(12) UK Patent Application (19) GB (11) 2 340 887 (13) A

(43) Date of A Publication 01.03.2000

(21) Application No 9919948.1

(22) Date of Filing 23.08.1999

(30) Priority Data
(31) 19838748 (32) 26.08.1998 (33) DE

(51) INT CL[7]
F02M 61/14

(52) UK CL (Edition R)
F1B B2JCM B2J15B2

(56) Documents Cited
US 4487178 A US 4296887 A

(58) Field of Search
UK CL (Edition Q) F1B B2JCM
INT CL[6] F02M 61/14
online: EPODOC, JAPIO, WPI

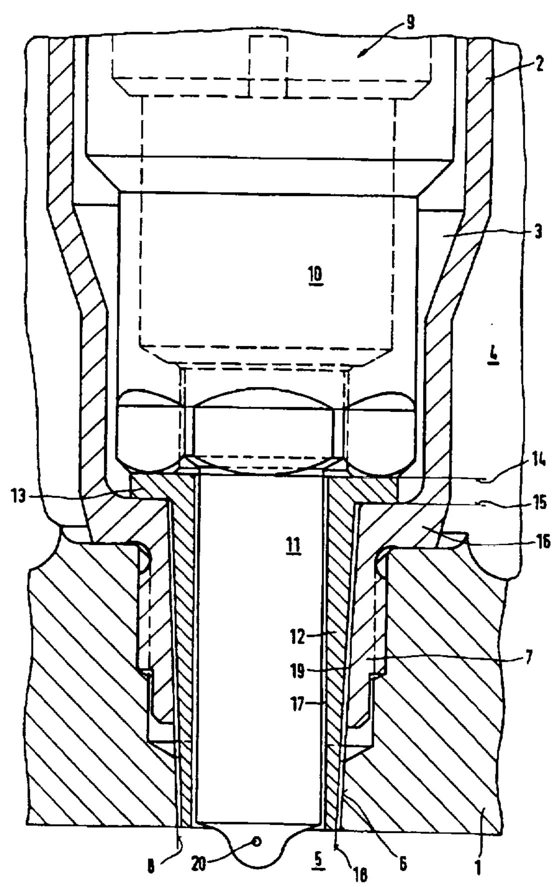
(71) Applicant(s)
DaimlerChrysler AG
(Incorporated in the Federal Republic of Germany)
Epplestrasse 225, D-70567 Stuttgart,
Federal Republic of Germany

(72) Inventor(s)
Erich Jehle
Rolf Kusterer
Bernhard Schwarzkopf

(74) Agent and/or Address for Service
Jensen & Son
70 Paul Street, LONDON, EC2A 4NA, United Kingdom

(54) Abstract Title
I.c. engine fuel injection nozzle with shielding sleeve

(57) The injection nozzle is received in a nozzle receptacle 3 formed by a wall portion 6 of the cylinder head 1 and an insert sleeve 2. The neck 11 of the injection nozzle is protected by a nozzle shielding sleeve 12, eg of copper, having a collar 13 by which it is clamped between bearing surfaces 14, 15 of the nozzle and of the insert sleeve 2, respectively. There is a clearance between the shielding sleeve 12 and both the nozzle neck 11 and the inner contour 8 of the nozzle receptacle 3. At least part of the outer contour 18 of the shielding sleeve 12 and of the inner contour 8 of the nozzle receptacle are shaped, eg conically, so that the shielding sleeve 12 cannot fall into the combustion space 5 if the shielding sleeve becomes detached from its collar 13. The shielding sleeve 12 may also engage axially under the free end of the nozzle neck 11 to secure it axially in case the nozzle neck 11 is fractured on installation.



