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File Number: T 116/91 - 3.5.2

Application No.: 84 305 231.7

Publication No.: 0 133 368

Title of invention: High current switch contact

Classification: H01H 33/66

D E C I S I O N  
of 17 March 1992

Applicant: Vacuum Interrupters Limited

Opponent: 01 Sachsenwerk Aktiengesellschaft  
02 Asea Brown Boveri AG  
03 Siemens AG

Headword:

EPC Article 54, 56, 100(a), 114(2)

Keyword: "Novelty - yes"  
"Inventive step - yes"  
"Amendment of claim - feature taken from drawings"  
"Late-filed evidence disregarded"

Headnote



Case Number : T 116/91 - 3.5.2

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.2  
of 17 March 1992

**Appellant :**  
(Opponent 02)

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**Respondent :**  
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**Decision under appeal :**

Interlocutory decision of Opposition Division of  
the European Patent Office dated 17.12.90  
concerning maintenance of European patent  
No. 0 133 368 in amended form.

**Composition of the Board :**

**Chairman :** J.A.H. van Voorthuizen  
**Members :** W.J.L. Wheeler  
G. Davies

## Summary of Facts and Submissions

- I. The Appellant (and two other opponents) opposed European patent No. 133 368 and now contests the interlocutory decision of the Opposition Division that, account being taken of the amendments made during the opposition proceedings, the patent and the invention to which it relates meets the requirements of the EPC.
  
- II. As amended during the proceedings before the Opposition Division, the patent has nine claims. Claim 1 is worded as follows:

"A contact (9) for high current electrical switch devices of the kind comprising an electrically conducting contact member having a base portion (4) and an annular rim portion upstanding from the base which rim portion carries a ring of low weld strength metal brazed on top of the rim to provide the contact surface, the member having a plurality of slots (6) formed in the rim portion in a generally helical direction and continuing across part of the base portion,

characterised in that the orientation of the slots in the rim portion and in the surface of the base within the rim portion is such that the distance between the inner end of each slot in said surface and the rim portion measured along the slot is greater than the distance between said inner end of the slot and the rim portion in a direction at right angles to the slot

whereby, on separation of the contact from a co-operating contact, an arc is formed between the contacts, and electric currents flowing between the centre of the base and the rim portion have appreciable tangential components which add to the magnetic field produced by tangential

components of the current flow in the rim portion, such that the arc is immediately forced to rotate around the rims of the contacts."

Claims 2 to 7 are dependent on Claim 1 and concern specific embodiments of the contact claimed in Claim 1. Claims 8 and 9 concern electrical switch devices comprising a pair of contacts according to Claim 1.

III. The following prior art documents were considered in the proceedings before the Opposition Division:

- D1: GB-A-997 384
- D2: EP-A-0 082 801
- D3: DE-A-2 638 700
- D4: DE-C-2 363 044
- D5: DE-C-2 443 141
- D6: DE-A-3 037 752
- D7: US-A-3 845 262.

IV. In the statement of grounds of appeal, the Appellant referred to the German patent corresponding to D1, i.e. DE-C-1 196 751, which the Board will refer to as D1a.

V. The Appellant argued that D3 disclosed a contact in accordance with the prior art part of Claim 1 of the patent in suit. In the third paragraph on page 3 of D3 it was explained that the slots in the base portion could extend inwards to the central conducting stem to improve the current distribution. As shown in Figure 3 of D3 the slots were not exactly radial; their direction was not disclosed in the description. D1 and D1a disclosed a contact with radially extending slots inclined to the axis of the annular rim so that the magnetic field produced by the current flowing along the angled path between two of the slots caused the ends of the arc to

move around the rim. A comparison of Figures 2 and 3 with Figures 7 and 8 of D1 showed that the slots could have different inclinations. If the inclination of the slots was varied while keeping their positions at the top of the rim constant, slots would be obtained which were in accordance with the characterising part of Claim 1 of the patent in suit. The alleged invention concerned only the arrangement of the slots in the base portion and the rim portion; the ring providing the contact surface did not contribute to the invention. D6 disclosed a cup shaped contact element with inclined slots whose length in the base portion was greater than the distance between the slots and the rim portion (Figure 4). Electric currents which flowed between the centre of the base and the rim portion had appreciable tangential components which added to the magnetic field produced by the current in the rim portion, as in the alleged invention. The Appellant referred to two papers written by the inventor of the patent in suit (published after the filing date) in which the alleged invention was described as a folded petal contact.

