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Boards of Appeal

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Case Number : T21/81

T 44

DECISION

of the Technical Board of Appeal 3.5.1

of 10 September 1982

Appellant: Allen-Bradley Company
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USA

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Decision under appeal: Decision of Examining Division 051 dated 4 March 1981 refusing European patent application N°.78300163.9 pursuant to Article 97(1) EPC

Composition of the Board:

Chairman: G. Korsakoff
Member: J. van Voorthuizen
Member: L. Gotti Porcinari

SUMMARY OF FACTS AND SUBMISSIONS

I. European Patent Application N°.78300163.9 filed on 19.07.78 (Publication N°. 0001872), claiming a priority of 19.10.77 (USA), was refused by a decision of the Examining Division 051 of the European Patent Office of 04.03.81. That decision was based on Claims 1 to 10 as filed on 10.09.80, the claims 1 and 5 being independent claims and claims 2 to 4 and 6 to 10 being dependent on claims 1 and 5 respectively.

II. The reason given for the refusal was that the subject matter of the claims did not involve inventive step with reference to FR-A-1 408 864, GB-A-1 272 916 and DE-B-1 158.174.

III. The applicant lodged an appeal against this decision on 28.04.81. The Statement of Grounds was filed on 25.06.81. On the same date amended claims 1 to 10 were filed, claims 1 to 8 corresponding (with certain modifications) to claims 1 to 8 as filed on 10.09.81 and claims 9 and 10 constituting two alternatives to claim 1.

IV. In a communication of 13.11.81 the Rapporteur of the Board of Appeal set out several objections to the application with regard to the absence of inventive step, the insufficiency of disclosure and the formulation of the claims.
With his reply to this communication the applicant filed on 09.01.82 a new set of claims consisting of claims 1 to 8, corresponding (with certain modifications) to the previous claims 1 to 8, an alternative claim 1, an alternative claim 5 and an alternative method claim. These claims read as follows:

.../...

1. An electromagnetic device comprising a housing;

a stationary core comprising laminations of ferromagnetic material disposed within the housing, the core having a base and a pair of legs extending substantially perpendicularly from the base, said core having a centre pole face and a pole face at the end of each leg;

a freely movable armature of ferromagnetic material having a centre pole face and two end pole faces, the armature being disposed in the housing so that each pole face on the core is opposite a corresponding pole face on the armature and the armature being loosely guided within the housing for rectilinear straight line motion;

a region of decreased magnetic permeability including an air gap being provided between the centre pole faces of the core and the armature to aid separation thereof;

an energising coil associated with the core, so that when the coil is energised a magnetic force is induced which moves the armature from an open position to a closed position in which a three-legged magnetic circuit is formed; characterised in that

means is provided for giving an audible signal of the need to replace the device, the said means comprising, on at least one of the centre pole faces but not on any of the end pole faces, a layer of a hard non-magnetic coating of a non-magnetic material having much greater resistance to wear than the ferromagnetic material constituting the end pole faces of the armature and the core.

2. An electromagnetic device as claimed in Claim 1, in which the hard non-magnetic layer on the or each centre pole face is a tungsten carbide coating.

3. An electromagnetic device as claimed in Claim 2, in which the tungsten carbide coating is applied to the centre pole face of the armature.

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4. An electromagnetic device as claimed in either Claim 2 or Claim 3, in which the coating of tungsten carbide is a coating between 0.025mm and 0.25mm in thickness applied to the or each centre pole face by the plasma flame spray process.

