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D E C I S I O N
of 26 November 2004

Case Number: T 0787/02 - 3.2.1

Application Number: 98115490.9

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IPC: F16H 57/04

Language of the proceedings: EN

Title of invention:
Mechanical transmission cooling and lubrication using associated engine systems

Applicant:
EATON CORPORATION

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 84

Keyword:
"Novelty (yes)"
"Inventive step (no)"
"Claims - clarity (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0787/02 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 26 November 2004

Appellant: EATON CORPORATION
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Ohio 44114-2584 (US)

Representative: Patentanwälte Rüger, Barthelt & Abel
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 8 February 2002 refusing European application No. 98115490.9 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: S. Crane
Members: J. Osborne
A. Pignatelli

Summary of Facts and Submissions

I. The appeal is directed against the decision posted 8 February 2002 to refuse European patent application No. 98 11 5490.9 (EP-A-0 900 954).

II. In the search report were cited *inter alia:*

D1: DE-C-906 303

D2: Patent Abstracts of Japan vol. 012, no. 475 (M-774), 13 December 1998 & JP-A-63 195469

D5: FR-A-905 290.

III. The Examining Division was of the opinion that the subject-matter of the independent claims 1, 6 and 10 lacked novelty.

IV. In a communication pursuant to Article 110(2) EPC the Board indicated its provisional opinion that the subject-matter of claim 10 was not novel with respect to the cited prior art and that although that of claims 1 and 6 was novel it did not involve an inventive step.

V. With a letter of 16 June 2004 the appellant filed an amended set of claims and:

D2': a translation into English of JP-A-63 195469.

VI. At oral proceedings held 26 November 2004 the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1

to 7 filed during the oral proceedings (main request) or alternatively on the basis of claims 1 to 4, 6 and 7 of the main request with the feature of claim 5 included in claim 1 (first auxiliary request), claims 1 to 5 according to the main request (second auxiliary request), claims 1 to 4 according to the first auxiliary request (third auxiliary request) or claims 6 and 7 according to the main request (fourth auxiliary request).

VII. Claims 1, 5 and 6 according to the main request read as follows:

"1. A cooling and lubrication system (10) for a mechanical change gear transmission (12) having a gear train (32) cooperating with at least one shaft (24) selectively connectable to an output shaft (20) of an internal combustion engine (14) by a coupling (16) disposed in a housing (26), the engine (14) including an engine cooling system for circulating coolant through an air-to-fluid heat exchanger (56) to cool a lubricating fluid (50) circulating through an engine lubrication system (40), the engine lubrication system (40) having a pump (42) for circulating lubricating fluid from an engine sump (44), a first engine port (48) in the sump for providing access to lubricating fluid (50) in the engine sump, and a second engine port (52) for providing access to pressurized lubricating fluid, the system comprising:
a transmission housing (28) defining a sump portion (36) for collecting a volume of lubricating fluid (34) sufficient to provide splash lubrication to at least a portion of the gear train (32) when rotating therein, the sump portion (36) having a first transmission port

(38) adapted for fluid coupling to the engine lubrication system (40), the housing (28) including a second transmission port (60) adapted for coupling to the engine lubrication system (40), the second transmission port (60) being positioned higher than the first engine port (48), the second transmission port (60) being positioned to control the volume of lubricating fluid in the sump portion (36) and facilitate return of lubricating fluid (34) from transmission sump portion (36) to the engine sump (44);
a first conduit (70) for providing pressurized lubrication fluid from the second engine port (52) to the transmission (12) via the first transmission port (38), the second engine port being positioned between the pump (42) and at least one engine component (46) lubricated by the pressurized lubricating fluid; and
a second conduit (72) for returning lubricating fluid from the transmission (12) via the second transmission port (60) to the engine sump (44) via the first engine port (48) to allow cooling of the lubricating fluid by the engine cooling system (54).

5. The system of claim 4 wherein the second transmission port (60) comprises the fill port.

6. A cooling and lubrication system (10') for a mechanical change gear transmission (12) having a gear train (32') cooperating with at least one shaft (24) selectively connectable to an output shaft (20) of an internal combustion engine (14) by a coupling (16) disposed in a housing (26), the engine (14) including an engine cooling system for circulating coolant through an air-to-fluid heat exchanger (56) to cool a lubricating fluid (50) circulating through an engine

lubrication system (40), the engine lubrication system (40) having a pump (42) for circulating lubricating fluid from an engine sump (44), a first engine port (48) in the sump for providing access to lubricating fluid (50) in the engine sump, and a second engine port (52') for providing access to pressurized lubricating fluid, the system comprising:

a transmission housing (28) defining a sump portion (36) for collecting a volume of lubricating fluid (34') and including first (38') and second (60') transmission ports adapted for fluid coupling to the engine lubrication system (40), the first transmission port (38') feeding a manifold being positioned above the geartrain (32) and the second port (60') which second port (60') also being positioned higher than the first engine port (48) to facilitate lubrication of the geartrain (32) and to utilize gravitational force in returning lubricating fluid to the engine (14);