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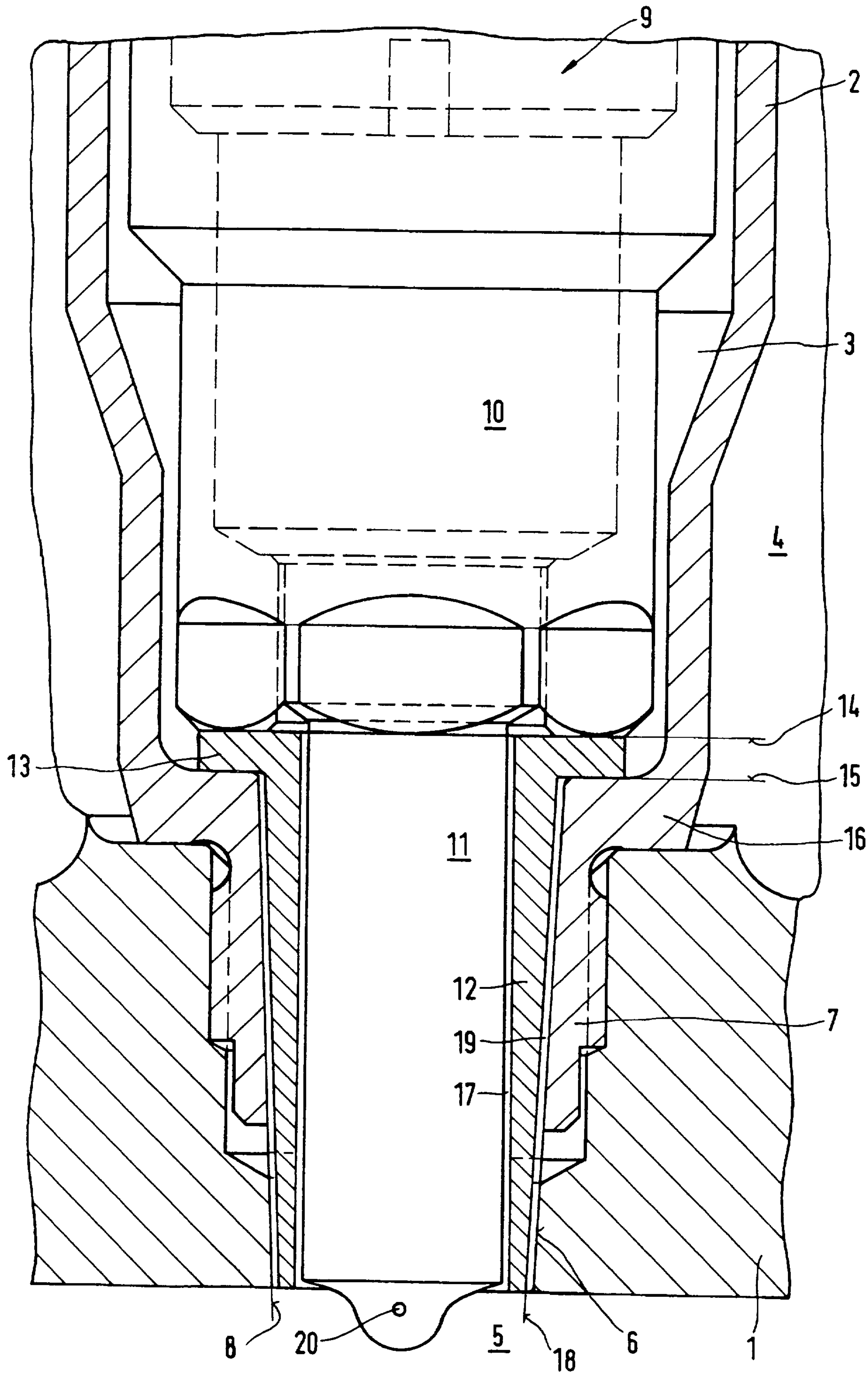
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Fuel injection nozzle for an internal combus... engine

The invention relates to a fuel injection nozzle for an internal combustion engine.

Fuel injection nozzles of the abovementioned type are known in many forms, thus, in particular, also from German Patent Specification 873 011, which shows various designs of fuel injection nozzles in which the nozzle neck is assigned a shielding sleeve which, via an annular collar provided at its end facing the nozzle body, is braced between the nozzle body and nozzle receptacle. Moreover, in some embodiments, the shielding sleeve is radially braced relative to the nozzle neck on part regions of the latter. Due to the direct connection with the combustion space, the shielding sleeve, like the nozzle neck, which has at least one injection orifice on the combustion-space side, is exposed to high thermal and also mechanical loads as a result of the extreme temperature and pressure fluctuations occurring when the internal combustion engine is in operation.

Particularly when the shielding sleeve is at least partially free relative to the nozzle neck surrounded by it and, because of the given dimensions of the gap in relation to the nozzle neck, on the one hand, and to the nozzle receptacle, on the other hand, is also exposed to different load pressures according to the pressure fluctuations in the combustion space, the loads acting on the shielding sleeve may even assume extreme values which ultimately, be it in the form of fatigue fractures, lead to fracturing of the shielding sleeve. There is therefore the risk that a part of the shielding sleeve which is remote from the annular collar in the direction of the combustion space loses its connection with the nozzle and falls into the combustion space, especially when the shielding sleeve has a thin-walled design over part regions of the nozzle neck, with corresponding transitions to regions of greater wall thickness, thus, for example, in the region of the transition to the annular collar.

