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**Datasheet for the decision
of 5 March 2018**

Case Number: T 0293/15 - 3.2.08

Application Number: 08709759.8

Publication Number: 2126412

IPC: F16H37/08

Language of the proceedings: EN

Title of invention:

DUAL CLUTCH TRANSMISSION WITH MULTIPLE RANGE GEARING

Patent Proprietor:

Eaton Corporation

Opponent:

ZF Friedrichshafen AG

Headword:

Relevant legal provisions:

EPC Art. 123(2), 83, 84, 54, 56

EPC R. 43(1)

RPBA Art. 13(1)

Keyword:

Amendments - allowable (yes)

Sufficiency of disclosure - (yes)

Claims - clarity (yes)

Novelty - (yes)

Inventive step - (yes)

Late-filed document - procedural economy

Decisions cited:

Catchword:



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Case Number: T 0293/15 - 3.2.08

D E C I S I O N
of Technical Board of Appeal 3.2.08
of 5 March 2018

Appellant: ZF Friedrichshafen AG
(Opponent) 88038 Friedrichshafen (DE)

Respondent: Eaton Corporation
(Patent Proprietor) Eaton Center,
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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted on
23 December 2014 concerning maintenance of the
European Patent No. 2126412 in amended form.

Composition of the Board:

Chairman M. Alvazzi Delfrate
Members: M. Foulger
Y. Podbielski

Summary of Facts and Submissions

- I. With the decision posted on 23 December 2014, the opposition division decided that taking into account of the amendments made by the patent proprietor according to the main request valid at the time, the European patent No. 2 126 412 and the invention to which it relates met the requirements of the EPC.
- II. The appellant (opponent) filed an appeal against this decision. The appeal was filed in due form and within the given time limits.
- III. Oral proceedings took place before the Board on 5 March 2018. For further details reference is made to the minutes. During the oral proceedings the respondent (patent proprietor) filed a new main request and two auxiliary requests, one of which was subsequently withdrawn. In the present decision, references to the auxiliary request are to the one filed at 15:30.
- IV. The appellant requested that the decision under appeal be set aside and the patent be revoked.

The respondent requested that the decision under appeal be set aside and the patent maintained in amended form according to the main request, or in the alternative according to the auxiliary request, both filed during the oral proceedings.

- V. Claim 1 of the main request reads:

"**(1.0)** A power transmission mechanism for an engine-powered vehicle comprising **(1.1)** a multiple ratio gear system (10) and **(1.2)** ratio range gearing (12) **(1.3)** with at least two ranges including **(1.4)** a high

range and a low range, **(1.5)** the multiple ratio gear system having first and second torque input shafts (14, 16);

(1.6) a dual clutch assembly (Fig. 2) with dual clutches for alternately connecting a vehicle engine selectively to the first and second torque input shafts (14, 16);

(1.7) ratio change clutches (92, 104) in the gear system selectively connecting and disconnecting elements of the gear system **(1.8)** whereby a torque flow path for the gear system is defined for each ratio as a torque flow path in an adjacent gear ratio in a ratio change sequence is preselected;

(1.9) the ratio range gearing (12) having range gearing elements with first range clutch elements (76)

(1.10) that are engageable and disengageable to establish and disestablish each speed range;

(1.11) and the range gearing (12) including a second range clutch (84) having first clutch elements (65, 82)

(1.12) for connecting together separate elements of the multiple ratio gear system (10) as one torque flow path is established and as another torque flow path is preselected without interruption of torque delivery through the range gearing (12), characterized by

(1.13) the ratio range gearing (12) being a planetary gear system;

(1.14) the first range clutch elements (76) selectively connecting one gear element of the planetary gear system to a stationary member (74) of the power transmission mechanism (10) and to a second gear element (68) of the planetary gear system whereby

(1.15) a transition is made between the speed ranges as the dual clutches are engaged and disengaged respectively;

(1.16) wherein the dual clutches of the dual clutch

assembly between the first and second torque input shafts (14,16) and the vehicle engine are selectively engageable and disengageable so that each gear ratio in the overall speed ratio range can be preselected as power is transferred through the powertrain with an adjacent gear ratio for all power shifts in the low speed range, the high speed range and during transitions between the speed ranges."

(Feature numbering in bold added by the Board.)

Claim 1 of the auxiliary request corresponds to that of the main request except that feature 1.16 has been placed after feature 1.12 in the preamble.

