with two substantially parallel sides 11 and 12 extending by and large perpendicular to the seating surface 6 and the opposed surface 13 of valve part 1. Via a circumferential fillet 14 located somewhat
10 inwardly of the radially outer surface of chamber 9, the generatrix of which is the side 12, surface 13 merges, towards combustion chamber 10, into a surface 15 which is retracted so far from valve part 4 that with closed valve, as shown in Fig. 2,
15 there is formed at this place a circumferential gap of relatively narrow gap width, so as about 0.2 mm.

Through said gap annular chamber 9 will, during the combustion stroke, become filled by
20 pure scavenging or charging air at a relatively low temperature, and if one or more of the previously mentioned small local leaks are present between seating surfaces 5 and 6, it will be this air rather than the hot and highly corrosive combustion gases
25 which is pressed out through the leaks in the seating surfaces in response to the pressure rise resulting from the combustion of the fuel injected into the engine cylinder. The high temperature rise in the material surrounding existing leaks in
30 the seating surfaces, which otherwise occurs during that period of the engine's working cycle in which the temperature in the combustion chamber is high while simultaneously the combustion gases have a high density, due to the

high pressure, and a high concentration of corrosive constituents, is consequently avoided. The configuration, as shown and described, of the step or transition between the two surface portions 13 and 15 as a fillet 14, the concavity of which is oriented towards the inflow gap from combustion chamber 10, contributes to limiting undesired mixing of the pure and relatively cool air within annular chamber 9 and the inflowing hot combustion gases.

The reduction of the rate, at which small local leaks between the seating surfaces increase due to corrosive and erosive attacks, results in the further advantage that within the regions surrounding such leaks there is maintained a more effective heat transfer from the movable valve part 4 directly subjected to the high temperatures within combustion chamber 10, to the somewhat colder bottom piece 1 during the periods in which the valve is closed. Consequently, it is possible to maintain a lower mean or average temperature of the regions in question and, hence, also a more uniform mean temperature of the entire seating surface. This contributes to ensuring that the corrosion of the seating surfaces, which unavoidably occurs during the lifetime of the valve, will be uniformly distributed so that its effect on the sealing function of the valve is less deleterious as that of selective local corrosion attacks on the surfaces.

In the embodiment of Figs. 3 and 4 the stationary valve part or bottom piece is designated by 21, the valve housing by 22 and the cylinder cover by 23. As in Figs. 1-2 the movable valve part,

here designated by 24, is designed as a poppet valve having a conical contact surface against bottom piece 21. The seating surfaces 25 and 26 between the two valve parts are formed on inserts 27 and
5 28 in the respective valve parts.

Contrary to the embodiment of Figs. 1-2 the annular chamber 29, which is characteristic of the invention, is formed solely in the stationary part of the valve and defined between a cylindrical
10 surface 30 of the cylinder cover 23, a flat annular end face 31 of bottom piece 21 and a conical surface 32 of poppet valve 24. In the closed position of the valve, as shown, annular chamber 29 communicates with the combustion chamber 33 of the engine
15 cylinder through a narrow annular gap 34 defined between the surface of cylinder cover 23 and the rounded transition between the above mentioned surface 32 of poppet valve 24 and the surface 35 of the poppet valve which is oriented towards the
20 combustion chamber 33. In order to reduce the temperature of those surfaces of bottom piece 21 which contact the hot exhaust gases, including seating surface 25 and surface 31, an internal coolant duct 36 is provided in the bottom piece,
25 as known per se.

The function of annular chamber 29 is generally the same as described above in connection with the description of annular chamber 9, and the radial width of gap 34 can be made approximately the same as the width of the corresponding
30 inflow gap leading to annular chamber 9.

While in the embodiments shown and described the annular chamber is formed solely in the movable or the stationary valve part, it will be understood

that alternatively it could be composed of two opposed recesses, one provided in each valve part. As a substitute for or a supplement to the described use of compression air from the engine cylinder for
5 filling the annular chamber there might be provided an external source of pressurized air which through a non-return valve supplies cool air at a suitable pressure to the annular chamber. Said pressure should not be lower than the compression pressure within
10 the engine cylinder, and it may be of substantially the same magnitude as the maximum pressure occurring in the cylinder. Since the necessary consumption of air is relatively small, the air can be supplied by a correspondingly relatively small compressor.

PATENT CLAIMS

1. Exhaust valve for an internal combustion engine, comprising a stationary valve part (1) and an axially movable valve part (4), cooperating seating surfaces (5, 6) on said valve parts and
5 an annular chamber (9) formed in at least one of said valve parts and communicating with the combustion chamber (10) of the engine cylinder when the valve is closed, characterized in that the annular chamber (9) is formed as a recess in a surface of one or
10 both valve parts which recess is open towards the opposed surface (13, 15) of the other valve part along its entire circumference.

