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Bezeichnung der Erfindung: Solid state optically coupled electrical switch
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : H03K 17/78

ENTSCHEIDUNG / DECISION

vom / of / du 11 October 1989

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet : Theta-J-Corporation

Einsprechender / Opponent / Opposant : Siemens AG

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Art. 56 EPC

Schlagwort / Keyword / Mot clé : "Inventive step (confirmed) - unobvious modifications"

Leitsatz / Headnote / Sommaire

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Office

Boards of Appeal

Office européen
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Chambres de recours



Case Number : T 558 /88 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal
of 11 October 1989

Appellant : Theta-J-Corporation
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Representative :

Decision under appeal : Decision of Opposition Division of the European Patent
 Office given orally on 23 June 1988 and posted on
 14 September 1988 revoking European patent No. 0 048 146
 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : P.K.J. van den Berg
Members : W.B. Oettinger
 E. Persson

Summary of Facts and Submissions

I. European patent No. 0 048 146 was granted on 23 July 1986 to the Appellant (Patentee) in respect of European patent application No. 81 304 179.5 filed on 11 September 1981 and claiming the priority of 12 September 1980 from an application in the United States of America.

II. Claim 1 as granted reads as follows:

"1. A solid state optically coupled electrical switch comprising a solid state light emitter (L-1) arranged to emit light in response to an input signal applied thereto, optically transparent material arranged to couple the light to a solid state photovoltaic series diode array (D-V) to thereby create a voltage, and a metal oxide semiconductor field effect transistor (MOSFET) (Q-1) responsive to the application of the voltage between the gate and source thereof to change from a first impedance state to a second impedance state, characterised by a second photovoltaic series diode array (D-V₂), both the diode arrays being positioned to be simultaneously illuminated by the light emitter (L-1), and by a second FET (Q-2) connected across the gate and source or drain of the MOSFET (Q-1), the second diode array (D-V₂) being connected across the gate and source of the second FET (Q-2), whereby at least one of the turn-on and turn-off of the MOSFET (Q-1) is accelerated."

Claims 2 to 9 are dependent upon Claim 1.

III. On 23 April 1987 the Respondent (Opponent) filed a Notice of Opposition to the European patent granted.

IV. In oral proceedings, held on 23 June 1988, the Opposition Division decided to revoke the patent on the ground that the subject-matter of Claim 1 did not appear to involve an inventive step in view of the prior art, particularly as disclosed in (d) and (e) of the following documents considered:

- Electronic Design, Vol. 28, No. 7, 29 March 1980, pages 60-63 (a),
- DE-A-2 910 748 (b),
- JP-A-551 756 (c),
- DE-A-3 000 890 (d),
- US-A-3 805 094 (e).

A similar view was taken on an alternative Claim 1 handed over in the oral proceedings.

A corresponding decision containing a full reasoning was issued on 14 September 1988.

V. The reasons given in the decision under appeal can be summarised as follows:

Document (d) discloses a solid state optically coupled electrical switch as specified in the preamble of granted Claim 1. In (d) a resistor (21) is connected between gate (28) and source (27) of the MOSFET (25) to provide a discharge path for the charge stored at the gate capacitance of the MOSFET. Furthermore (d) suggests to replace this resistor (21) by any suitable active component such as a transistor.

Document (e) describes a switching circuit having a switching transistor (1) and an auxiliary transistor (14), the latter serving as a discharge path for the charge stored at the control electrode of the switching

transistor, in full equivalence to the discharge resistor (21) known from (d).

It would therefore be obvious to combine the teachings of (d) and (e) which would result directly in the subject-matter of granted Claim 1.

In the circuit of (e), the switching transistor (1) and the auxiliary transistor (14) are not controlled by coupling means using photovoltaic diodes but rather by coupling means using a pulse transformer (4). These are considered as equivalent coupling means, since both of them are known in connection with electrical switches. A skilled person faced with the problem of controlling transistors in an electrical switch would therefore select the most appropriate coupling means to meet the requirements of the particular electrical switch. In particular where DC signals need to be transmitted, only the optical coupling means known from (d) would be appropriate.

Furthermore the application of transistors of a particular type in a known circuit is a matter of mere design choice for a skilled person. Therefore no inventive step could be involved in specifying transistors of a known particular type.

VI. On 12 November 1988 the Appellant lodged an appeal against this decision. The appeal fee had been paid on 11 November 1988.

The Statement of Grounds accompanied by a draft Affidavit was filed on 17 January 1989.

The Respondent replied to the Appellant's arguments with a letter dated 1 June 1989.

