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D E C I S I O N
of 14 July 1995

Case Number: T 0287/93 - 3.2.2

Application Number: 84903638.9

Publication Number: 0159337

IPC: D21G 1/02

Language of the proceedings: EN

Title of invention:

Method and device for electromagnetic heating of a roll, in particular of a calender roll, used in the manufacture of paper or of some other web-formed product

Patentee:

Valmet Oy

Opponent:

1. Kleinewefers GmbH
2. Eduard Küsters Maschinenfabrik GmbH & Co. KG

Headword:

-

Relevant legal provisions:

EPC Art. 56, 84, 123

Keyword:

- "Amendments - broadening of claims (no)"
"Clarity (yes)"
"Inventive step (yes) - general technical knowledge"

Decisions cited:

-

Catchword:

-



Case Number: T 0287/93 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 14 July 1995

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Decision under appeal: Decision of the Opposition Division of the
European Patent Office dated 25 January 1993
revoking European patent No. 0 159 337 pursuant to
Article 102(1) EPC.

Composition of the Board:

Chairman: H. J. Seidenschwarz
Members: M. G. Noel
J. C. M. de Preter

Summary of Facts and Submissions

- I. European patent No. 0 159 337 was revoked by a decision of the Opposition Division on the ground that its subject-matter did not involve an inventive step having regard to the prior art documents:
- (1) US-A-4 384 514
 - (2) DE-B-1 038 671, and
 - (12) "Induktive Erwärmung", Jörg Fasholz, RWE, ISBN 3-87200-612-6, Energie-Verlag Heidelberg, 2. Aufl. 1979.
- II. The reason given by the Opposition Division was that with respect to the teaching of document (1) considered as closest prior art, the subject-matter of Claim 1 only differed by three features, each known per se from either one of the above-mentioned prior art documents or based on the general technical knowledge of the skilled person. These differences, therefore, did not involve an inventive step.
- III. The Appellant (Proprietor of the patent) lodged an appeal against this decision on 22 March 1993, paying the fee for appeal and submitting a Statement of Grounds in due time.
- IV. Oral proceedings were held on 14 July 1995, in the course of which the Appellant upheld his main request based on the claims in the version as revoked and also submitted an auxiliary request.

Claim 1 according to the main request reads:

"Method for electromagnetic heating by induction of a roll, in particular of a calender roll, used in the manufacture of paper or of some other web-formed product, in which method a variable magnetic flux is directed to the shell of the roll (10), free of contact, by a magnetizing device (20) through air gaps (40a, 40b, 40c), the said magnetic flux inducing eddy currents in the shell of the roll (10), which eddy currents generate heat owing to the resistance of the shell of the roll, the magnetizing device (20) comprising a plurality of component cores ($20_1 \dots 20_N$) side by side, which are excited by a common magnetizing current or each by a respective magnetizing current provided by a resonance circuit (37) or a respective resonance circuit, and in which method the magnetizing device (20) is located outside the shell of the roll (10) such that the magnetic flux is directed to the outer circumferential surface (10') of the shell, and the width of the air gap (Δ) between each of the said component cores ($20_1 \dots 20_N$) and the outer circumferential surface (10') of the roll is adjusted, and in the said heating, the frequency (f_s) of the magnetizing current of the component cores, is within the range of $f=0.5$ to 50 kHz, characterized in

- (i) that the temperature profile of the surface of the roll (10) in the axial direction thereof and/or the thickness profile of the web-formed product treated on the roll are measured to provide signals for carrying out said air gap width adjustment so as to automatically control the distribution of the heating effect in the axial direction (K-K) of the roll, and
- (ii) that the quantity representing and/or determining the impedance of the resonance circuit (37) or each resonance circuit, that is the current flowing in the resonance circuit, or any other electrical quantity, or

the width of the air gaps, is measured to provide a return signal (b and/or c) or return signals ($e_1 \dots e_N$) for adjusting the operating frequency (f_s) of the magnetizing current(s) of the cores automatically, such that this frequency is provided near above or below the resonance frequency (f_r) and at a safe distance therefrom."

V. In their written statements and during oral proceedings the contentions of the parties were as follows:

- (i) The Appellant argued that the subject-matter of Claim 1 was not only clear and fairly based on the application as originally filed but also involved an inventive step since three documents had to be combined to challenge the patentability of Claim 1 in suit.

In document (1), although a resonance circuit was shown in Figure 4, the frequency of the magnetic field generated by the coils was not regulated. Also the setting of the air gap for varying the heating energy was not performed in a controlled way; a closed loop control was only suggested in an alternative embodiment using permanent magnets. Document (2) described manual adjustment of the air gap without any possibility of controlling the operating frequency of the magnetizing current. Besides, no resonance circuit was provided in this document.

Document (12) described the use of a resonance circuit for induction heating in general, working next to its resonance frequency. However, the control of the frequency in relation to measuring parameters was not disclosed. Therefore, the

skilled person could not arrive at the subject-matter of Claim 1 when considering these documents.

(ii) The Respondent 1 (Opponent 1) argued that the wording of Claim 1 had been amended during the opposition proceedings to extend beyond the original disclosure and also in such a way as to extend the protection conferred, both contrary to the provisions of Article 123 EPC. Further, Claim 1 was not clear (Article 84 EPC) and thus left the reader in doubt as to the real extent of the protection conferred. As to inventive step, document (1) described a control method and apparatus for induction heating having a resonance circuit, the operating frequencies of which were within the same range as those used in the patent in suit. For a skilled person it was obvious that the frequency had to be controlled to provide optimum heating as need be. Since document (1) also provided for air gap control in the case of permanent magnets, the same could also be applied in the case of magnetizing coils using sliding cores without the exercise of any inventive skill.