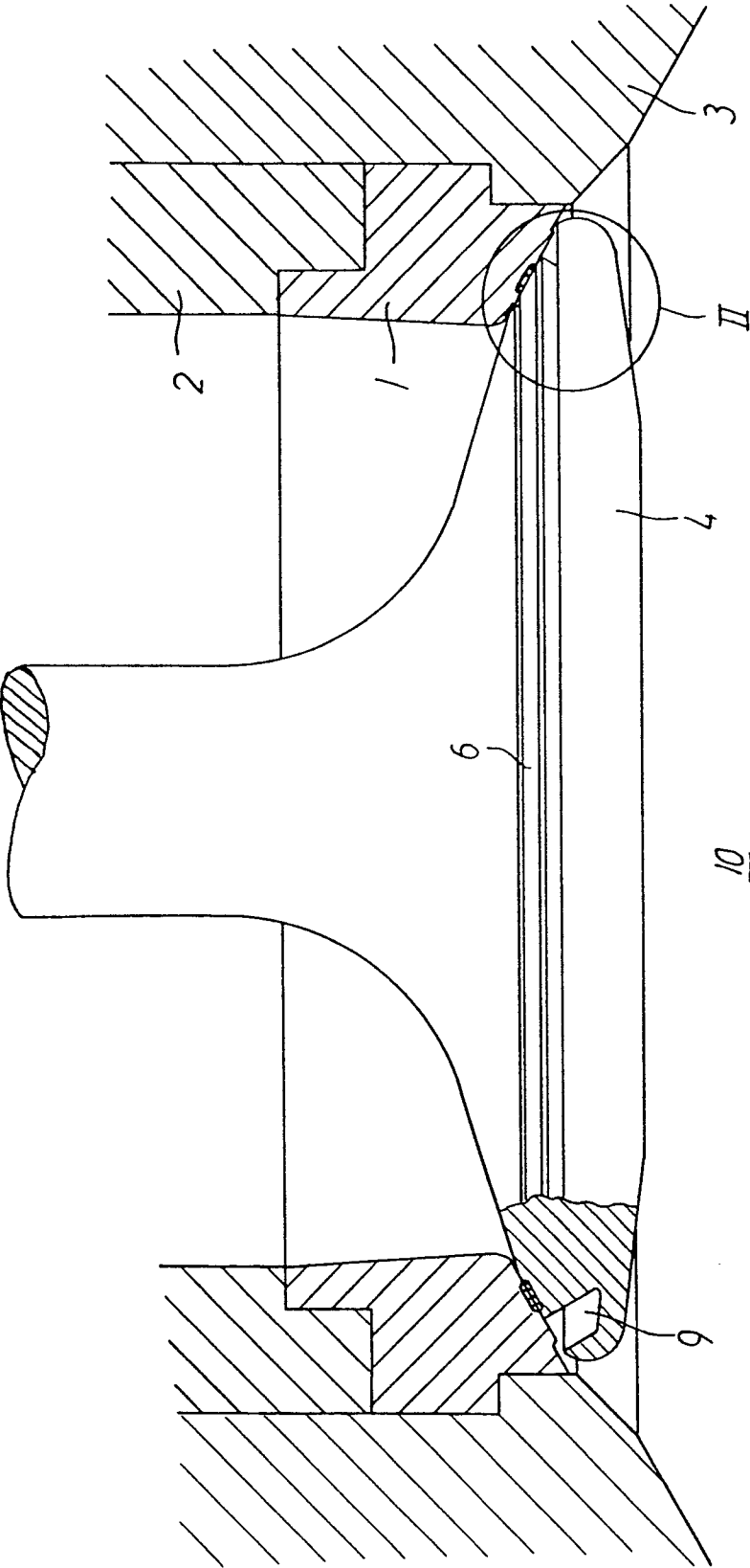
2. Exhaust valve as claimed in claim 1, characterized in that the width of an axial
15 cross-section through the annular chamber (9) has a maximum value at the surface of the valve part (4) in which the recess is formed.