VI. The Respondent argued that the Appellant's arguments were based on hindsight. Regarding D3, one should bear in mind that figures in patent specifications were not accurate engineering drawings. The skilled person would be likely to assume that the slots were meant to be radial as there was no indication to the contrary in D3. Regarding D1, it was not disputed that the slots in the rim could have different inclinations. However, the only figure showing slots extending into the base was Figure 8, and that figure showed radially extending slots. Regarding D6, the tangential component of the current flow in the base was in the opposite direction to that in the rim and did not add to the magnetic field produced by the tangential components of the current flow in the rim. The present

invention had taken a great deal of experimentation and was not simply the result of folding up the rim of a conventional spiral petal contact.

VII. Oral proceedings were held on 17 March 1992. Nobody appeared on behalf of Opponents 1 and 3.

VIII. The Appellant expanded the arguments presented in the grounds of appeal (see paragraph V above) and argued that Claim 1 of the patent in suit did not define an adequate technical teaching. D6 disclosed a contact comprising an electrically conducting member (13) having a base portion and an annular rim portion upstanding from the base. A plurality of inclined slots (16) were formed in the rim and continued across part of the base. Fig. 4 showed the length of each slot in the base portion was greater than the distance between the inner end of the slot and the rim in a direction at right angles to the slot. This prior art contact member therefore had all the essential constructional features recited in Claim 1 of the patent in suit. The "whereby" clause at the end of the claim did not define a technical feature; the arc rotating effect depended more on the arrangement of the co-operating contact than on the measurements recited in the claim. The ring brazed on top of the rim did not contribute to the solution of the problem of forcing the arc to rotate. The fact that the contact disclosed in D6 had a central button electrode (14) was not important because Claim 1 of the patent in suit said: "comprising", not "consisting of".

The disclosure of D1 was not limited to the embodiments shown in the drawings. Claims 1, 3 and 7 of D1, read together, defined a contact in which the annular ridge was formed with a plurality of radially extending slots inclined to the axis of the ridge to form helical current paths in the upstanding ridge. At least one of the

slots extended into the base. Claim 8 specified that that slot extended radially within the base, from which it followed that Claim 7 covered arrangements in which the slot extended in the base in a non-radial direction. Claim 10 of D1 specified that the sides of at least one of the slots were plane. It was geometrically impossible for a slot cut in the contact on an inclined plane to be radial at the top of the ridge and also in the base; only a helical slot could be radial throughout its length. The contact according to the patent in suit fell within the claims of D1.

D3 disclosed a contrate contact according to the prior art part of Claim 1 of the patent in suit. Fig. 3 of D3 showed the slots were not exactly radial in the base. If the slots were inclined at a greater angle to the axis of the contact in accordance with the teaching of D1 the result would fall within Claim 1 of the patent in suit. The overlapping slots would produce tangential components in the current flow in the base. There was no difficulty to be overcome in combining the teaching of D1 and D3.

IX. The Respondent replied that in vacuum interrupters of the type having contrate contacts it was the common, probably universal, practice to incline the slots in the opposing contacts in opposite directions to produce rotation of the arc. A person skilled in the art would not need to be told this.

The Respondent's technical expert, Mr. Reece, explained the history of the development of vacuum interrupters. In the early 1960's flat disc contacts with spiral slots were used. On breaking the contacts the arc started in the centre and was blown radially outward and ran around the outside of the contacts. The arc bowed out beyond the circumference of the discs, so the devices had to be of

large diameter to prevent damage to the surrounding arc shields. The contrate type of contact was designed to prevent the arc bowing out too far. It produced a tube of arc. The slots in the rim did not always extend into the base, as this weakened the base. It was generally thought that tangential components of the current flowing in the base should be avoided. The present invention went against the knowledge at the time.

The contact disclosed in D6 effectively had no slots in the base because the electrically conductive rimmed disc (19) shorted them out. D1 and D3 did not suggest changing the angle of inclination of the slots to get tangential cuts in the base; D1 said the slots in the base were radial and D3 showed them practically radial. In contrate contacts, the radially flowing current in the base was further from the arc than in the disc type contacts, and this prevented constriction of the arc at high currents. The present invention surprisingly produced a constricted arc which started to rotate around the rims of the contacts within 10 to 100 microseconds and did not bow outwards. It was not understood why it worked so well.