5. An electrical relay comprising a housing;

a stationary core of ferromagnetic material disposed within the housing, the core having a base and a pair of legs extending substantially perpendicularly from the base, said core having a centre pole face and a pole face at the end of each leg;

a freely movable armature of ferromagnetic material having a centre pole face and two end pole faces, the armature being disposed in the housing so that each pole face on the core is opposite a corresponding pole face on the armature and the armature being loosely guided within the housing for rectilinear straight line motion;

a region of decreased magnetic permeability including an air gap being provided between the centre pole faces of the core and the armature to aid separation thereof;

an energising coil associated with the core, so that when the coil is energised a magnetic force is induced which moves the armature from an open position to a closed position in which a three leg magnetic circuit is formed;

a stationary pair of electrical contacts mounted on the housing;

a pair of electrical contacts connected to the movable armature; characterised in that

means is provided for giving an audible signal of the need to replace the device, the said means comprising, on at least one of the centre pole faces but not on any of the end pole faces, a layer of a hard non-magnetic coating of a non-magnetic material having much greater resistance to wear than the ferromagnetic material constituting the end pole faces of the armature and the core.

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6. An electrical relay as claimed in Claim 5, wherein:

the core is U-shaped and the pole faces at the ends of the two legs are salient pole faces, the centre pole face of the core being a non-salient pole face, and the armature being T-shaped.

7. A relay as claimed in Claim 5, wherein the core and the armature are both E-shaped.

8. A relay as claimed in any one of Claims 5 to 7, in which the hard non-magnetic coating on the or each centre pole face is a tungsten carbide coating between 0.025mm and 0.25mm in thickness.

Alternative Claim 1

1. An electromagnetic device comprising a housing;

a stationary core comprising laminations of ferromagnetic material disposed within the housing, the core having a base and a pair of legs extending substantially perpendicularly from the base, said core having a centre pole face and a pole face at the end of each leg;

a freely movable armature of ferromagnetic material having a centre pole face and two end pole faces, the armature being disposed in the housing so that each pole face on the core is opposite a corresponding pole face on the armature and the armature being loosely guided within the housing for rectilinear straight line motion;

a region of decreased magnetic permeability including an air gap being provided between the centre pole faces of the core and the armature to aid separation thereof;

an energising coil associated with the core, so that when the coil is energised a magnetic force is induced which moves the armature from an open position to a closed position in which a three-legged magnetic circuit is formed; characterised in that

means is provided for giving audible warning of the need to replace the device, the said means comprising, on at least one of the centre pole faces but not on any of the end pole faces, a layer of a hard non-magnetic coating of a non-magnetic material having much greater resistance to wear than the ferromagnetic material constituting the end pole faces of the armature and the core, and the region of decreased magnetic permeability between the core and the armature, when the coil is energised and before there is any wear of the engaging end pole faces of the core and the armature, being constituted by an air gap and the layer of the hard non-magnetic coating.

Alternative Claim 5

5. An electrical relay comprising a housing;

a stationary core of ferromagnetic material disposed within the housing, the core having a base and a pair of legs extending substantially perpendicularly from the base, said core having a centre pole face and a pole face at the end of each leg;

a freely movable armature of ferromagnetic material having a centre pole face and two end pole faces, the armature being disposed in the housing so that each pole face on the core is opposite a corresponding pole face on the armature and the armature being loosely guided within the housing for rectilinear straight line motion;

a region of decreased magnetic permeability including an air gap being provided between the centre pole faces of the core and the armature to aid separation thereof;

an energising coil associated with the core, so that when the coil is energised a magnetic force is induced which moves the armature from an open position to a closed position in which a three leg magnetic circuit is formed;

a plurality of stationary pairs of electrical contacts mounted on the housing;

a plurality of pairs of electrical contacts mounted on the movable armature and forming with the stationary pairs of electrical contacts a normally open switch and a normally closed switch; characterised in that

means is provided for giving an audible signal of the need to replace the device, the said means comprising on at least one of the centre pole faces but not on any of the end pole faces, a layer of a hard non-magnetic coating of a non-magnetic material having much greater resistance to wear than the ferromagnetic material constituting the end pole faces of the armature and the core, the layer ajoining the air gap.