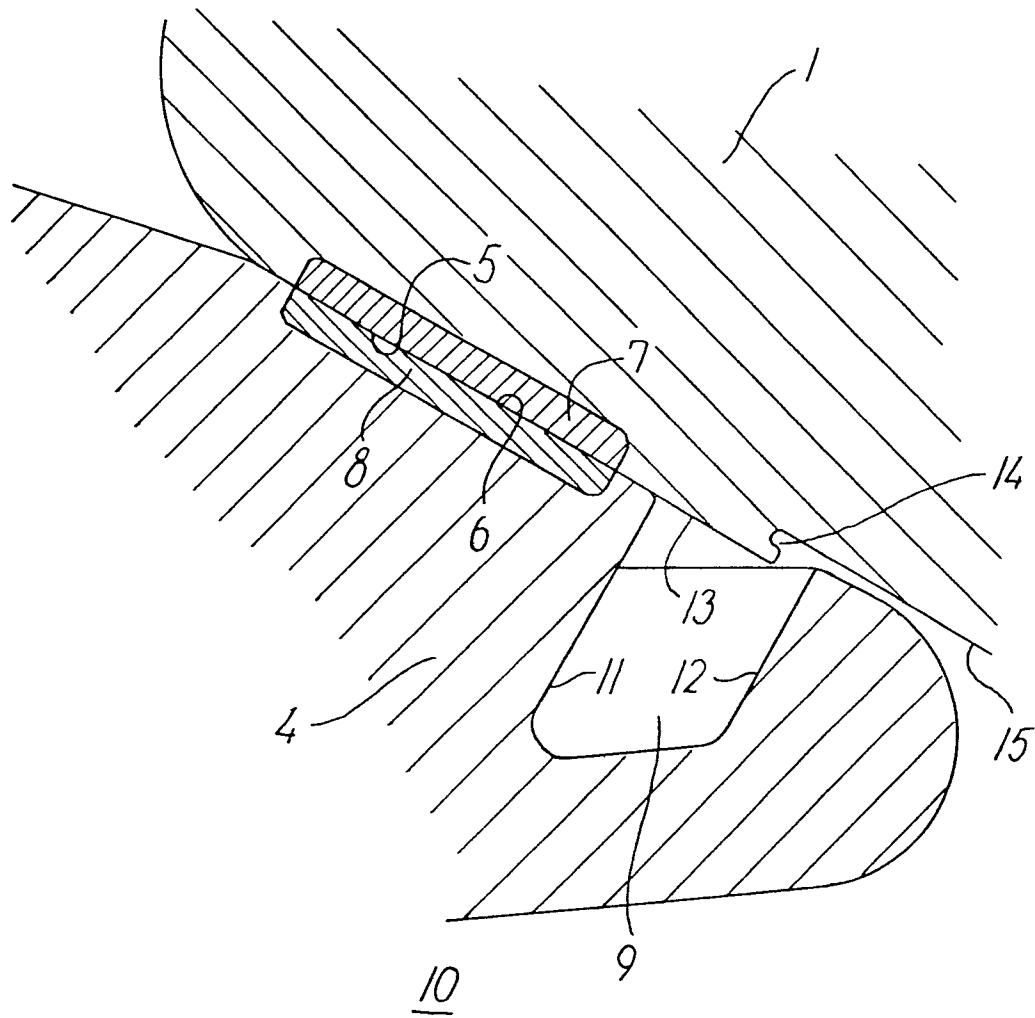
3. Exhaust valve as claimed in claim 1 or 2 and wherein the annular chamber (9) is formed
20 solely in one valve part (4), characterized in that at the inlet from the combustion chamber (10) to the annular chamber (9) the opposed surface (13, 15) of the other valve part is stepped such that the portion (15) of said surface nearest to
25 the combustion chamber is retracted relative to the surface portion (13) facing the annular chamber.

4. Exhaust valve as claimed in claim 3, characterized in that the transition (14) between said two surface portions (13, 15) is shaped, in
30 a cross-section extending through the valve axis, as a fillet oriented towards the inlet from the combustion chamber (10).

5. Exhaust valve as claimed in claim 1 or 2, characterized in that the annular chamber (29) is formed in the stationary valve part and defined by a cylindrical or substantially cylindrical first surface (30) coaxial with the movable valve part (24) and a second surface (31) extending perpendicular or substantially perpendicular to the first surface.

6. Exhaust valve as claimed in claim 5, characterized in that the surface (32) of the movable valve part, which faces the annular chamber (29), is substantially conical with a rounded outer edge which, together with said first surface (30) of the stationary valve part, defines, in the closed position of the valve, an annular gap (34), the cross-section of which, as seen from the combustion chamber (33) towards the annular chamber (29), is first convergent and then divergent.





