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Anmeldenummer / Filing No / N° de la demande : 80 850 143.1

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Bezeichnung der Erfindung: A transducer for electrohydraulic or electro-
Title of invention: pneumatic signal conversion
Titre de l'invention :

Klassifikation / Classification / Classement : F15B 5/00

ENTSCHEIDUNG / DECISION

vom / of / du 5 July 1988

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Zettergren, Ted

Einsprechender / Opponent / Opposant :

WABCO Westinghouse Fahrzeugbremsen GmbH

Stichwort / Headword / Référence : Transducer/Zettergren

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé : "Inventive step (yes)"

Leitsatz / Headnote / Sommaire

Summary of Facts and Submissions

- I. European patent No. 0 027 437 was granted on 2 November 1983 with six claims on the basis of European patent application No. 80 850 143.1.
- II. The patent was opposed in due time and form on 19 July 1984. The Opponent requested revocation of the patent on the grounds that its subject-matter does not involve an inventive step having regard to the state of the art as reflected in the company publication "Beschreibung der Druckluftgeräte in Fahrzeugen". Ausgabe April 1978, WABCO Fahrzeugbremsen GmbH, Seite 83 (Relais ventil 973 001).

In a response received 12 October 1985, the Patentee contested the arguments of the Opponent and filed new Claims 1 to 6 (Claims 2 to 6 corresponding to the granted Claims 2 to 6) and an amendment to the description in column 1 of the patent, requesting that the patent be maintained in this amended form.

Claim 1 reads as follows:

"A transducer for electrohydraulic or electropneumatic signal conversion, comprising a housing (2), a piston (4) movable in a cylinder bore (6) of said housing (2), a tappet (3) reciprocable by means of electromagnet relative to the piston (4), a channel (P) for the supply of pressure medium, a control channel (C) for outflow and inflow of control pressure medium and a channel (T) for draining the converter, said tappet (3) acting on piston (4) which controls the pressure in control channel (C), characterised in that the piston (4) is tubular and includes an axial channel (12) extending through the piston, above and beneath which a respective cavity (7, 8) is located, where

in the upper cavity (8) said tappet (3) is located and into which said drainage channel (T) opens, and into said lower cavity (7), the control channel (C) opens, that the pressure channel (P) opens into an annular space (9) located between the piston (4) and the cylinder bore wall, which space extends downwards to the lower end of the piston (4) where the lower end of the piston has a widened portion (10), preferably conically shaped, so that the widened portion (10) and the shoulder between the lower cavity (7) and the cylinder bore (6) form a first seat valve (S1) between said annular space (9) and said lower cavity (7), which seat valve (S1) is closed when the piston is in its uppermost position, that the upper end (11) of the inner channel (12) of the piston together with the free end of the tappet (3) form a second seat valve (S2), and that a weak return spring (5) is provided to press the piston (4) against its uppermost position."

- III. The Opposition Division rejected the opposition in a decision notified 28 May 1986, maintaining the patent in the requested amended form. According to the decision the subject-matter of the main claim was novel. The cited publication showing the known relay valve does not disclose any suggestion to connect the upper and lower cavities to the drainage and control channel respectively, to locate the widened portion of the piston at the lower end thereof, and to arrange the annular space between the piston and the cylinder bore wall. Therefore, there was no suggestion to modify a transducer of the type defined in the preamble of Claim 1 in the manner as claimed in the characterising portion. Since even a combined consideration of the Opponent's citation with the other documents cited in the pre-grant proceedings does not lead to any other conclusion, the transducer according to Claim 1 involves an inventive step.

- IV. The Opponent appealed against this decision on 5 June 1986, at the same time paying the appropriate fee. In his Statement of grounds, filed 3 July 1986, the Appellant (Opponent) relies on the same publication cited in the opposition proceedings, arguing that in their decision the Opposition Division have not considered carefully the details of the characterising features of the claim which are either known from the cited publication or form merely constructive measures known to the man skilled in the art.
- V. In his response received 11 November 1986, the Respondent (Patentee) contests the arguments advanced by the Appellant, relying mainly on his submissions filed in the opposition proceedings since he maintains that the Appellant has merely repeated his arguments.
- VI. In response to a communication from the Board (dated 12 January 1988) setting out its provisional opinion that the subject-matter of Claim 1 appeared to include an inventive step, the Appellant replied on the 4 February 1988 maintaining his previous arguments and contesting the Board's interpretation of how the prior art relay valve works.
- VII. The Appellant requests that the decision under appeal be set aside and the patent be revoked. The Respondent requests that the appeal be dismissed and the patent be maintained as amended.

Reasons for the Decision

1. The appeal is admissible.
2. No formal objections arise in respect of the amended Claim 1. The claim has been amended to clarify that the

first valve seat is positioned between the annular space and the lower cavity, as clearly shown for example, in the original Figure 1. No objection therefore arises under Articles 123(2) or (3). Similarly, the amendments to the description take account of the scope of the claim in its present form and of the prior art relay valve. No objection arises here either in respect of Article 123(2).