If parts of the shielding sleeve enter the combustion space, this usually results in serious damage to the internal combustion engine, as also in the case of other foreign bodies entering the combustion space, if only in view of the small free spaces available at least in the top dead centre position, and such damage is to be avoided by means of the invention.

According to the present invention there is provided a fuel injection nozzle which injects into the combustion space of an internal combustion engine, is adapted to be arranged in a nozzle receptacle located on the same side as the internal combustion engine, is open towards the combustion space, has a nozzle body, and a nozzle neck offset relative to the nozzle body, and having an injection orifice arranged at the neck end located on the combustion-space side, and is provided with a shielding sleeve which radially overlaps the nozzle neck, delimits an annular gap relative to the nozzle neck and, when the nozzle is in the mounting position, is radially on the outside with a clearance relative to the surrounding nozzle receptacle, the nozzle being capable of being inserted into the nozzle receptacle in the direction of the combustion space and, with the nozzle mounted, the shielding sleeve being axially clamped, with an annular collar provided at its end facing the nozzle body, between the nozzle body and nozzle receptacle in the region of the start of the neck, wherein, in relation to the mounting position of the nozzle, the shielding sleeve has, in an axial region running towards the annular collar, an outer contour which, at least over a part region of its circumference, radially undercuts the inner contour of the nozzle receptacle in an axial region offset in the direction of the combustion space.

If the broken-off part preserves the sleeve structure, the broken-off part of the sleeve cannot, in any case, fall into the combustion space when there is a positive overlap with the cross section of the nozzle receptacle in the direction of the combustion space. The overlap may be restricted to part regions of the circumference and, according to the invention, is achieved in the simplest way in that a radial widening of the nozzle receptacle corresponds to a radial widening of the sleeve. According to the invention, this is possible in a particularly simple way if the sleeve is widened conically with respect to its outer circumference in the direction of its annular collar, along with a corresponding conical widening of the nozzle receptacle to the side facing away from the combustion space. The conical widening may be restricted to portions of the nozzle circumference which are assigned corresponding widening portions on the nozzle receptacle. The conical widening may also be achieved, furthermore, by means of corresponding axially successive steps, that is to say may also take place in step form. According to the invention, it is also possible to bring about the radial overlap by providing only one step jump, specifically with wall profiles which are otherwise cylindrical.

The radial widening provided on the outer circumference of the shielding sleeve may, according to the invention, correspond to a widening of the inside diameter, so that a, for example, conical and/or stepped profile on the outer circumference of the sleeve is not associated with any corresponding thickenings of material, but only with widenings of the annular gap between the shielding sleeve and nozzle neck, which are essentially not detrimental to the desired insulating function of the sleeve when the annular gap located on the combustion-space side between the shielding sleeve and the nozzle neck is correspondingly small or approaches zero.

If it is assumed that the shielding sleeve is at especially high risk particularly at the transition to the annular collar, it proves sufficient for a radial overlap acting as a safeguard against loss to be provided only in that region of the shielding sleeve which is remote from the combustion space. If, on account of the sleeve structure and/or the load conditions in the region nearer the combustion space, there is a corresponding risk of fracture or breakage, then it is advantageous to provide the corresponding overlap even in the axial region nearer the combustion space, and, particularly in a case of this kind, an overlap produced by appropriate stepping on the outer circumference of the shielding sleeve proves expedient, whilst a corresponding radially inner stepping can correspond to this radially outward stepping of the shielding sleeve.

The design according to the invention of the shielding sleeve may be expedient in the case of shielding sleeves consisting both of steel and, in particular, of highly heat-conductive materials, such as, in particular, copper or copper alloys, wall thicknesses within the range of about one tenth of the nozzle-neck diameter and, in part, considerably smaller than 1 mm being used, at least in part regions, for the sleeve.

The design according to the invention of the shielding sleeve still has no influence on the mounting of the nozzle, since the radial widenings associated with the design according to the invention are provided opposite to the push-in direction of the injection nozzle during mounting, that is to say as the distance from the combustion space increases.

Further details and features of the invention may be gathered from the claims. Moreover, the invention is explained in more detail below with reference to a diagrammatic embodiment which is illustrated in the drawing and which shows, in section, that part of a fuel injection nozzle which opens out onto the combustion space of an internal combustion engine.

