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Bezeichnung der Erfindung: Light weight tappet for direct-acting valve gear

Title of invention:

Titre de l'invention :

Klassifikation / Classification / Classement : F01L 1/24

ENTSCHEIDUNG / DECISION

vom / of / du 16 May 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /

Titulaire du brevet :

Eaton Corporation

Einsprechender / Opponent / Opposant : Daimler-Benz AG

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Art. 56, 111(1) and 114

Schlagwort / Keyword / Mot clé :

"Inventive step (denied)"

"Case not remitted to the first instance"

Leitsatz / Headnote / Sommaire

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European Patent  
Office

Boards of Appeal

Office européen  
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Chambres de recours



Case Number : T 626/88 - 3.2.2

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.2  
of 16 May 1990

**Appellant :** Daimler-Benz AG  
(Opponent) Postfach 60 02 02  
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**Representative :**

**Respondent :** Eaton Corporation  
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**Decision under appeal :** Decision of the Opposition Division of the European  
Patent Office dated 12 October 1988 rejecting  
the opposition filed against European patent  
No. 0 030 780 pursuant to Article 102(2) EPC.

**Composition of the Board :**

**Chairman :** G. Szabo  
**Members :** P. Dropmann  
J-C. Saisset

## Summary of Facts and Submissions

I. European patent No. 0 030 780 comprising two independent and five dependent claims was granted on 21 November 1985 on the basis of European patent application No. 80 302 754.9 filed on 11 August 1980.

II. Claim 1 reads as follows:

"An hydraulic lash adjusting tappet (10) for the valve gear of an internal combustion engine having valve gear of the direct-acting type in which an engine cam contacts one end of the tappet and the other end of the tappet contacts a stem of a combustion chamber valve, said tappet (10) comprising:

(a) structure (40;90;110;130) defining:

- (i) an outer annular wall (42;92;132) having a wear resistant surface on the outer periphery thereof;
- (ii) an annular hub (46;94;114;134) disposed within said outer annular wall and spaced therefrom;
- (iii) connecting means (44;78;98;136) extending inwardly from said outer annular wall and supporting said annular hub; and
- (iv) a cam face adapted to contact said engine cam;

(b) hydraulic lash adjusting means (52;150) movably received in said annular hub, said lash adjusting means including a plunger (54) defining a reaction surface (56) adapted for contacting said valve stem, said reaction surface extending generally parallel to said cam face and being movable with respect thereto, said lash adjusting means further including a piston (60) received within said plunger, said piston and said plunger defining within said annular hub a fluid reservoir chamber (62,106; 124,152) and said piston defining with said plunger a fluid pressure chamber (63) between them, and one-way valve

means (66;70;72) operable to admit fluid from said fluid reservoir chamber to said fluid pressure chamber for altering the position of said reaction surface with respect to said cam face, said lash adjusting means further including means (55) biasing said reaction surface away from said cam face;

(c) means for retaining said lash adjusting means (50;150) within said annular hub;

(d) said structure including means defining a fluid passage (80;100;118;142;150) from the outer surface of said outer annular wall to said one-way valve means for communicating fluid thereto upon installation of said tappet in an engine and supplying pressurized fluid to passage; characterised in that

said annular hub, said connecting means and said outer annular wall are integrally formed from a material having a coefficient of thermal expansion of at least  $22.0 \times 10^{-6}$  per unit length per degree centigrade as measured in the range 20-100 degrees centigrade, said connecting means comprising at least one radial web (78;98;136) joining the ends of said outer annular wall and said annular hub adjacent said cam face to leave one or more substantially circumferential spaces between the annular outer wall and the annular hub, and in that said cam face is provided by a separate member (48;140) which is formed of material having a hardened surface adapted for contacting the cam lobe and which is fixed about the periphery thereof to said outer annular wall and is supported against said at least one radial web."

Independent Claim 7 differs from Claim 1 only in that the material from which the annular hub, the connecting means and the outer annular wall are formed is specified to be aluminium.