- X. The Respondent presented an amended version of Claim 1, which is now worded as follows:

"A contact (9) for high current electrical switch devices of the kind comprising an electrically conducting contact member having a base portion (4) and an annular rim portion upstanding from the base which rim portion carries a ring of low weld strength material brazed on top of the rim to provide the contact surface, the member having a plurality of slots (6) formed in the rim portion in a generally helical direction and continuing across part of the base portion,



characterised in that the orientation of the slots in the rim portion and in the surface of the base within the rim portion is such that the distance between the inner end of each slot in said surface and the rim portion measured along the slot is greater than the distance between said inner end of the slot and the rim portion in a direction at right angles to the slot

whereby, on separation of the contact from a co-operating contact having slots inclined in the opposite direction, an arc is formed between the contacts, and electric currents flowing between the centre of the base and the rim portion have appreciable tangential components creating a magnetic field which adds to the magnetic field produced by tangential components of the current flow in the rim portion, such that the arc is immediately forced to rotate around the rims of the contacts."

- XI. The Appellant objected that it was not clear what was meant by "appreciable" tangential components, and asked where the measuring rule in Claim 1 had been disclosed in the originally filed application.
- XII. The Respondent explained that the claim was clear to a person skilled in the art, and that the measuring rule was taken from the drawings. The Respondent filed an amended version of a page of description (identified as Annex 4), acknowledging the prior art according to D6.
- XIII. The Appellant requests that the interlocutory decision of the Opposition Division be set aside and that the patent in suit be revoked in its entirety.
- XIV. The Respondent requests that the patent be maintained on the basis of the amended form decided upon by the Opposition Division, but with Claim 1 and the page of

description identified as Annex 4 (to be inserted between lines 5 and 6 of column 2 of the printed patent specification) being replaced by Claim 1 and Annex 4 presented during the oral proceedings.

#### Reasons for the Decision

1. The appeal is admissible.
2. Before turning to the questions of novelty and inventive step, it is appropriate to make some preliminary remarks about the two papers ("Anlage 1" and "Anlage 2") filed with the Appellant's statement of grounds of appeal, and to consider the Appellant's objections to the "whereby" clause in Claim 1 and the added subject-matter objection raised at the end of the oral proceedings.
  - 2.1 As was foreshadowed in the communication accompanying the summons to the oral proceedings, the Board does not consider the papers "Anlage 2" and "Anlage 3", which were published after the filing date of the application for the patent in suit, to be relevant for determining whether or not the presently claimed subject-matter was obvious at the time the patent was applied for. The Board therefore exercises its discretion under Article 114(2) EPC to disregard them.
  - 2.2 Regarding the Appellant's objections to the "whereby" clause at the end of Claim 1, it is necessary to remember that although the claim has been drafted in three blocks (the prior art part, the middle part and the "whereby" clause) it must be read as a whole, with the intention of making sense of it, bearing in mind that it is addressed to a person skilled in the art. When the claim is read as a whole, it is clear that the slots must be arranged as

specified in the first two blocks of the claim and, as a further, functional, requirement, be such as to produce the effects specified in the third block. Given that the art is rather empirical in nature, it is not unreasonable to have such a functional requirement specified in the claim. As a practical matter, "immediately" cannot be so strictly interpreted as to mean that the arc must start to rotate with no delay whatsoever. In the opinion of the Board, "immediately" can be construed as embracing up to 100 microseconds, which is the upper figure mentioned by the Respondent's technical expert.

- 2.3 Regarding the added subject-matter objection, the Board notes that an objection under Article 100(c) EPC was raised by the Appellant within the nine months period prescribed by Article 99 EPC for filing an opposition to the particular matter in question, namely the measuring rule specified in Claim 1 that "the distance between the inner end of each slot in said surface and the rim portion measured along the slot is greater than the distance between said inner end of the slot and the rim portion in a direction at right angles to the slot". The Respondent replied to this objection in the letter dated 14 July 1988, paragraphs 1.1 to 1.3. However, it appears from the minutes of the oral proceedings held before the Opposition Division that the objection was then dropped. The interlocutory decision of the Opposition Division does not explicitly mention the point. Nevertheless, the decision that the patent could be maintained in amended form implies, inter alia, that the Opposition Division considered that the objection under Article 100(c) EPC could not be upheld.

- 2.4 In the opinion of the Board, the Appellant has the right to have this implied decision reviewed on appeal, but

should preferably have raised the matter in the statement of grounds instead of withholding it to the last minute.