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METHOD CLAIM

A method of obtaining from an electromagnetic device, when worn, an audible warning of the need to replace the device, comprising mounting an armature of ferromagnetic material for rectilinear sliding movement with respect to a stationary core of ferromagnetic material, the core having a centre pole face and two end pole faces respectively cooperating with a centre pole face and two end pole faces on the armature, coating the centre pole face of the armature or the core, but not any of the end pole faces, with a layer of a hard-non-magnetic material such as tungsten carbide, so that when a coil of the device is energised the end pole faces of ferromagnetic material on the armature and the core are in direct contact and the centre pole faces are separated by a region of decreased magnetic permeability which is constituted by an air gap and the layer of the hard non-magnetic material which is more wear-resistant than the ferromagnetic material constituting the end pole faces of the armature and core, and causing wear on the end pole faces of the armature and the core to an extent greater than that necessary to eliminate the air gap between the centre pole faces by repeatedly energising the coil to bring the end pole faces of the armature and the core into direct contact, and thereby causing the device, upon further energisation of the coil, to chatter.

V. In the course of the oral proceedings which were held on 06.07.82 the applicant limited his claims to the use of tungsten carbide, after the Board of Appeal had expressed the opinion that in the expression "hard non-magnetic coating of a non-magnetic material having much greater resistance to wear than" the terms "hard" and "much" do not have a precise meaning, so that the claims were not allowable under Article 84 EPC.
The applicant requested that a patent be granted on the basis of the so limited claims.

VI. In the Notice of Appeal, in the reply to the Rapporteur's communication and in the oral proceedings the applicant argues essentially as follows:
The man skilled in the art would not apply the teachings of a document pertaining to an electromagnetic device for pivotal movement (i.c. FR-A-1408864) to an electromagnetic device for longitudunal movement to which the application pertains because of the inherently different structure of these two devices and the different problems they presented. Moreover the device according to FR-A-1 408 864 is a heavy duty contactor, which will probably fail as a consequence of contact wear rather than as a consequence of magnetic sticking.
Even if the man skilled in the art had considered applying the teaching of the FR specification, he would have used the plastic material preferred in that document and not a hard material such as tungsten carbide and thus would not have obtained the clearly audible chatter, which results automatically from the use of tungsten carbide. In all cited documents concerning the use of tungsten carbide this material is applied to those pole faces which engage one another during operation, in order to extend the life of the device which is a purpose quite different from the double purpose according to the present application: prevent magnetic sticking and provide an audible signal (chatter) at the end of the useful life of the device.

Reasons for the decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. Devices as described in the introductory part of claim 1, comprising the combination of either a substantially U-shaped core and T-shaped armature or of a substantially E-shaped core and armature and in which an airgap is present to aid separation of core and armature are generally known.

   It is also well established practice that in such devices, where the armature executes a linear movement, the armature is loosely guided to prevent it from sticking to its guiding channel and to diminish friction losses and wear .(cf.US 3.185.90 and GB 1.272.916).

   Finally, it has been proposed to realise such an airgap by providing at least part of the pole faces with a layer consisting of a non-magnetic wear-resistant material, such as tungsten carbide (cf. US 3.573.690, DT 1.158.174).

3. According to the application as filed the invention is intended to provide a remedy to the problem that coating all the pole faces is time-consuming and costly and that the added reluctance caused by the non-magnetic material adversely affects the operation of the device. This is a problem of which the man skilled in the art is of course well aware.

4. From the FR 1.408.864 an electromagnetic device having a pivoting armature is known in which only one of the central pole faces defining an airgap is covered with a non-magnetic wear-resistant material "to prevent the airgap from disappearing and the consequential sticking of the armature if the faces of the other two poles are worn away". (p.2, left column,line 49-52)

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It is well known that in order to prevent magnetic sticking of the armature due to residual magnetism an airgap must be provided somewhere in the magnetic circuit. Although not explicitly stated in the document, it is immediately clear to the man skilled in the art that the solution proposed in the FR specification to retain such an airgap under conditions of substantial wear is a simpler one than covering all the pole faces, as is apparently implicit in the other cited documents.

Therefore, although this measure is described in connection with a relay having a pivoting armature it is obvious that it can be applied for the same purpose to an electromagnetic device having a linearly moving armature.