III. The patent was opposed on the grounds of lack of novelty and inventive step in the light of the prior art reflected by the documents DE-A-2 829 423, DE-A-2 942 926, DE-A-2 158 156, GB-A-1 213 776 and DE-B-1 914 693.

IV. The Opposition Division rejected the opposition pursuant to Art. 102(2) EPC in a decision dated 12 October 1988. According to the decision, the subject-matter of Claims 1 and 7 was novel and involved an inventive step, the documents DE-A-2 829 423 and DE-A-2 942 926 having been considered as not comprised in the state of the art in accordance with Art. 54 EPC.

V. The Appellant (Opponent) lodged an appeal against this decision on 10 December 1988, accompanied by the Statement of Grounds. The appeal fee was paid on the same date.

The Appellant stated that the subject-matter of Claims 1 and 7 as granted did not involve an inventive step in view of the document GB-A-1 354 347, which had been used to formulate the prior art portion of Claims 1 and 7, and the documents DE-A-2 158 156, DE-B-1 914 693 and US-A-3 877 446, the latter document being cited for the first time in the proceedings.

VI. In a letter dated 6 July 1989, the Respondent (Proprietor of the patent) requested that the appeal be dismissed because it relied on newly introduced US-A-3 877 446. He further requested that the case be referred back to the Opposition Division for further consideration in the event that the Appeal Board decided to consider the relevance of this document. In addition, the Respondent contested the arguments brought forward by the Appellant.

VII. In a Communication pursuant to Art. 11(2) of the Rules of Procedure of the Boards of Appeal and dated 19 February

1990, the Board expressed its intention to take the late-filed document US-A-3 877 446 into account under Art. 114(1) EPC. It further took the view that GB-A-1 354 347 represented the closest prior art document.

VIII. During oral proceedings both parties defended their cases essentially on the basis of the arguments previously put forward in written form, while taking the opportunity to submit their views in more detail.

The Appellant, basing his arguments on GB-A-1 354 347 as the closest state of the art, pointed out that this document disclosed an hydraulic lash adjusting tappet which comprised, in addition to the features specified in the preamble of Claims 1 and 7, some of the characterising features, such as an outer annular wall (intermediate guide member 90 in the GB document) made of aluminium, i.e. a material having the same coefficient of thermal expansion as that mentioned in Claim 1, and a cam face provided by a separate member (valve operator body 42 in the GB document) which was formed of material having a hardened surface adapted for contacting the cam lobe 30.

In addition the Appellant submitted that most of the remaining essential features of the characterising portion of Claim 1 were obvious, as necessary and consequential adjustments on the basis of common knowledge and in the light of US-A-3 877 446. In particular, the feature that the annular hub, the connecting means and the outer annular wall were integrally formed from the material specified in Claims 1 and 7, and the features concerning the provision of a radial web, and one or more circumferential spaces between the annular outer wall and the annular hub, were obvious to a person skilled in the art for these reasons. The features concerning the separate member and especially its fixation about the

periphery thereof to the outer annular wall were in themselves already known and therefore obvious having regard to DE-B-1 914 693. In this respect, reference was also made to DE-A-2 158 156. The remaining feature that the separate member is supported against the at least one radial web follows inevitably when providing the cam face of the tappet known from US-A-3 877 446 with a separate cam face member.

- IX. The Respondent submitted that the late-filed document US-A-3 877 446 should not be considered by the Board because it was only of marginal relevance and was already available to the Appellant at the time of lodging the opposition since it had been cited against US patent 4 367 701 corresponding to the contested European patent.

The Respondent pointed out that in any case the problem underlying the present patent was to be seen in reducing the weight of the prior art tappet while maintaining its stiffness and compatibility with the cylinder head without causing any leakdown problem.

Document GB-A-1 354 347 was, in the Respondent's view, the closest relevant state of the art and was solely concerned with reducing the cost of a tappet. It was not concerned with the same problem as the present invention and therefore had nothing to offer in relation to this problem.