VI. The following documents are referred to in this decision:

D1: DE 40 00 832 C1
D7: EP 0 061 845 A2
D8: GB 2412148 A
D10: DE 40 00 833 A1

VII. The appellant argued essentially the following:

a) Admission of D10 into the proceedings

D10 was similar in content to D1. The problem to be solved by this document was however more relevant for the question of inventive step. D10 should therefore be admitted into the proceedings.

b) Articles 123(2), 83 and 84 EPC

The feature whereby the dual clutches of the dual clutch assembly were between the first and second

torque input shafts and the vehicle engine (part of feature 1.16) was unclear, not originally disclosed and, moreover, could not be carried out by the skilled person. Fig. 2 of the application as filed and the patent showed the clutch discs mounted on, and radially to the exterior of, the torque input shafts. Therefore they were not originally disclosed as being between the torque input shafts and the engine. Moreover, the skilled person could not build such an arrangement and the feature was unclear. Thus the requirements of Articles 83, 84 and 123(2) EPC were not met.

c) Novelty

D1 disclosed a transmission according to the preamble of claim 1, in particular a dual clutch assembly with dual clutches K2 and K4 (feature 1.6) was disclosed. Moreover, D1 disclosed that the ratio range gearing was a planetary gear system (see fig. 1) and that the first range clutch elements selectively connected one gear element of the planetary gear system to a stationary member (33) of the power transmission mechanism and to a second gear element (23) of the planetary gear system whereby a transition is made between the speed ranges as the dual clutches (K2 and K4) are engaged and disengaged respectively. Hence features 1.13, 1.14, 1.15 were also known from D1.

The dual clutches were selectively engageable and disengageable such that power shifts could be performed between adjacent ratios and during transitions between the speed ranges. Thus feature 1.16 was also known from D1 and consequently the subject-matter of claim 1 was not new.

d) Inventive step

i) D8 as closest prior art

D8 disclosed the features of the preamble of claim 1 and, additionally, feature 1.16.

The problem to be solved was to provide a more compact transmission.

The skilled person would immediately recognise that the planetary gear system of D1 provided a more compact arrangement. They would therefore apply this teaching to the transmission of D8 and thereby arrive at the subject-matter of claim 1 without an inventive step being involved.

ii) D1 as closest prior art

Starting from D1 the skilled person would try to provide a simplified transmission. This was possible by leaving out clutches K1 and K3 resulting in a much simpler transmission. The skilled person would therefore have arrived at the subject-matter of claim 1 without an inventive step being involved.

iii) D7 as closest prior art

D7 disclosed a dual clutch transmission but however did not disclose a ratio range gearing.

The subject-matter of claim 1 differed from the transmission of D7 by the features 1.2 - 1.4 and 1.9 - 1.16.

The problem to be solved was to increase the number of available gears.

D1 demonstrated how to solve this problem by adding a planetary ratio range gearing.

The skilled person would therefore apply this teaching from D1 to the transmission known from D7 in order to solve the above problem and would thereby arrive at the subject-matter of claim 1 without the exercise of inventive skill.

c) Two-part form

If D8 was regarded as closest prior art then feature 1.16 should be placed in the preamble as this feature was known from D8 in combination with the features of the preamble. Thus, the requirements of Rule 43(1) EPC were not met.

d) Auxiliary request

There were no further objections against the auxiliary request.

VIII. The respondent argued essentially the following:

a) Admission of D10 into the proceedings

D10 was presented very late in the proceedings - at the actual oral proceedings. It did not appear to add anything that was not already in D1 and therefore should not be admitted into the proceedings.

b) Articles 123(2), 83 and 84 EPC

The clutches were to be regarded as being functionally between the engine and the torque input shafts. This

interpretation was shown in Fig. 2 of the application as filed. Thus the requirements of Articles 83, 84 and 123(2) EPC were met.

c) Novelty

D1 did not disclose features 1.6, 1.15 and 1.16 of claim 1. In particular D1 did not disclose a dual clutch transmission, nor did it disclose a transition between the speed ranges as the dual clutches were engaged and disengaged respectively. D1 also did not disclose that each gear ratio could be preselected with an adjacent gear ratio for all power shifts because if the dual clutches were considered to be K2 and K4 then these only allowed shifting between the even numbered gears.