2.5 The Board agrees with the observations made in paragraphs 1.1 to 1.3 of the Respondent's letter dated 14 July 1988. Although the measuring rule is not recited verbatim in the originally filed description, it is clearly and unmistakably fully derivable from Figures 3 and 4 of the drawings as originally filed, bearing in mind that the purpose of the slots as described in the last paragraph on page 7 of the description as originally filed and as defined in Claim 9 as originally filed, is to form a current path having appreciable tangential components of current flow in the base. Therefore, in the opinion of the Board, the measuring rule recited in Claim 1 of the patent in suit does not extend beyond the content of the application as filed. This is in line with decision T 169/83 (OJ EPO, 1985, 193).

2.6 Furthermore, the Board considers that the amended form requested by the Respondent in the oral proceedings (paragraph XIV above) complies with Article 123(2) and (3) EPC in all respects. Thus, the objection brought under Article 100(c) EPC cannot be sustained.

3. Turning now to the cited prior art (see paragraph III above), it appears that the most relevant documents are D1, D1a, D3 and D6, no arguments based on documents D2, D4, D5 and D7 having been presented to the Board.

3.1 D1 and D1a disclose several different contrate contacts for high current electrical switch devices of the kind comprising an electrically conducting contact member (8) having a base portion and an annular ridge portion (11) upstanding from the base, the tip of the ridge providing the contact surface. The ridge is formed with a plurality

of radially extending slots (15) inclined to the axis of the ridge in a generally helical direction. In all but one of the embodiments, the slots do not extend into the base portion. In the embodiment described with reference to and shown in Figures 7 and 8, the slots do extend into the base portion. The part of each slot which is in the ridge is inclined very obliquely to the axis and extends half way round the ridge in a generally helical path, but the part of the slot which extends into the base portion lies in a plane which is parallel to the axis and extends radially towards the centre of the base. Although the slots in the ridge are inclined at different angles in the various embodiments, there is no suggestion in D1 or D1a that the orientation of the slots in the base portion could be other than radial, as shown in Figures 7 and 8. Nor is there any disclosure of electric currents flowing between the centre of the base and the ridge having tangential components creating a magnetic field which adds to the magnetic field produced by tangential components of the current flow in the ridge.

3.2 The Appellant pointed out that the claims in D1 and D1a covered more arrangements than were explicitly disclosed in those documents and expressed the opinion that the invention claimed in the patent in suit fell within the scope of some of these claims. It is true that the particular combination of Claims 1, 3, 7 and 10 of D1 would seem to suggest that slots extending non-radially in the base are not excluded. However, in the absence of any further indication in the description and drawings, where radially extending slots are clearly preferred, the fact that the claims seem to permit a configuration in which the slots in the base are non-radial cannot be fairly construed as a hint to a person skilled in the art to use just this configuration, let alone that it would be advantageous with respect to the movement of the arc.

On the contrary, in the opinion of the Board, a person skilled in the art would simply not think that the feature recited in Claim 10 of D1, namely "the sides of at least one of said slots are plane" could apply to the embodiment shown in Figures 7 and 8 because of the abrupt change in the direction of the sides of the slots at the point where they pass from the ridge into the base. Thus, the disclosure in D1 and D1a does not anticipate or hint at the present invention.

3.3 D3 (which is the document on which the prior art part of Claim 1 is based) discloses a contact for high current electrical switch devices of the kind comprising an electrically conducting contact member having a base portion (14) and an annular rim portion upstanding from the base which rim portion carries a ring (15) of low weld strength material brazed on top of the rim to provide the contact surface. A plurality of slots (13) are formed in the rim portion, the slots being inclined to the axis of the rim and continuing through the base at the same inclination to the axis. The parts of the slots which are in the base are preferably extended inwards towards the centre of the base to improve the current distribution (see D3, page 4 (handwritten numbering), third paragraph). It is true that as shown in Figure 3, the slots are not exactly radial in the surface of the base within the rim portion. However, the slots are drawn approximately radial and they are described as being radial (see D3, page 5, line 26). There is no suggestion in D3 that the slots in the surface of the base within the rim portion could be other than substantially radial. In the opinion of the Board, a person skilled in the art would assume that the slots were meant to be radial in the surface of the base within the rim portion, this being approximately their midpoint when viewed from the side as in Figure 2, thereby keeping the whole slot as radial as possible. There is no

disclosure of electric currents flowing between the centre of the base and the rim having tangential components creating a magnetic field which adds to the magnetic field produced by tangential components of the current flow in the rim.