The Respondent was further of the opinion that there was nothing in GB-A-1 354 347 to suggest that the prior art tappet be modified in such a way as to arrive at a tappet having the features set forth in Claims 1 and 7. It was true that US-A-3 877 446 disclosed a tappet comprising, integrally formed, an annular hub, an outer annular wall and a connecting radial web, but the material of this

integrally formed tappet body was apparently steel and not aluminium. If it were considered to be obvious to make the tappet body known from US-A-3 877 446 from aluminium and to provide the body with a separate cam face member as disclosed in DE-B-1 914 693 (cf. Fig. 1, reference numeral 6) or DE-A-2 158 156 (cf. Figs. 1 and 2, reference numerals 17, 17'), then that separate cam face member would merely be put on top of the cam face of the US tappet body. In this case the separate cam face member would not be supported against the radial web.

In response to the argument that the person skilled in the art, faced with the problem to make the prior art tappet lighter, might be in a 'one-way street' position and the modifications of the prior art would appear to be based on consequential common general knowledge, the Respondent argued (i) that there was no suggestion in GB-A-1 354 347 of making the whole tappet body except for a separate cam face member from aluminium, (ii) that the GB document did not suggest any of the modifying steps indicated in Claims 1 and 7, (iii) that the invention had to be seen in the whole combination of features, (iv) that it was surprising that these modifications had not been done earlier and (v) that, when assessing inventive step, the question to be asked was not whether the person skilled in the art could modify the prior art tappet in the manner specified in the characterising portion of Claims 1 and 7, but rather whether he or she would do that.

- X. The Appellant requests that the decision under appeal be set aside and the patent be revoked.

The Respondent requests that the appeal be dismissed or the case be referred back to the Opposition Division under Art. 111(1) EPC if the Board intends to revoke the patent on the basis of the late-filed document US-A-3 877 446.



## Reasons for the Decision

1. The appeal is admissible.
2. Late-filed document

Document US-A-3 877 446 was cited by the Appellant for the first time during the appeal proceedings. Since the independent claims as granted have not been amended either during the opposition or appeal procedure, the US document should have been filed during the opposition period and is thus deemed not to have been submitted in due time.

Nevertheless, the Board considers this document because of its relevancy and for the following reason. Since the Opposition Division has argued that exactly the features concerning the hub, the web and the circumferential spaces 'include', i.e. represent the inventive step (see sheet 12, lines 2 and 3 of the decision under appeal), it cannot be denied that a document which, like US-A-3 877 446, discloses exactly these features missing from the primary document, can be relevant. Hence, noting that the parties have had an opportunity to present their comments on the matter (Art. 113(1) EPC), the Board decided not to disregard this document under Art. 114(2) EPC as requested by the Respondent, but to take it into account of its own motion (cf. Art. 114(1) EPC).

3. Novelty

The subject-matter of Claims 1 and 7 is novel over the prior art documents mentioned during the proceedings, since none of the documents discloses an hydraulic lash adjusting light weight tappet for direct-acting valve gear

which comprises all the features specified in Claim 1 or 7. The Board shares the opinion of the Opposition Division that documents DE-A-2 829 423 and DE-A-2 942 926 cited during the opposition procedure do not constitute state of the art in accordance with Art. 54 EPC.

4. Closest state of the art

As acknowledged by the parties, GB-A-1 354 347 must be considered as a document which is structurally closest to the subject-matter of Claims 1 and 7. In fact, this document discloses a tappet comprising all the features specified in the prior art portion of Claim 1 or 7. In addition, it is known from the GB document that the outer annular wall 90 of the structure can be formed from aluminium, i.e. a material having the same coefficient of thermal expansion as that mentioned in the characterising portion of Claim 1 in relation to the wall and integrally formed annular hub and connecting means. In further correspondence with Claim 1 or 7, the document discloses that the cam face 44 is provided by a member 42 which is formed of material having a hard surface adapted for contacting the cam lobe 30.