a first conduit (70) for providing pressurized lubricating fluid from the second engine port (52') to the transmission (12) via the first transmission port (38'), the second engine port (52') being positioned between the pump (42) and at least one engine component (46) lubricated by the pressurized lubricating fluid;

a second conduit (72') for returning lubricating fluid from the transmission (12) via the second transmission port (60') to the engine sump (44) via the first engine port (48) to allow cooling of the lubricating fluid by the engine cooling system (54); and

the manifold (80) being disposed within the transmission (12) and connected to the first transmission port (38') to spray pressurized lubricating fluid on the geartrain (32') to provide lubrication and cooling thereof, wherein the level of

the lubrication fluid is controlled such that the geartrain (32') rotates above the lubricating fluid collected in the transmission sump."

VIII. The appellant's submissions in respect of novelty and inventive step may be summarised as follows:

The system disclosed in D1 does not employ splash lubrication and the subject-matter of claim 1 according to the main request is novel. Also in both D2/D2' and D5 the lubricating fluid is pressure fed to the transmission components.

There is considerable prior art dealing with the lubrication of heavy duty vehicle transmissions. Conventionally the transmission sump is placed at a higher level than the engine sump and in the case that the engine and transmission share a common lubricating fluid there is the risk that it will drain from the transmission if the engine is not run. This problem is particularly acute if the transmission employs splash lubrication as the level of lubricating fluid in the transmission sump is critical. There is no model example in the cited prior art of splash lubrication in a transmission which uses the same lubricating fluid as the engine. The subject-matter of claim 1 according to the main request therefore also involves an inventive step.

Each of D1, D2/D2' and D5 discloses pressurised feed of lubricating fluid directly to the transmission components. By comparison, according to claim 6 there is a manifold to spray the lubricating fluid; this

results in a more general application of the lubricating fluid.

It is explained in the description of the application that prior art arrangements in which the engine and transmission employed a common lubricating fluid required substantial modifications at the time of design and manufacture. An object of the present invention is to provide a system which does not require substantial modifications. According to the feature of claim 5 of the main request, which is incorporated into claim 1 of the first and third auxiliary requests, the fill port of the transmission serves for attachment of the conduit returning lubricating fluid to the engine such that no additional port in the transmission housing is necessary.

Reasons for the Decision

Main request

1. D1 relates to a combination of an internal combustion engine and a transmission and aims to ensure that lubricating fluid in the transmission as quickly as possible reaches and then maintains its correct working temperature. The engine and transmission have a common lubricating circuit, illustrated in figure 1. After being pumped from the engine sump the fluid in the circuit divides, some leaving the engine (through a "second engine port") and the remainder passing to the main lubrication gallery of the engine. The lubricating fluid which leaves the engine passes through a conduit leading to the transmission housing (to a "first

transmission port"), lubricates the gear train and then passes into the transmission sump. When fluid collecting in the transmission sump reaches a particular level a pump operates to return it (from a "second transmission port") through a conduit to the engine sump (through a "first engine port"). According to the description the fluid supplied to the transmission is fed directly to those places where lubrication is most important.

2. It is stated in D1 that the illustration in figure 1 is schematic and this is clearly the case in respect of the representation of the outlines of the engine and particularly the transmission gearbox and differential, the latter two of which are shown merely as having rectangular forms. The illustrated relative vertical position of the engine and transmission housings is based on a centre line apparently representative of the engine crankshaft. However, the description is silent regarding any particular spatial relationship between the first engine port and the second transmission port. Moreover, there is no functional requirement for the presently claimed arrangement to be present in D1. Return flow of lubricating fluid to the engine is controlled by pumps. Even if gravity were to play a role in the transfer it would not be influenced by the relative heights of the outlet ports from the transmission housings and the inlet port to the engine; flow under gravity would be dependent on a difference in heights of the respective free surfaces of the fluid in each component, which are not shown. The illustrated arrangement of the various ports therefore appears to be no more than a convenient representation devoid of technical teaching.

2.1 The Board concludes from the foregoing that the subject-matter of claim 1 is novel (Article 54 EPC) and differs from that of D1 by the features that:

- the transmission housing defines a sump portion for collecting a volume of lubricating fluid sufficient to provide splash lubrication to at least a portion of the gear train when rotating therein; and

- the second transmission port is positioned:

  - higher than the first engine port, to facilitate return of lubricating fluid from the transmission sump portion to the engine sump; and

  - to control the volume of lubricating fluid in the sump portion.