VII. The Appellant's arguments can be summarised as follows:

Nothing is said in (d) about the nature of the transistor which would replace the discharge resistor (21) or about how it is to be operated. there is nothing in (d) to suggest that the unspecified kind of transistor should be controlled by a second photovoltaic diode array. Even if such a second array were to be used there is no suggestion in (d) that it should be energised by the same light emitter as the other array or that it should be energised simultaneously with the other array.

In respect of (e), relating to a transformer driving circuit for a switching device, to which the decision under appeal refers for the information absent from (d), the Appellant observes that this driving circuit, being transformer coupled, depends on AC activation and therefore belongs to a class of device radically different from the coupling device of (d) and to which it is not functionally equivalent. Thus the provision of an independent photovoltaic diode array is not equivalent to and not suggested by the secondary transformer winding of (e).

VIII. In his response to the appeal, the Respondent agrees with the reasoning in the decision under appeal and further submits that it would be obvious to a skilled person to replace the discharge resistor (21) used in (d) by the switch shown on Figure 2 of (b) and thereby arrive at the subject-matter of Claim 1.

IX. The Appellant requests that the impugned decision be set aside and the patent maintained as granted.

As a first auxiliary request he asks that the patent be maintained with a new Claim 1 filed as annex "A" to the Statement of Grounds and an amendment to the description

as specified in the Statement of Grounds. As a second auxiliary request he asks that the patent be maintained on the basis of a new Claim 1 filed as annex "B" to the Statement of Grounds, amended dependent claims and said amendment to the description.

The Respondent requests that the appeal be dismissed.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 EPC and the reference, in the Notice of Appeal, to "the Decision of Revocation" is taken as a statement in the sense of Rule 64 that cancellation of the decision in its entirety is requested.

The appeal is therefore admissible.

2. Novelty of the subject-matter of granted Claim 1 does not appear to have been contested. Since the Board has found no reason to take a different view on that matter there is no need to discuss it further.

The subject-matter of Claim 1 is therefore considered to be novel.

3. Claim 1 as granted appears, in accordance with its wording (col. 5, line 65), to cover in effect two alternative solid state switches.

In the first alternative, the second FET (Q-2) is connected across gate and source of the MOSFET (Q-1). This first alternative is supported by the embodiment described with reference to Figure 5 of the patent. From the description (col. 4, lines 19 to 20 and 42 to 44) it can

be understood that it is this embodiment which allows turn-off of the MOSFET to be accelerated, as also mentioned in the Claim (col. 6, lines 3 to 4). Apparently, Claim 5 is more specifically directed to this embodiment.

In the second alternative, the second FET (Q-2) is connected across gate and drain of the MOSFET (Q-1). This second alternative is supported by the embodiment described with reference to Figure 7 of the patent. From the description (col. 4, lines 45 to 46 and 58 to 61) it can be understood that this embodiment allows turn-on of the MOSFET to be accelerated, as also mentioned in the Claim (col. 6, lines 3 to 4). Apparently, Claim 4 is intended to specify this embodiment further.

The expression "at least one" in Claim 1 (col. 6, line 3) appears to point to the fact that this claim does not exclude the possibility of combining turn-on accelerating means with turn-off accelerating means (cf. col. 4, line 62 to col. 5, line 1).

4. It appears from the file that the arguments of the Respondent are exclusively directed against the first alternative covered by Claim 1 and further specified in Claim 5. This allegation of obviousness of the first alternative switch will therefore be discussed hereinafter in detail.
- 4.1 There seems to be agreement that document (d) discloses the prior art closest to the invention. This document shows a solid state switch as specified in the preamble of Claim 1 as granted (see in particular pages 9 to 11 and Figure 1). Furthermore a resistor (21) is connected between gate and source of the output MOSFET (25) to accelerate discharge of the gate capacitance of the MOSFET (page 10, lines 5 to 10). According to page 18, lines 27

to 32 however the discharge resistor (21) may be replaced by an active element such as a transistor.

- 4.2 It is not specified in (d) whether this active element should be controlled or not. In this respect, however, the following is noted:

It is general knowledge that a resistor can, in particular in IC technology, be implemented by such semiconductor elements as a diode or a transistor with two of its electrodes connected together to form, in effect, a diode. It is this implementation which will normally be understood, by the ordinary skilled person, when reference is made to a resistor implemented or replaced by a transistor.

The reference in (d) to an "active" element (page 18) may, however, lead the skilled person to further consider an implementation in which the "active" properties of the transistor replacing the resistor (21), which as such is a "passive" element, are used, i.e. its ability to amplify or switch.

The teaching in (d) that the resistor is provided for allowing gate 28 to be discharged "at switch-off" of the input signal (page 10, lines 8 to 10) may, possibly, lead the skilled person moreover to consider somehow controlling the transistor replacing the resistor (21) in dependence upon the occurrence of this event, since he would see that this would have the advantage that the effective resistance, during said event, of "resistor" 21 can be made much lower and, therefore, discharge of the input capacity of the MOSFET can be accelerated.