5. Problem and solution

Since the tappet known from GB-A-1 354 347 comprises an outer annular wall 90 which may be made from aluminium and may have a wear resistant surface (cf. page 3, lines 98 to 102 of the GB document), and since the valve operator body 42 and the backlash adjuster body 50 and plunger 60 are all made of high quality material (cf. page 2, lines 126 to 130), most of the problems indicated in columns 2 and 4 of the specification of the contested patent have already been solved by the prior art tappet. These are the problems (i) that the tappet has lower weight than an iron

or steel tappet and yet has similar durability and wear properties, (ii) that if the engine head is formed of aluminium, the tappet matches the surface wear and thermal expansion properties of the aluminium engine head in order to enable the tappet to be slidably compatible with the guide bore in the engine head and to maintain the proper running clearance between the tappet and the guide bore for necessary directional control and lubrication between the sliding surfaces without excessive oil flow at high temperatures, (iii) that the tappet will be capable of operating against a cam shaft formed of hardened iron base material (this requires that the cam face of the light weight tappet be compatible in hardness and wear properties with the hardened face of the cam lobe) and (iv) that tightly controlled leakdown surfaces between the piston and plunger of the lash adjusting unit are formed.

Hence, an objective assessment of what is actually achieved over the prior art as known from GB-A-1 354 347 requires the reformulation of the technical problem underlying the present patent. In view of the preceding statements, the technical problem can only be seen in the provision of a tappet whose weight is reduced in comparison with that of the prior art tappet. While reducing the weight, the remaining positive properties of the prior art tappet should, as pointed out by the Respondent, be maintained.

The problem indicated above is solved by the features specified in Claim 1 or 7, in particular by the features that the annular hub, the connecting means and the outer annular wall are integrally formed from a material having a certain coefficient of thermal expansion (according to Claims 3 and 7, this material is aluminium), that the connecting means comprises at least one radial web joining the ends of the outer annular wall and the annular hub

adjacent the cam face to leave one or more substantially circumferential spaces between the outer annular wall and the annular hub and that the cam face is provided by a separate member which is fixed about the periphery thereof to the outer annular wall and is supported against the at least one radial web.

6. Inventive step

6.1 The technical problem of reducing weight is a well known desideratum which arises naturally in relation to any known appliance. The recognition of such problem has in itself no surprising or non-obvious character and is independent of any other consideration which might have been relevant to the creation of the closest existing art itself. It is therefore irrelevant that the primary GB document was reducing the cost of the tappet vis-à-vis its own earlier state of the art. The fact that the subject-matter of the claim is a solution of a different problem from that prevailing at an earlier stage of development does not necessarily render the solution inventive, as suggested by the Respondent.

6.2 Faced with the problem to reduce the weight of the prior art tappet without impairing the remaining properties, a person skilled in the art, starting from an hydraulic lash adjusting tappet according to document GB-A-1 354 347, would immediately think of reducing its weight by choosing a light weight material, for example aluminium. No prejudice may have existed against the choice of aluminium as material for lash adjusting tappets of the type indicated in the preamble of Claims 1 and 7, since the GB document (cf. pages 3, lines 94 to 102) already teaches that aluminium may be used as material for the guide member 90 (which corresponds to the outer annular wall 42 of the contested patent), i.e. in a component which is

very much exposed to friction and wear. In view of this teaching and the common practice of using light weight material for weight reducing purposes, no inventive step can be seen in making parts other than the outer annular wall 90 of the prior art tappet, i.e. the valve operator body 42, from aluminium in order further to reduce the weight of the tappet, in particular since light weight tappets comprising structures which, except for a separate cam face member and the lash adjusting unit, are completely made from aluminium, are already known in the art (cf. DE-A-2 158 156, Figs. 1 and 2, page 3, lines 1 to 5 and Claim 7).

6.3 Once the person skilled in the art and faced with the problem mentioned above has decided to modify the prior art tappet by making the operator body 42, which houses the backlash adjuster body 50, from aluminium, he or she will think of an easy way of manufacturing the tappet body. One way would be to make the tappet body comprising the outer annular wall, the inner annular hub and the connecting means from different elements and connecting them by diffusion welding as known from DE-A-2 158 156. Another way would be to form the outer annular wall, the annular hub and the connecting means integrally. Such a way of manufacturing is known from US-A-3 877 446 (cf. in particular Fig. 2).

Both these ways of manufacturing the tappet body lie well within the realm of a person skilled in the art and do not appear to give rise to any surprising effect. They cannot therefore be considered as involving an inventive step. In particular, it is considered to be obvious to form certain adjacent components integrally when, as in the present case, all these elements are made of the same material.