The subject-matter of claim 1 was thus new.

d) Inventive step

i) D8 as closest prior art

D8 disclosed the preamble of claim 1. It was not possible to simply replace the range gearing of D8 with the planetary range gearing of D1 because doing so would require further modifications to the gearbox in order to enable the power shifting between ranges as required by the claim.

ii) D1 as closest prior art

To modify D1 to arrive at the subject-matter of claim 1 would require extensive modification of the transmission of D1. Moreover, D1 related to a transmission with 16 forward gears such as is used for

heavy goods vehicles. Modifying this transmission to provide fewer gears would go against this teaching as it would mean that the resulting transmission would not be suitable for the same purpose. Hence, D1 could not be regarded as the closest prior art.

iii) D7 as closest prior art

D7 did not disclose a range gearing. It was not possible to simply add the planetary range gearing known from D1 to the gearbox of D7 because doing so would require further modifications to the gearbox in order to enable the power shifting between ranges as required by the claim.

The subject-matter of claim 1 therefore involved an inventive step when considering either D1, D7 or D8 as closest prior art.

c) Two-part form

The two-part form of claim 1 was correct.

d) Auxiliary request

Claim 1 had been amended to take account of the objection under Rule 43(1) EPC and consequently met the requirements of the EPC.

Reasons for the Decision

1. Admission of D10 into the proceedings

The appellant requested at the oral proceedings before the Board that D10 be admitted into the proceedings. D10 was very similar in content to D1 and thus could be readily understood by the Board and the respondent.

The Board did not however admit D10, which was indeed filed at an extremely late stage of the proceedings, into the proceedings because it did not add any new matter over D1 relevant to the claims on file. Its admission would only prolong the oral proceedings without affecting their outcome and would therefore run counter to the principle of procedural economy (Article 13(1) RPBA).

2. Main request - Articles 123(2), 83 and 84 EPC

2.1 Claim 1 of the main request has been amended by the introduction of feature 1.16. This feature was not present in the claims as granted. Clarity is therefore to be examined.

The person skilled in the art would understand feature 1.16 to mean that the dual clutches are not geometrically but rather functionally between the engine and the first and second torque input shafts. The dual clutch assembly is defined in feature 1.6 as being "for alternately connecting a vehicle engine...". Thus the dual clutches are defined in a functional and not a geometric manner and consequently the person skilled in the art would also interpret feature 1.16 in

this manner. The part-feature of feature 1.16, whereby the dual clutches of the dual clutch assembly are between the first and second torque input shafts and the vehicle engine, is thus clear (Article 84 EPC).

2.2 With this interpretation the claimed invention is also sufficiently disclosed as Fig. 2 demonstrates how this feature can be carried out (Article 83 EPC).

2.3 Feature 1.16 is also disclosed in the application as originally filed. The arrangement in Fig. 2 is in accordance with said feature as interpreted above. Moreover, feature 1.16 is also disclosed on p. 4, 3rd paragraph where it is clear for the person skilled in the art that the torque input "elements" represent the torque input shafts (Article 123(2) EPC).

3. Main request - Novelty

3.1 D1 discloses:

(1.0) A power transmission mechanism ("Mehrwege-Gangwechselgetriebe") for an engine-powered vehicle comprising

(1.1) a multiple ratio gear system (see Figs. 1 & 2) and **(1.2)** ratio range gearing (29) **(1.3)** with at least two ranges including **(1.4)** a high range and a low range, **(1.5)** the multiple ratio gear system having first and second torque input shafts (4,42);

(1.6) a clutch assembly (16) with dual clutches (K2,K4) for alternately connecting a vehicle engine selectively to the first and second torque input shafts;

(1.7) ratio change clutches (S4,S2 etc.) in the gear system selectively connecting and disconnecting elements of the gear system (see Fig. 1)

(1.8) whereby a torque flow path for the gear system is

defined for each ratio as a torque flow path in an adjacent gear ratio in a ratio change sequence is preselected;

(1.9) the ratio range gearing (29) having range gearing elements (21,32,23) with first range clutch elements (KN)

(1.10) that are engageable and disengageable to establish and disestablish each speed range;

(1.11) and the range gearing including a second range clutch (BN) having first clutch elements

(1.12) for connecting together separate elements of the multiple ratio gear system as one torque flow path is established and as another torque flow path is preselected without interruption of torque delivery through the range gearing,

whereby

(1.13) the ratio range gearing being a planetary gear system (see Fig. 1);

(1.14) the first range clutch elements selectively connecting one gear element of the planetary gear system to a stationary member (33) of the power transmission mechanism and to a second gear element (23) of the planetary gear system whereby

(1.15) a transition is made between the speed ranges as the dual clutches are engaged and disengaged respectively (see below).