2.2 The differentiating features relating to the splash lubrication and volume of lubricating fluid in the sump portion have the effect of providing an alternative to the system of D1 in respect of the method of lubricating the gears in the transmission. Those features relating to relative heights of the ports have the effect of providing an alternative to the system of D1 in respect of the method of returning fluid to the engine sump. These effects are mutually independent and consideration of inventive step of the respective differentiating features is therefore to be made separately.

2.3 As acknowledged in the description of the present application splash lubrication is well known *per se*. Whilst the skilled person would recognise that forced lubrication is generally superior to splash lubrication, he would also be aware that the choice of which method to use is dependent on particular factors related to the specific application. Although D1 discloses direct lubrication of the gears it is silent in respect of all details of the gear train itself and it would fall within the normal activity of the skilled person to select the most appropriate method of lubrication. D1 already discloses that the sump portion of the transmission holds a reservoir of lubricating fluid having a controlled level, which with appropriate selection of the level would appear suitable for use in splash lubrication. In the Board's view the skilled person would choose to provide splash lubrication in addition to or instead of the direct lubrication if this were appropriate to the chosen transmission gear arrangement.

2.3.1 The appellant argues that the skilled person would be aware that when a transmission and engine have a common lubrication system there is a problem of fluid draining from the transmission, that he would realise that this problem would assume greater importance when employing splash lubrication of the transmission and so would not consider the presently claimed solution. However, the appellant has provided no evidence to support this alleged technical prejudice. Although all three cited prior art documents which relate to combined lubrication systems for the engine and transmission (D1, D2/D2', D5) do employ forced lubrication for the latter, none states that it is the combined lubrication system

of the engine and transmission which is determinative for so doing. Moreover, the application itself is silent in respect of the alleged technical prejudice and any advantage achievable by overcoming it. Indeed, the only references to the matter of choice between splash and forced lubrication relate to the improved efficiency achievable by not using splash lubrication.

2.4 D1 discloses a pump for returning fluid from the transmission to the engine sump when the fluid reaches a certain level in the sump portion of the transmission. According to the appellant, however, it is normally the case that the sump portion of the transmission is above the sump of the engine, permitting the use of the elementary principle of gravitational feed to return the oil to the engine sump in place of the pump. Such an arrangement has already been proposed in D2/D2' which also relates to an engine and transmission employing a common lubrication system and providing a pool of lubricating fluid in the base of the transmission sump portion. In the light of that teaching it would not require inventive activity on the part of the skilled person to adopt the same system in D1. It is not relevant here that D2/D2', despite providing a pool of lubricating fluid in the base of the transmission sump portion, proposes avoiding splash lubrication. Its reason for doing so is the generally known lower efficiency of splash lubrication and is not related to the matter of returning fluid to the engine sump.

2.5 In view of the foregoing the Board considers that the subject-matter of claim 1 does not involve an inventive step (Article 56 EPC) and the main request fails.

First auxiliary request

3. The subject-matter of claim 1 according to this request contains the additional feature that "the second transmission port comprises the fill port".

According to the application this feature arises from a desire to avoid the need for substantial modifications at the time of design and manufacture of components when integrating the previously separate lubrication systems of an engine and transmission. It is stated that this would be possible by using the fill and drain ports of the transmission as the first and second ports to which the respective conduits are connected. It is from this context of the transmission having its own lubrication system that the term "fill port" derives. However, there is no feature in the system as presently claimed which restricts it to employing such a modified transmission and the term "fill port" has no clear meaning. Moreover, in the present system the function of the second transmission port is to allow fluid to return to the engine i.e. the opposite function to that of a fill port. As a result, the claim lacks clarity in defining the subject-matter (Article 84 EPC) and the first auxiliary request fails.

Second auxiliary request

4. Claim 1 of this request is identical to that of the main request. This request therefore fails for the same reasons as set out above.

Third auxiliary request

5. Claim 1 of this request is identical to that of the first auxiliary request. This request therefore fails for the same reasons as set out above.

Fourth auxiliary request

6. The independent claim of this request corresponds to claim 6 of the main request. The subject-matter essentially differs from that of claim 1 of the main request only by the feature that instead of there being a volume of fluid sufficient to provide splash lubrication:

– the first transmission port feeds a manifold being disposed within the transmission above the gear train to spray pressurized lubricating fluid on the gear train to provide lubrication and cooling thereof, wherein the level of the lubricating fluid is controlled such that the gear train rotates above the lubricating fluid collected in the transmission sump.

6.1 As already explained above, although D1 discloses leading the lubricating fluid directly to the gears, the choice of lubrication would in fact be dependent on the details of the gear train, about which D1 is silent. A spray manifold is well known in the art, as accepted by the appellant, and its use would fall within the normal activity of the skilled person. Indeed, D5 shows such an arrangement in a transmission having a lubrication system common with that of the engine.

6.2 The Board therefore takes the view that also the subject-matter of this claim does not involve an inventive step (Article 56 EPC) and the fourth auxiliary request also fails.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner S. Crane