An example of an integrally formed tappet body is disclosed in US-A-3 877 446. As depicted in Fig. 2, the tappet body comprises an outer annular wall 22 and an annular hub 23 being interconnected by radial webs 24 joining the ends of the outer annular wall and the annular hub adjacent the cam face to leave one or more substantially circumferential spaces between the outer wall and the hub in a similar way as the tappet body according to the patent in suit.

The Board is of the opinion that, in view of the prior art known from the US document, it is obvious to modify the prior art tappet as known from GB-A-1 354 347 by using such well-known construction which offers itself when the elements of the tappet body are to be integrally formed from the same material. Moreover, it is considered to be obvious to transfer the teaching of the US document to that of the GB document because the construction disclosed in the US document does not limit cam contact to a surface smaller in diameter than the cylinder head bore which is the case in the GB construction. The US construction rather permits a full size cam contacting face.

- 6.4 In any case the Board is of the opinion that to make adjacent parts a rigid whole, or conversely to provide a whole as connected parts, is normally not inventive, unless contributing something unexpected to the problem solving effect. In fact, there is no surprise involved to make the three aluminium pieces as a single component. It is decisive that the aim of reducing weight is no further advanced by the integral formation and the feature becomes thereby irrelevant for the consideration of the inventive step (cf. T 37/82, "Low-tension switch/SIEMENS", OJ EPO 1984, 71, point 3 of the Reasons and Headnote II).

6.5 In addition to reduce weight by using lighter metal, the skilled person may well consider the provision of empty spaces in the solid components as a further measure to contribute to the desired effect. It is commonly known in engineering that structures provided with appropriate cavities or holes are not only providing virtually identical mechanical properties but are also preferable since they "par excellence" reduce weight and costs. This well known possibility was utilised by the patentee when referring in the claim to "one or more circumferential spaces" which are left adjacent to the "at least one radial web" to connect the annular (outer) wall (42) and the (inner) annular hub parts of the integral component.

6.6 It is generally true that when basically the structure is to be retained, reduction of weight can only be achieved by replacing the material of construction with a lighter one (aluminium) or with empty "spaces" (air). From the point of view of the desired effect it is irrelevant where spaces are located, as long as they do not influence the mechanical properties of the component in an unacceptable manner. The provision of circular holes in particular only represents a typical manner of saving material. It follows that what is left over must remain connected, i.e. at least one or more webs are provided. Thus neither the presence of circumferential spaces nor the webs contribute to the reduction of weight anything which could be considered as inventive in itself.

6.7 It is also evident that a tappet body which is entirely made of aluminium is not capable of operating against an engine cam shaft formed of hardened iron base material. Therefore, it goes without saying that the cam face must be provided with a surface or a member adapted for contacting the cam lobe as before. Conversely, it can be stated that the hard surface 44 of the operator body 42

which touches the cam 30, cannot be replaced by aluminium and must remain in the combination as a surface of "high quality" material withstanding the reciprocal action of the cam (cf. GB-1 354 347, page 2, line 125 to page 3, line 2). Such use of a separate cam face member on tappet bodies made of aluminium or other material and its fixation about the periphery thereof to the outer annular wall form part of the common general knowledge (cf. DE-A-2 158 156, Figs. 1 and 2, reference numerals 17 and 17', and DE-B-1 914 693, Fig. 1, reference numeral 6) and are therefore considered to be also obvious in the circumstances.

6.8 The Respondent argues that such a separate cam face member would merely be put on top of the cam face of the tappet body known from US-A-3 877 446 and would then not be supported against the radial web as specified in Claim 1 or 7. However, the Board considers that this would not create any distinguishing feature between the claimed and the modified tappet. Indeed, the final feature of Claim 1 or 7 that the separate member is supported against the radial web has, in view of Fig. 3 of the contested patent and the fact that only web 78 and not web 44 is considered to be a radial web (see the reference numerals in Claim 1, column 12, line 13 of the specification), to be interpreted in a way that the separate member 48 can be supported against the radial web 78 via the transverse web 44.