The sectional illustration shown as an embodiment comprises that part of a cylinder head 1 which is located on the combustion-space side and into which is screwed an insert sleeve 2 which delimits a nozzle receptacle 3 relative to the water space 4 of the cylinder head 1. The nozzle receptacle 3 is formed, in the end region facing the combustion space 5 and adjoining the insert sleeve 2, by a wall portion 6 of the cylinder head 1, and, in the diagrammatic embodiment shown here and serving for explaining the invention, this wall portion 6 forms, together with that portion 7 of the insert sleeve 2 which is screwed into that region of the cylinder head 1 which is located on the combustion-space side, the inner contour 8 of that region of the nozzle receptacle 3 over which the injection nozzle, designated as a whole by 9 and only partially illustrated, extends with its nozzle neck 11 which axially adjoins the nozzle body surrounded by the nozzle holder, jointly designated below as the nozzle body 10. The nozzle neck 11 is offset radially inwards relative to the nozzle body 10. The nozzle neck 11 is assigned a shielding sleeve 12 which, at its end remote from the combustion space 5, has an annular collar 13 which is located in the transitional region between the nozzle body 10 and nozzle neck 11 and which, when the nozzle body 10 is braced axially relative to the cylinder head 1 in the direction of the combustion space 5, lies between the radial bearing surface 14, formed by the radial offset of the nozzle body 10 at the transition to the nozzle neck 11, and the bearing surface 15, which is formed by an offset 16 of the insert sleeve 2 at the transition to that portion 7 of the latter which is screwed into the cylinder head 1.

In the embodiment shown, the shielding sleeve 12, over its entire length, surrounds the nozzle neck 11 with a clearance, so as to form an annular gap 17. The shielding sleeve 12 is surrounded radially on the outside, with a clearance, by the wall portion 6 of the cylinder head 1 and the portion 7 of the insert sleeve 2, these two portions 6 and 7 determining the inner contour 8 of the nozzle receptacle 3, the said inner contour being continuous in the embodiment, widening conically to the side facing away from the combustion space 5 and being overlapped by the shielding sleeve 12, which has an outer contour 18 running correspondingly to the inner contour 8 and widening conically in the direction of the annular collar 13. The conicity of the outer and inner contours is defined in such a way that, as seen axially from the combustion space 5 in the direction of the annular collar 13, the inner contour 8 and outer contour 18 overlap radially, in such a way that, on the assumption that the shielding sleeve 12 is displaced in the direction of the combustion space 5 after being separated from the annular collar 13, the outer contour 18 would run onto the inner contour 8. The possible length over which that part of the shielding sleeve 12 which has come loose from the annular collar 13 is displaced relative to the cylinder head 1 can be deter-mined via the width of the annular gap 19 between the outer contour 18 and inner contour 8 and the amount of conicity.

Thus, by simple means, the invention makes it possible, without any contact, to protect the shielding sleeve 12 from falling into the combustion space 5, should the shielding sleeve 12 break off due to thermal and/or mechanical loads and corresponding material failure below or at the transition to the annular collar 13.

The illustration chosen for the embodiment serves merely to clarify the invention, but in no way signifies a restriction of the invention to the embodiment apparent from the illustration. Thus, within the scope of the invention, it is, for example, possible to arrive at a corresponding radial overlap between the outer contour 18 of the shielding sleeve 12 and the inner contour 8 of the insert sleeve 2 by giving the shielding sleeve 12 and/or the corresponding axial portion of the insert sleeve 2 or the inner contour 8 of the nozzle receptacle 3 a stepped design, in which case one or more steps may be provided and the transitions between the steps may run cylindrically.

Contrary to the embodiment shown, the inner contour of the shielding sleeve 12 may follow the profile of the outer contour 18 of the shielding sleeve 12, the said profile being chosen with regard to the intended overlapping, so that, if appropriate, the annular gap 17 widens to the side facing away from the combustion space 5.

Contrary to what has been shown, it is also possible for only part regions of the shielding sleeve 12 to be designed conically with respect to their outer contour 18, thus, for example, the end region located on the combustion-space side, so that overlap is ensured in this region and there is no possibility of the shielding sleeve 12 or of parts thereof falling into the combustion space 5.

In order to explain the invention, the embodiment is based on a rotationally symmetrical design of the respective contours, specifically of the inner contour 8 and outer contour 18. However, it is, of course, also possible, within the scope of the invention, for only part regions over the circumference to be designed so as to produce an overlap.