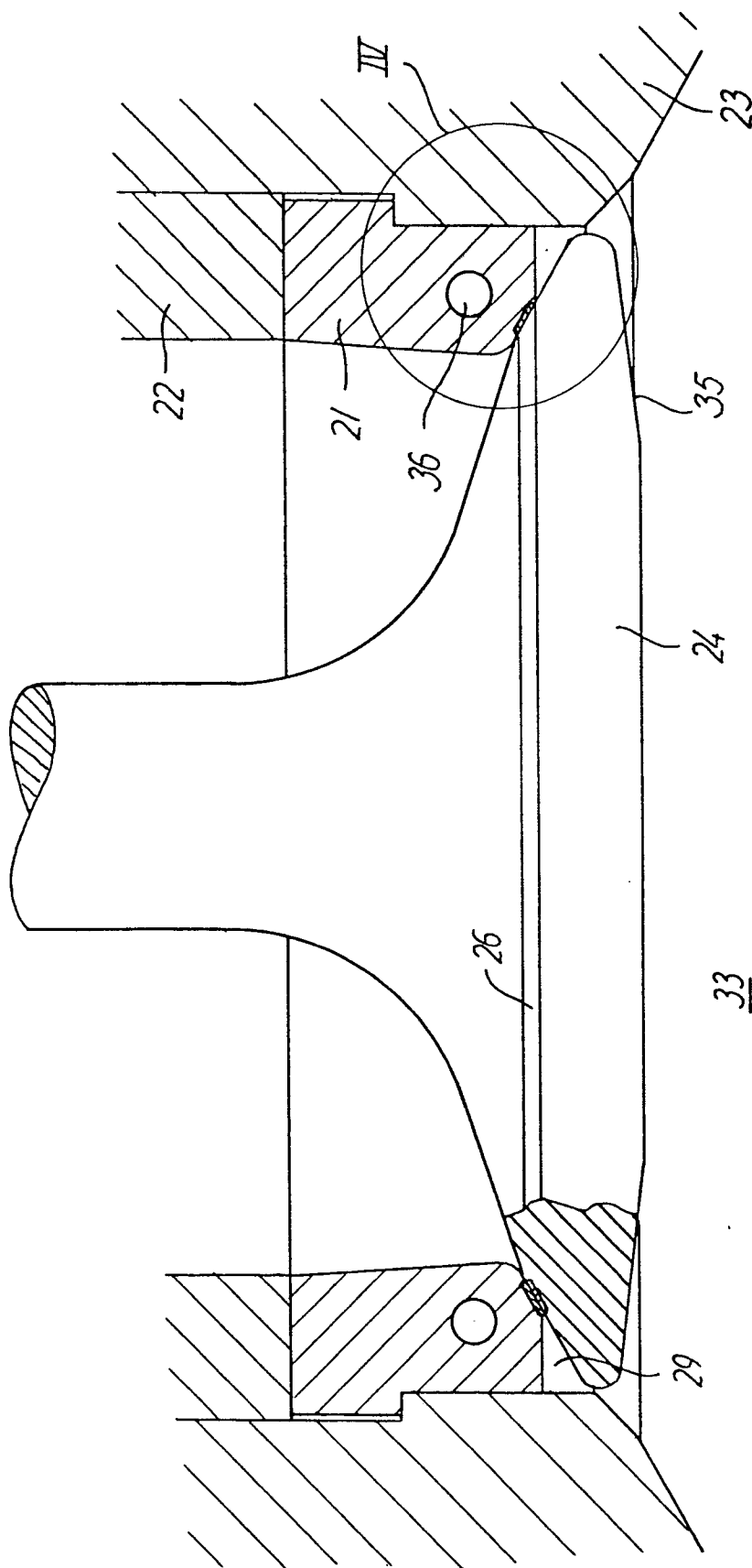
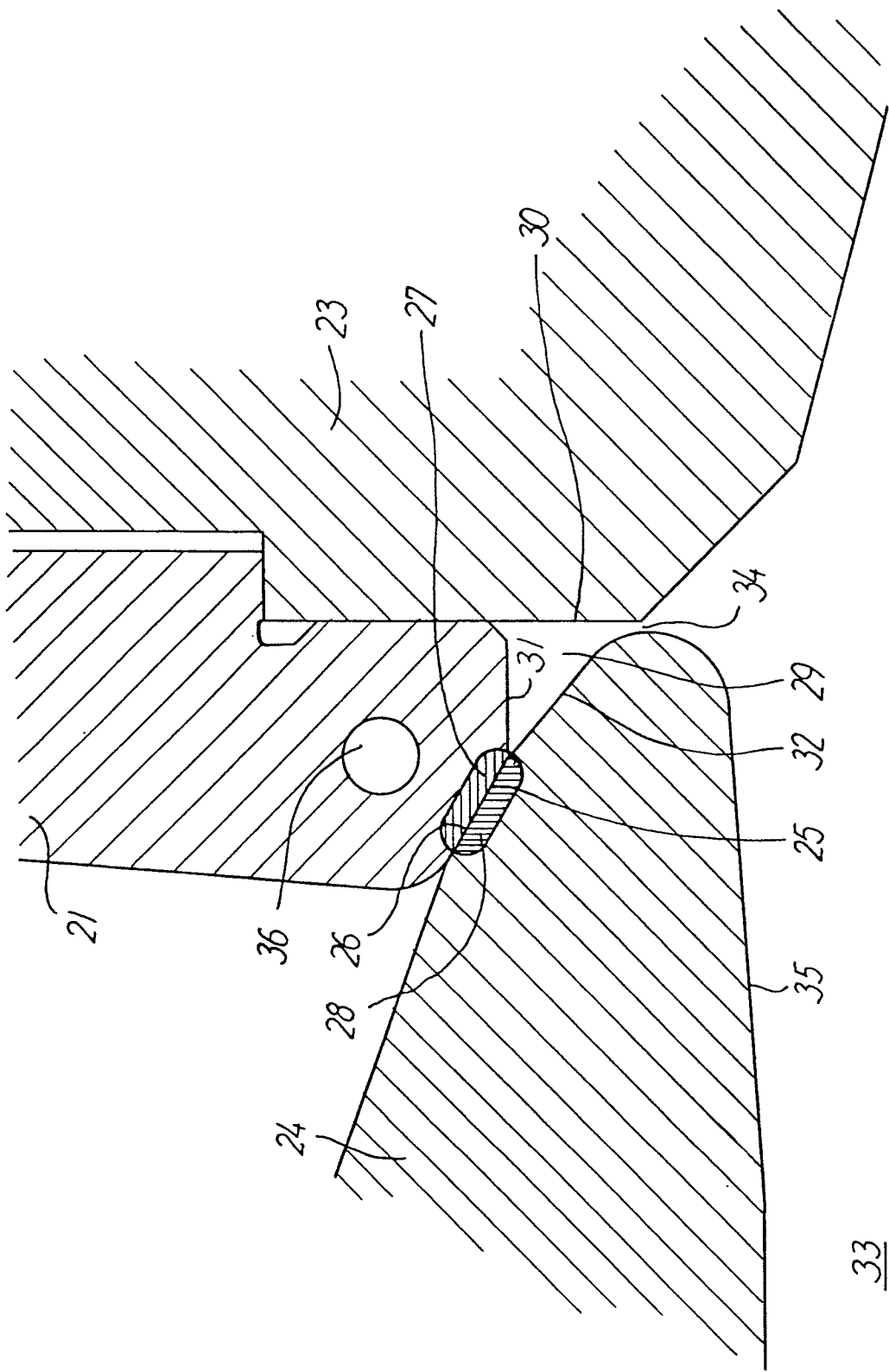
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FIG. 3