6.9 It follows from the statements under points 6.1 to 6.8 that the modifications of the tappet known from GB-A-1 354 347 are based on common general knowledge including prior art known from the documents mentioned above. All measures suggested are either known to achieve reduction of weight or are completely irrelevant to such aim.



6.10 As to the Respondent's arguments that the invention had to be seen in the whole combination of features and that this combination was not obvious, the Board takes the following view.

Since, as shown above, each of the features of the characterising portions of Claims 1 and 7 is obvious, an invention can be seen in the combination of features only if there is a functional interrelationship between the features, i.e. if the features support each other in their effects to such an extent that a new and surprising technical result is achieved.

In the present case, however, the features function in their normal way and do not produce any non-obvious functional interrelationship. The overall weight reducing effect of the combined features is merely the sum of the effects of the single features. In fact, combination of these features has no unforeseeable overall effect extending beyond the sum total of the individual effects, cf. T 144/85 (dated 25 June 1987, unreported). The Respondent failed to provide explanations indicating a functional interrelationship or synergistic effect. Thus, the claims are directed merely to a juxtaposition of features and not to a true combination when the sole problem solving weight reducing effect is considered.

The Respondent's argument that it was surprising that the modifications of the tappet according to GB-A-1 354 347 were not made earlier is not convincing. The GB document and US-A-3 877 446 were published in 1974 and 1975, respectively. Thus, they were available to the public only about five years before the priority date (5 December 1979) of the contested patent, which period is considered to be normal for technical developments.

- 6.11 The subject-matter of Claims 1 and 7 is therefore lacking in inventive step.

Accordingly, the maintenance of the impugned patent as granted is not allowable under Art. 100(a) EPC.

7. The Respondent requested that in order to avoid by-passing of one level of jurisdiction, the case be remitted to the Opposition Division in the event that the Board intended to revoke the patent on the basis of the late-filed document US-A-3 877 446. This request is refused for the following reason.

According to Art. 111(1) EPC, the Board of Appeal may either exercise any power within the competence of the department which was responsible for the decision appealed or remit the case to that department for further prosecution. Thus, it is at the Board's discretion whether it examines and decides the case or remits the case to the first instance. This was also made clear in the Decision T 273/84, "Silicoaluminat/RHONE-POULENC", OJ EPO 1986, 346 cited by the Respondent (cf. Headnote: "...it may be appropriate to refer the matter back...").

In the present case, a decision of the Board to refer the case back to the first instance after giving an opportunity to argue the case on the basis of the most relevant state of the art and other facts, would clearly have prejudiced the first instance.

The Board considers that, since the US document was known to the Respondent before 1983 (the Respondent stated that it was cited in the corresponding US patent US-A-4 367 701), and at least from the Statement of Grounds since 1988, the Respondent must have been fully aware of its technical relevance and its close relationship to the

claimed subject-matter in the present case. The fact that the Rapporteur of the Board has indicated that "so far it (the Board) cannot see any reason for disagreeing with the final conclusion of the first instance..." (emphasis added), cannot mean that such preliminary view, or as a matter of fact any view expressed in a Communication, could be taken as final. There would have been hardly any reason to invite the parties to an oral hearing to argue their cases before the Board if this view had been uncontestable or irreversible. The preliminary view expressed in a Communication was reversed or otherwise changed on a great number of occasions by the Boards to the ultimate benefit of one party or of the other. The actual wording or manner of expression of the views in such Communication makes no difference and clearly all questions are open to further arguments since only the Decision is final and irreversible. In the present case the arguments and explanations discussed at the oral hearing which, as it is often the case, finally determined the outcome of the appeal. Parties must be aware of this and representatives should be prepared and ready to comment in detail on the evidence (documents) presented in the proceedings and even on new arguments, not excluded by the wording of Art. 114(2) EPC, relating to them.

**Order**

**For these reasons, it is decided that:**

1. The decision of the Opposition Division is set aside.

2. The patent is revoked.

The Registrar:



N. Maslin

The Chairman:

  
G. Szabo

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A.