3.2 Feature 1.6 requires a clutch assembly having dual clutches for alternately connecting a vehicle engine selectively to the first and second torque input shafts. The clutch unit 16 shown in Fig. 1 of D1 is able to connect the vehicle engine (shaft 3) via clutches K2 and K4 to the input shafts 4 and 42 respectively. Moreover, the clutch assembly of D1 is suitable for connecting the engine alternately and selectively because in the arrangement of D1 it is not

possible to engage both clutches together. Thus they must be engaged alternately. Furthermore, they must be selected and thus engaged selectively. Therefore feature 1.6 is known from D1.

3.3 Regarding feature 1.15, this feature requires that a transition is made between the speed ranges as the dual clutches are engaged and disengaged respectively. This requirement is met in the transmission of D1 as shown in Fig. 2 of D1 which shows how the transmission may be shifted from gear ratio 8 to gear ratio 10 by actuating clutches K2 and K4.

3.4 Feature 1.16 requires that the dual clutches be selectively engageable and disengageable so that each gear ratio in the overall speed ratio range can be preselected as power is transferred through the powertrain with an adjacent gear ratio for all power shifts. The person skilled in the art would understand this as meaning that the dual clutches allow the shift to an adjacent gear ratio for each gear ratio in the overall speed range.

In the above, the dual clutches are identified as being K2 and K4. However, clutches K2 and K4 are only responsible for shifting between even numbered gear ratios, see Fig. 2. The clutches K1 and K3 are then responsible for shifting between the odd numbered gear ratios. Therefore, the clutches K2 and K4 do not allow all power shifts with each gear ratio in the overall speed ratio range. Thus the requirement of feature 1.16 that each gear ratio in the overall speed ratio range can be preselected ... with an adjacent gear ratio for all power shifts is not fulfilled. Hence, D1 does not disclose feature 1.16.

3.5 The subject-matter of claim 1 is therefore new (Article 54(2) EPC).

4. Main request - Inventive step

4.1 D8 as closest prior art:

The Board considers D8 to be the closest prior art because it discloses a transmission which is closest in structure and purpose to that claimed.

It is common ground that D8 discloses the preamble of claim 1, as follows:

(1.0) A power transmission mechanism for an engine-powered vehicle comprising **(1.1)** a multiple ratio gear system (Fig. 1) and **(1.2)** ratio range gearing (p. 3, l. 9-11) **(1.3)** with at least two ranges including **(1.4)** a high range and a low range, **(1.5)** the multiple ratio gear system having first and second torque input shafts (16, 20);

(1.6) a dual clutch assembly (14, 18) with dual clutches for alternately connecting a vehicle engine selectively to the first and second torque input shafts;

(1.7) ratio change clutches (60, 62, 64 etc.) in the gear system selectively connecting and disconnecting elements of the gear system **(1.8)** whereby a torque flow path for the gear system is defined for each ratio as a torque flow path in an adjacent gear ratio in a ratio change sequence is preselected;

(1.9) the ratio range gearing having range gearing elements with first range clutch elements (66)

(1.10) that are engageable and disengageable to establish and disestablish each speed range;

(1.11) and the range gearing including a second range

clutch (66 - see Fig. 1) having first clutch elements **(1.12)** for connecting together separate elements of the multiple ratio gear system as one torque flow path is established and as another torque flow path is preselected without interruption of torque delivery through the range gearing (Fig. 1).

Moreover, D8 discloses feature 1.16, in particular from p. 10, 1.15 to p. 13, 1.22, D8 describes how each power shift from each gear ratio to the adjacent gear ratio is accomplished and this for all shifts in the low speed and high speed ranges as well the transition between the ranges.

The subject-matter of claim 1 differs from this known power transmission mechanism in that

(1.13) the ratio range gearing is a planetary gear system;

(1.14) the first range clutch elements selectively connecting one gear element of the planetary gear system to a stationary member of the power transmission mechanism and to a second gear element of the planetary gear system whereby **(1.15)** a transition is made between the speed ranges as the dual clutches are engaged and disengaged respectively.

The problem to be solved is to provide a more compact transmission.

D1 discloses a multiple path gearbox wherein the ratio range gearing is a planetary gear system. It is correct that the skilled person would recognise that planetary gearing allows a more compact arrangement than with pinion gears.

However in trying to use the planetary ratio range

gearing of D1 instead of the spur gear ratio range gearing of D8 the person skilled in the art would be faced with a further problem. Simply adding the ratio range gearing of D1 onto either the shaft (16), the gear (32) or the counter-shaft (38) of D8 would not allow a power shift between ranges as required by the claim feature 1.16. As argued by the appellant, it would be possible to overcome this with further design modifications. However, such modifications are not suggested by any of the prior documents in the proceedings and would effectively require the design of a new gearbox. They can not therefore be regarded as the routine activities of the person skilled in the art.