Within the scope of the invention, the shielding sleeve 12 may, furthermore, also be designed in such a way that it forms an axial securing means for the nozzle neck 11, too, for example by engaging axially under the nozzle neck 11 at the end of the latter which is assigned to the combustion space 5 and which contains the injection orifice 20. In conjunction with a solution of this kind or one corresponding to it in functional terms, a design according to the invention which results in a radial overlap of the shielding sleeve 12 and insert sleeve 2 or cylinder head 1 achieves a retention securing means not only for the shielding sleeve 12, but also for the nozzle neck 11, should the nozzle 9 be fractured when it is inserted into the cylinder head 1.

Within the scope of the invention, the shielding sleeve 12 may be designed as a steel sleeve, but is preferably formed from materials of high thermal conductivity, such as, for example, copper, within the scope of the invention the wall thickness for the shielding sleeve preferably amounting to only a fraction of the diameter of the nozzle neck 11 and therefore being, for example, of the order of magnitude of less than one millimetre. The widths of the annular gaps are correspondingly also of the orders of magnitude preferably in the tenths of a millimetre range, for example about 0.5 mm. In relation to annular gaps with dimensions of this kind, it proves advantageous to have conicities of up to approximately 3E, preferably approximately between 1E and 2E, or step widths corresponding to such conicities in the case of a radial overlap achieved by means of one or more steps.

Claims

1. A fuel injection nozzle which injects into the combustion space of an internal combustion engine, is adapted to be arranged in a nozzle receptacle located on the same side as the internal combustion engine, is open towards the combustion space, has a nozzle body, and a nozzle neck offset relative to the nozzle body, and having an injection orifice arranged at the neck end located on the combustion-space side, and is provided with a shielding sleeve which radially overlaps the nozzle neck, delimits an annular gap relative to the nozzle neck and, when the nozzle is in the mounting position, is radially on the outside with a clearance relative to the surrounding nozzle receptacle, the nozzle being capable of being inserted into the nozzle receptacle in the direction of the combustion space and, with the nozzle mounted, the shielding sleeve being axially clamped, with an annular collar provided at its end facing the nozzle body, between the nozzle body and nozzle receptacle in the region of the start of the neck, wherein, in relation to the mounting position of the nozzle, the shielding sleeve has, in an axial region running towards the annular collar, an outer contour which, at least over a part region of its circumference, radially undercuts the inner contour of the nozzle receptacle in an axial region offset in the direction of the combustion space.

2. A fuel injection nozzle according to Claim 1, wherein the outer contour of the shielding sleeve widens conically, at least in portions, in the direction of the annular collar.

3. A fuel injection nozzle according to Claim 1, wherein the outer contour of the shielding sleeve widens in at least one step in the direction of the annular collar.

4. A fuel injection nozzle according to any one of the preceding claims, wherein the inner contour of the nozzle receptacle tapers conically, at least in portions, in the direction of the combustion space.

5. A fuel injection nozzle according to any one of Claims 1 to 3, wherein the inner contour of the nozzle receptacle tapers at least in one step in the direction of the combustion space.

6. A fuel injection according to any one or more of the preceding claims, wherein that region of the inner contour of the nozzle receptacle which overlaps with the outer contour of the shielding is axially adjacent to the combustion space.

7. A fuel injection nozzle according to Claim 6, wherein the distance of that region of the inner contour of the nozzle receptacle which overlaps with the outer contour of the shielding sleeve from the combustion space corresponds at least approximately to one eighth of the length of the shielding sleeve.

8. A fuel injection nozzle according to any one of Claims 1 to 5, wherein that region of the inner contour of the nozzle receptacle which overlaps with the outer contour of the shielding sleeve is located axially in the longitudinally middle region of the shielding sleeve.

9. A fuel injection according to any one of Claims 1 to 5, wherein that region of the inner contour of the nozzle receptacle which overlaps with the outer contour of the shielding sleeve is axially adjacent to the annular collar.

10. A fuel injection nozzle according to any one of the preceding claims, wherein the inner contour of the shielding sleeve has a profile corresponding approximately to the outer contour of the shielding sleeve.

11. A fuel injection nozzle according to any one or more of the preceding claims, wherein the inner contour of the shielding sleeve has a cylindrical profile.

12. A fuel injection nozzle according to any one or more of Claims 1 to 10, wherein the inner contour of the shielding sleeve has at least one step.

13. A fuel injection nozzle which injects into the combustion space of an internal combustion engine, substantially as described herein with reference to, and as illustrated in, the accompanying drawing.

INVESTOR IN PEOPLE

Application No: GB 9919948.1
Claims searched: 1 to 13
Examiner: John Twin
Date of search: 26 October 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F1B (B2JCM)

Int Cl (Ed.6): F02M 61/14

Other: online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 4487178 (M A N)	
A	US 4296887 (Robert Bosch)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.