He may even see that it would be inconvenient to control the transistor directly from the input circuit and more appropriate to derive the control signal from the voltage created in the diode (18) array (17).

Finally, it may be assumed that the skilled person would consider implementing the transistor replacing the resistor (21) in the same technology as the output transistor 25, i.e. as a FET, for instance of the depletion mode type (cf. page 9, lines 14 to 15).

This, however, is clearly the utmost which can be regarded as obvious from (d), taking the skilled person's general knowledge into account. More particularly, it can clearly not be regarded as suggested by (d) to derive the control signal in any other way than indicated above.

4.3 Regarding the Respondent's argument based on document (b), the Board observes that Figure 2 of (b) relates to an optically coupled FET switch which is largely similar to the switch described in (d), Figure 1, except for the fact that, in (b), the FET (3) is switched off by an input signal whereas, in (d), the FET (25) is switched on. Resistor R2 in (b) corresponds directly to resistor 21 in (d) and document (b) suggests to choose a compromise value for this discharge resistor which is large enough so as not to load appreciably the photodiode array when illuminated and small enough compared with the impedance of the array (page 12, lines 5 to 14). From this document (b) the skilled person would not receive any suggestion to replace the discharge resistor by a controlled switch, since nothing in (b) points to an equivalence between the former and the latter.

4.4 It is known from document (e) to connect an auxiliary transistor (14) between base and emitter of a switching

transistor (1) to accelerate turn-off of the latter. More particularly, the auxiliary transistor is controlled so as to become conductive and thereby accelerate discharge of the base capacitance of the switching transistor (1) when the latter has to be turned off. In (e) both the auxiliary and the switching transistors are controlled from a source of pulsed signals. The control signals for the auxiliary and switching transistors are coupled to the bases of these transistors through a pulse transformer (4) which has a first secondary winding (5) coupled to the base of the switching transistor (1) and a second secondary winding (13) connected to the base of the auxiliary transistor (14).

- 4.5 The skilled person would consider the teaching of (e) as relevant, since this document relates to the same problem of accelerating the discharge of the input capacity of a switching transistor as is solved by the replacement of the resistor 21 in (d) by a controlled transistor, which replacement is considered above and regarded as obvious (paragraph 4.2).

However, it appears that the solution specified in (e) is different from the solution claimed, since different coupling means are used resulting in different effects. Transformer 4 of (e) is not equivalent to the optical coupling means 11/17 of (d) because of its well-known function to transform an input pulse (shown at 10) into a pair of successive pulses of opposite polarity (cf. col. 5, lines 20 to 23), the switching transistor being controlled by the leading pulse, and the trailing pulse being used in the auxiliary transistor 14.

Furthermore, the transformer coupling means specified in (e) does not allow coupling of DC signals unlike the invention.

In the opinion of the Board, the skilled person would not, therefore, attempt to derive from (e) any teaching to further modify the optically controlled switch according to (d) beyond what can be regarded as obvious from (d) alone (para. 4.2), or from (d) and (b) (para. 4.3). In particular, he would not draw any conclusion from the fact that the auxiliary transistor (14) is controlled by means of a second secondary winding (13), for the case of an optically coupled switch.

4.6 None of the other prior art documents on file is relevant enough to require particular consideration.

4.7 In a case like this, where even a considerable number of obvious steps, specified above (para. 4.2), does not eventually lead to the claimed invention, but where at least one additional step or modification, albeit a simple one, must be done (para. 4.5) which is not based on a clearly obvious consideration and which calls forth a different function or effect of the resulting combination of features, obviousness should not be concluded.

For these reasons, the Board is of the opinion that the first alternative switch covered by Claim 1, and further specified in Claim 5, involves an inventive step.

5. The Respondent has not argued that the second alternative switch covered by Claim 1, and appearing to be specified in Claim 4, would lack inventive step nor has the Board found any reason to question that.

Therefore, this second alternative, too, involves an inventive step.

6. For these reasons, the Board concludes that the subject-matter of Claim 1 as granted is patentable and this then also applies to that of the dependent claims so that the grounds of opposition do not prejudice maintenance of the patent unamended.

In these circumstances, it is not necessary to consider the Appellant's auxiliary requests including his offer to amend the description. Even if the latter does not comply with Rule 27(1)(c) EPC in that it does not indicate the prior art known from (d), Article 102(2) EPC does not provide for amendment for the sole purpose of complying with this formal requirement.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The opposition is rejected.

The Registrar:

The Chairman:

S. Fabiani

P.K.J. van den Berg