3.4 D6 discloses a contact for high current electrical switch devices of the kind comprising an electrically conducting member (13) having a base portion with an upstanding annular rim surrounding a button shaped contact electrode (14) mounted in the centre of the base portion in an electrically conductive cup-shaped member (19). There are a plurality of non-radial slots (16) formed in the rim, the slots being inclined to the axis of the rim and continuing through the base at the same inclination to the axis. The slots cut the surface of the base within the rim such that the distance between the inner end of each slot in said surface and the rim measured along the slot is greater than the distance between said inner end of the slot and the rim in a direction at right angles to the slot, thereby imparting some tangential components to electric currents flowing between the centre of the base and the rim. However, these tangential components are in the opposite direction to the tangential components of the current flowing in the rim, so that their magnetic field does not add to the magnetic field produced by the tangential components of the current flowing in the rim.

3.5 The Board notes that although each of the documents D1, D1a, D3 and D6 discloses that the purpose of the slots in the rim is to produce rotation of the arc around the rim, none of them discloses the basic idea underlying the present invention of arranging the slots in the base such that electric currents flowing between the centre of the base and the rim have appreciable tangential components creating a magnetic field which adds to the magnetic field

produced by tangential components of the current flow in the rim portion, such that the arc is immediately forced to rotate around the rims of the contacts.

4. Since none of the documents D1, D1a, D3 and D6 discloses a contact displaying all the features recited in Claim 1 of the patent in suit, the subject-matter of the claim is novel within the meaning of Article 54 EPC.

5. Concerning inventive step, the Appellant has presented several lines of attack, in an attempt to show that it was obvious to arrive at the claimed invention, starting from D1/D1a, D3 and D6 respectively.

5.1 It appears that with the prior art contrate contacts known from D1, D1a and D3, the arc formed on separating the contacts is initially stationary and can damage the contact elements. The present invention solves the objective problem of forcing the arc to start moving around the contact elements with less delay. The Board does not agree with the Opposition Division's formulation of the problem (see the first complete paragraph on page 4 of the decision under appeal), because it includes the phrase "by increasing the tangential components of the current flow within the base portion" which points to the solution and is therefore not in accordance with the practice of the Boards of Appeal, see decisions T 99/85 (OJ EPO, 1987, 413) and T 229/85 (OJ EPO 1987, 237).

5.2 According to the present invention, to solve the objective problem, the orientation of the slots in the rim portion and in the surface of the base within the rim portion is such that the distance between the inner end of each slot in said surface and the rim portion measured along the slot is greater than the distance between said inner end of the slot and the rim portion in a direction at right



angles to the slot, whereby, on separation of the contact from a co-operating contact having slots inclined in the opposite direction, an arc is formed between the contacts, and electric currents flowing between the centre of the base and the rim portion have appreciable tangential components creating a magnetic field which adds to the magnetic field produced by tangential components of the current flow in the rim portion, such that the arc is immediately forced to rotate around the rims of the contacts.

5.3 As noted in paragraph 3.5 above, none of the documents D1, D1a, D3 and D6 discloses the basic idea underlying the present invention. Furthermore, in the opinion of the Board, although it might be obvious to experiment with different slot angles in the contacts described in D1, D1a, D3 and D6, as suggested by the Appellant, this on its own would not lead to the present invention, since the radial or non-radial orientation of the slots in the base is independent of the angle of the slots relative to the plane of the base.

5.4 In the case of the contrate contacts described in D1, D1a and D3, all the slots which extend into the base cut the surface of the base within the rim in a radial direction. As explained by the Respondent's technical expert (who is named as an inventor in D1/D1a), non-radial slots were deliberately avoided in contrate contacts, because it was thought they would cause the arc to bow outwardly as was the experience with spiral or chordal slots in disc type contacts. Thus, a person skilled in the art experimenting with different slot angles, would be unlikely to depart from the radial orientation of the slots in the surface of the base within the rim.

- 5.5 In the case of the contact described in D6, the contact electrode (14) is not mounted on the rim. It is mounted in an electrically conducting cup in the centre of the base, thereby short circuiting the slots in the base portion. The Board cannot see an obvious reason for a person skilled in the art to apply the non-radial slots shown in D6 to contrate contacts of the types disclosed in D1, D1a and D3, and then modify them to such an extent as to produce the effects recited in Claim 1 of the patent in suit.
- 5.6 Thus, in the opinion of the Board, the contact according to Claim 1 of the patent in suit involves an inventive step over the cited prior art, and the patent may be maintained with this claim. The same applies to Claims 2 to 9.
6. In the result, the Board is of the opinion that the patent may be maintained in amended form as requested by the Respondent.

#### Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance to maintain the patent in amended form as requested by the Respondent (see paragraph XIV above).

The Registrar:

The Chairman:

M. Kiehl

J.A.H. van Voorthuizen