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EUROPEAN SEARCH REPORT

0024890

Application number

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
DA	<u>US - A - 1 873 119 (GRISWOLD)</u> * Page 1, left-hand column, lines 1-36 * --	1	F 01 L 3/02 F 01 L 3/20// F 01 L 3/04 F 01 L 3 /22
DA	<u>FR - A - 1 481 241 (SEMT)</u> * Page 1, paragraphs 1-5 * --	1	
A	<u>GB - A - 1 215 972 (SEMT)</u> * Page 1, lines 1-70 * --	1	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
	<u>GB - A - 532 571 (PURDAY)</u> * Figure 2; page 2, line 110 to page 3, line 31 * --	1,3	F 01 L
	<u>GB - A - 108 436 (McKECHNIE)</u> * Page 1, lines 1-37 * --	1,3	
	<u>US - A - 1 560 235 (HINSCH)</u> * Figures 2,4; page 1, lines 9-110 * --	1,3,5	
	<u>US - A - 4 106 466 (CATERPILLAR)</u> * Figure 2; column 2, lines 26-63 * --	1,5,6	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
	<u>US - A - 3 820 522 (DAIMLER-BENZ)</u> * Figure; column2, lines 20-63 * --	1,5,6	
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search The Hague		Date of completion of the search 04-12-1980	Examiner WASSENAAR



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EUROPEAN SEARCH REPORT

0024890

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EP 80 30 2900

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	DE - C - 744 250 (DAIMLER-BENZ) * Figure 3; page 2, lines 72-110 * ---	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)