Consequently, the subject-matter of claim 1 involves an inventive step.

4.2 D1 as closest prior art:

4.2.1 D1 discloses a transmission with the features identified above.

4.2.2 The problem to be solved as proposed by the appellant is to provide a simpler transmission.

4.2.3 The appellant argued that the person skilled in the art would solve this problem by removing the clutches K1 and K3. In doing so however, the result would be a transmission with fewer gear ratios.

4.2.4 A transmission with fewer ratios would have a different functionality and purpose to the transmission disclosed in D1. This then poses the question why the person skilled in the art would wish to do this starting from D1 whose purpose is to provide a large number of gear

ratios. If a reduced number of gear ratios were required then the person skilled in the art would have rather chosen one of the available simpler transmissions, e.g. as disclosed in D7 or D8.

4.2.5 Hence, the subject-matter of claim 1 involves an inventive step with regard to this document.

4.3 D7 as closest prior art:

4.3.1 It is not disputed that D7 discloses a dual clutch transmission and that D7 does not disclose a ratio range gearing.

4.3.2 D7 discloses:

(1.0) A power transmission mechanism for an engine-powered vehicle comprising **(1.1)** a multiple ratio gear system

(1.5) the multiple ratio gear system having first and second torque input shafts (14, 15);

(1.6) a clutch assembly (Fig. 2) with dual clutches for alternately connecting a vehicle engine selectively to the first and second torque input shafts (14, 15);

4.3.3 The subject-matter of claim 1 differs from the power transmission mechanism of D7 in that:

(1.2) ratio range gearing **(1.3)** with at least two ranges including **(1.4)** a high range and a low range, **(1.7)** ratio change clutches in the gear system selectively connecting and disconnecting elements of the gear system **(1.8)** whereby a torque flow path for the gear system is defined for each ratio as a torque flow path in an adjacent gear ratio in a ratio change sequence is preselected;

(1.9) the ratio range gearing having range gearing elements with first range clutch elements **(1.10)** that are engageable and disengageable to establish and disestablish each speed range;

(1.11) and the range gearing including a second range clutch having first clutch elements **(1.12)** for connecting together separate elements of the multiple ratio gear system as one torque flow path is established and as another torque flow path is preselected without interruption of torque delivery through the range gearing,

(1.13) the ratio range gearing being a planetary gear system;

(1.14) the first range clutch elements selectively connecting one gear element of the planetary gear system to a stationary member of the power transmission mechanism and to a second gear element of the planetary gear system whereby

(1.15) a transition is made between the speed ranges as the dual clutches are engaged and disengaged respectively,

(1.16) wherein the dual clutches of the dual clutch assembly between the first and second torque input shafts and the vehicle engine are selectively engageable and disengageable so that each gear ratio in the overall speed ratio range can be preselected as power is transferred through the powertrain with an adjacent gear ratio for all power shifts in the low speed range, the high speed range and during transitions between the speed ranges.

4.3.4 In D7 the highest ratio is provided by gear set B in the example of Fig. 1 and by gear set G in the example of Fig. 3. Thus as discussed above with respect to D8, the addition of the ratio range gearing of D1 to the transmission of D7 would require further modifications

to the transmission of D7. These modifications are not disclosed in any of the prior art documents cited and would effectively require the skilled person to undertake a redesign of the transmission in order to arrive at the subject-matter of claim 1. Such modifications would not have been obvious for the skilled person and consequently the subject-matter of claim 1 involves an inventive step.

5. Main request - two-part form

As may be seen from the feature analysis above, feature 1.16 is known from D8 in combination with the features of the preamble of claim 1. Claim 1 of the main request does not therefore comply with Rule 43(1) EPC.

6. Auxiliary request

The only modification of claim 1 according to the auxiliary request compared with that of the main request is that feature 1.16 has been placed in the preamble. Therefore, claim 1 of the auxiliary request is new and involves an inventive step and complies with the requirements of Articles 83, 84 and 123(2) EPC for the reasons given above for the main request.

As discussed above, the Board considers D8 to be the closest prior art and in claim 1 of the auxiliary request, the features which are known from D8 are correctly placed in the preamble. The auxiliary request therefore complies with Rule 43(1) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent as amended in the following version:

Claims 1-9 according to the auxiliary request filed during the oral proceedings before the Board on 5 March 2018

Description: columns 1-14 of the patent specification

Figures 1, 1a, 2-17 of the patent specification.

The Registrar:

The Chairman:



C. Moser

M. Alvazzi Delfrate

Decision electronically authenticated