3. After considering all the revealed prior art, the Board has arrived at the opinion that the subject-matter of the claim is novel. As this is not contested by the Appellant, it is not necessary to substantiate this here in any detail.
4. The examination of whether the subject-matter of Claim 1 involves an inventive step reveals the following considerations:
 - 4.1 The invention relates to a transducer for electrohydraulic or electropneumatic signal conversion as set out in the preamble of Claim 1.
 - 4.2 Such transducers (or converters) are stated in the patent

"to show the disadvantage of being not suited for pulse voltage feed in connection with proportional control.

The use of pulsed voltage has the advantages of reducing occurring hysteresis effects in the converter as well as in the selector valve or corresponding device controlled by the converter. The hysteresis effect is due primarily to inner friction, springs and different areas, against which the pressure medium in the converter acts.

The disadvantages of known converters are a.o. continuous oil consumption, sensitivity to dirt, slow pressure build up, slow drainage, overlap between inlet and outlet for the

pressure medium in the converter, and the requirements of a proportional magnet".

This has not been contested by the Appellant.

- 4.3 The problem to be solved by the transducer according to the present invention is therefore to eliminate the aforesaid disadvantages. In addition to being suitable to be used for operation according to two different principles at pulsed feed, the transducer can be used also for direct voltage control with a proportional magnet.
- 4.4 This problem is solved according to the patent by the features as set out in the characterising part of Claim 1.
- 4.5 The publication referred to by the Appellant discloses a relay valve, comprising a housing, a piston movable in (a cylinder bore of) said housing, means (3) (a piston actuated by air pressure) reciprocable relative to the piston, a channel (V) for the supply of pressure medium, a control channel (Z) for outflow and inflow of control pressure medium and a channel (E) for draining the relay valve, said means (3) acting on said piston which controls the pressure in control channel (Z). Moreover, the piston is tubular and includes an axial channel extending through the piston, above and beneath which a respective cavity is located, where in the upper cavity said means (3) is located and into which said control channel (Z) opens and into said lower cavity said drainage channel (T) opens. Further, the pressure channel (V) opens into an annular space located between the piston and the cylinder bore wall, which space extends downwards to the lower end of the piston (4). The piston has a widened portion which, together with the shoulder between the upper cavity and the cylinder bore, forms a first seat valve (4) between said annular space and said upper cavity, which seat valve (4) is closed when the

piston is in its uppermost position. The upper end of the inner channel of the piston together with the free end of the means (3) form a second seat valve (1), and a weak return spring is provided to press the piston against its uppermost position.

4.6 It is therefore clear that whereas the known relay valve does share many of the constructional features with the transducer of the present invention, it does also differ in many ways. In particular, it differs in the following ways:

- i) The means (3) is an air-actuated piston rather than a tappet reciprocable by means of an electromagnet,
- ii) the control channel opens into the upper cavity rather than the lower cavity,
- iii) the drainage channel opens into the lower cavity rather than the upper cavity,
- iv) the widened portion of the piston is formed intermediate its ends rather than at its lower end, and
- v) the shoulder of the first seat valve is formed between the upper cavity and the cylinder bore rather than the lower cavity and the cylinder bore.

Whilst each of these features could be considered to be minor in itself, they have the cumulative effect of causing the relay valve to act in a different way from the transducer not bringing the advantages of the inventive transducer, so that this valve can give no indication as to how the problem posed is to be solved.

For example, according to the European patent the hysteresis effect is maintained small by using the axial channel (12) of the piston for a comparison between the control pressure (C) and the force (F) of the tappet (3) and by allowing the pressure channel to open into the annular space so as to fully balance hydraulically the piston when the valve (S1) is closed. In the known relay valve, the comparison is made between the pressure (S) and the control pressure (Z) across the means (piston) (3), the axial channel of the piston being always connected to drain. Also, the annular space into which the pressure channel opens is defined at its upper end by the widened portion of the piston extending out of the bore and at its lower end by a flange within the bore so that the pressure exerts an upward force on the piston when the valve (4) is closed. Thus, not only is there no suggestion that the means (3) of the known relay valve be replaced by an electromagnetically-actuated tappet, but also the relay valve would not be suitable for such replacement. If such a tappet acted directly on the end of the piston, no effective upward force would act on the pin since the axial channel in the piston is not under pressure. If, on the other hand, the tappet were to act on the means (3), a much stronger electromagnet would be required due to the forces exerted on the means (3) by the pressure in the control channel (Z) and the axial force exerted on the piston by the pressure in the annular space (as discussed above), thus losing the reduction in the hysteresis effect which was part of the problem to be solved.

- 4.7 The arguments of the Appellant against the Board's interpretation of how the prior art relay valve works cannot be followed. He argues, for example, that the piston of this relay valve is also hydraulically balanced when the valve 4 is closed. This analysis however ignores the finite thickness of the cylinder wall, the end of which blocks a

part of the upper surface of the flange causing an hydraulic imbalance.

5. The subject-matter of Claim 1 does therefore involve an inventive step, and the claim must be held allowable.

Order

For the above reasons, it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

S. Fabiani

P.E.M. Delbecque