The facts that substantial clearances are not likely to be present in the device according to the FR specification, at least before the device has been in use for some time and that possibly the amounts of wear occurring on the different pole faces may in the case of a pivoting armature be different from those in the case of a linearly moving armature, do not seem significant here and would certainly not deter the man skilled in the art from applying this known measure to a device with linear movement for the same purpose.

In the Board's opinion it must be expected from a designer who is faced with a problem concerning a device with a linearly movable armature to consult also the prior art in the very related field of devices with pivoting armatures if the problem is common to these two types of device, which is clearly the case here. For the same reason it is immaterial whether the device according to the FR specification could be regarded as a heavy duty contactor or not.(Incidentally the application does not contain any limitation which would exclude such devices from the protection sought.)

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5. With respect to the non-magnetic material, the FR specification states that this material should be "a - non magnetic material, preferably plastic, having a great resistance to wear by compression and friction such as for example teflon".No reason is given, however, for this preferred choice(p.2,left column, line 38-41).

As far as selection of materials is concerned, the Board generally considers it as forming part of the normal activities of the man skilled in the art to select from the materials which are known to him as suitable for a certain purpose the most appropriate one, and this also in the case where he is presented with no more than an unreasoned preference for a specific material in a document forming part of the prior art.

Now it is well known that tungsten carbide is one of the small group of materials which have been proposed in the prior art as having a greater resistance to wear than the material normally used for the core and armature of electromagnetic devices of the kind under consideration(cf. documents cited in the search report).

Moreover it is known that its use is not limited to cases where pole faces are subject to continuous impacts but that this material can be used in a general sense in magnetic devices to create an anti-corrosion effect or a magnetic isolation. (See DT 1.158.174,column 1, line 47-51).

Finally, it is known that tungsten carbide has several advantages over other materials used for the same purpose and that it can be relatively easily applied (see DT 1.158.174, column 2, line 50 - column 3,line 6 and the description of the application p.9, line 16-20).

The Board therefore considers that no inventive step is present in the selection of this particular material.

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6. The applicant has stressed that the choice of the material has the advantage that a clear chatter is obtained without any further measures at the end of the useful life of the device.

The Board considers, however, that if having regard to the state of the art it would already have been obvious for a person skilled in the art to arrive at something falling within the terms of a claim, because an advantageous effect could be expected to result from the combination of the teachings of the prior art documents, such claim lacks inventive step, irrespective of the circumstance that an extra effect (possibly unforeseen) is obtained.

7. The applicant, referring in particular to the passage in the FR specification where it is stated that the non-magnetic material "... at the time of closing fills, completely or not, the small airgap which is generally present ...."(p.2,left column line 43-45),contends that it would follow that an embodiment having an airgap already completely filled at the beginning of the useful life of the device must be considered as the preferred embodiment according to the FR specification.

The applicant furthermore contends that it would follow then that a hard material, such as tungsten carbide,is excluded because in this preferred embodiment a compressible material is required since otherwise airgaps would develop in the two outer branches of the magnetic circuit which after a short time of use would make the device unsuitable for its purpose. However, from the fact that the FR specification mentions only a preference for a plastic it is clear that other known materials, i.e. metallic ones,were also contemplated and could be used for the purpose,which materials can hardly be regarded as compressible.

Moreover applicants reasoning on this point is only applicable in a situation where indeed the airgap is filled completely

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from the beginning, which is, in the opinion of the Board, not the most likely situation, in view of the stated purpose of the coating (cf. the quotation in the first phrase of para.4).

It is more likely therefore that the man skilled in the art would read the passage on the completely filled or not airgap as referring to a situation where the airgap is not completely filled at the beginning, but becomes so after the outer poles have worn down.

8. Consequently the subject matter of claims 1 and 5 does not involve an inventive step and the same applies to the alternative claims presented by the applicant. These claims therefore are not allowable.

9. Claims 2 to 4 and 6 to 8 are dependent on claims 1 and 5 respectively and are therefore not allowable either.

For these reasons, it is decided that:

The appeal against the decision of the Examining Division 051 of 04.03.81 is dismissed.

The Registrar: The Chairman:

J. Rückerl G. Korsakoff