(iii) The Respondent (2) (Opponent 2) argued that document (1) described an air gap control using permanent magnets only by way of an example. In fact, a more general concept of control had to be understood, including also control of the air gap in the case of magnetizing coils as well as control of the operating frequencies of the resonance circuit within the indicated range and possibly near the resonance frequency proposed in document (12). Also, the provision of a control

signal expressed as a function of the impedance of the resonance circuit did not exceed the normal skill of a person in the art.

VI. The Appellant requested that the decision under appeal be set aside and that the patent be maintained either in the form of the main or the auxiliary request. The documents referring

to the main request are:

- Claims 1 to 8 received on 15 October 1992.
- Description: - columns 1 to 4 filed during the oral proceedings,
- columns 5 to 10 of the patent as granted.
- Figures 1 to 7 of the patent as granted.

to the auxiliary request are:

- Claims 1 to 7 filed during the oral proceedings.
- Description and Figures as in the main request.

The Respondents requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments (Article 100(c) and 123 EPC)*
 - 2.1 Preamble of Claim 1 (main request)

The expression "excited by a common magnetizing current or each by a respective magnetizing current" is fairly supported by the application as originally filed (second characterising feature of original Claim 1 and original Claims 4 and 5). Since the magnetising current or currents are provided from the power taken out of the three-phase network, it is quite clear that magnetizing current and power have the same general meaning in the present context.

The subsequent expression "provided by a resonance circuit or a respective resonance circuit" is supported by original Claims 4 to 6. According to the original description, two embodiments are provided, one with a plurality of component cores, a common induction coil 30 and a resonance circuit 37, in accordance with Figure 5 and text referred to (see page 10, lines 28 to 38), the other embodiment in which each core is provided with an induction coil and a separate resonance circuit, in accordance with Figure 6 and text referred to (see page 13, lines 15 to 31). Therefore, the alleged broadening of the claimed subject-matter with respect to the original disclosure is unfounded. Since, further, no other possibility exists of mounting the capacitor either in series or in a parallel configuration, there is no need to specify Claim 1 more closely by the incorporation of specific constructional details.

2.2 Characterising feature (i) of Claim 1

The feature according to which "the temperature profile of the surface of the roll in the axial direction thereof and/or the thickness profile of the web-formed product treated on the roll are measured" is based on the original disclosure, page 10, lines 12 to 26 and original Claims 9 and 21. The claims do not need to incorporate all the details of the description, unless it becomes essential to distinguish it from the state of the art.

The rest of the feature "to provide signals for carrying out said air gap width adjustment so as to automatically control the distribution of the heating effect in the axial direction of the roll" is derivable from the same paragraph as above since "the adjustment of the positions of the cores" corresponds to "said air gap width adjustment". See also the relevant passage on page 7, lines 8 to 11 of the original description. Article 123 EPC does not require a word for word correspondence between the wordings of the amended claim and those of the application as filed.

2.3 Characterising feature (ii) of Claim 1

The feature according to which "the quantity representing and/or determining the impedance of the resonance circuit or each resonance circuit is measured" is based on original Claims 7 and 8. Since the present Claim 1 further specifies which parameters are likely to be measured, that is e.g. "the current flowing in the resonance circuit", any ambiguity is thus avoided. Among "any other electrical quantity", it remains only the voltage applied to the coil and the operating frequency of the resonance circuit, both made adjustable (see page 10, lines 3 to 5 and page 14, lines 1 to 6).

Although the specific expression "return signal" is mentioned in the original description only with reference to an alternative embodiment for characterising the connection (not shown) between the stepping motors 29 and the control block 47 (see page 13, lines 11 to 13), it is clear that what is generally meant by "return signals b, c or $e_1 \dots e_N$ " in Claim 1 in suit is any feed back control signal characterising an automatic closed control system as specified in the original application (see page 10, lines 12 to 15; page 13, lines 2 to 11 and 22 to 28).

2.4 It results from the foregoing that the amendments brought to the subject-matter of Claim 1 are not such as to extend beyond the content of the application as filed in conformity with the requirements of Article 123(2) EPC. With respect to the version as granted, amendments have been made only by way of additional, more specific features. Therefore, the protection conferred has been narrowed, which meets also the requirements of Article 123(3) EPC.

3. *Clarity (Article 100(b) and 84 EPC)*

The last portion of the characterising feature (ii) according to which "such that this frequency is provided near above or below the resonance frequency and at a safe distance therefrom" was taken from the original Claim 6. This feature interpreted as it is necessary in the light of the description under Article 69 EPC and its protocol on interpretation states clearly that in order to eliminate phenomena of instability and to keep the high efficiency of the heat transfer, it is recommended to select the operating frequencies on either side of the resonance frequency, so as to operate close to ("near") the resonance frequency and, at the same time, "at a safe distance therefrom" within the

frequency ranges from f_{a1} to f_{y1} or from f_{a2} to f_{y2} which correspond to the linear portions of the curve illustrated on Figure 7 (see patent, column 8, lines 34 to 49; column 9, lines 28 to 38 and column 10, lines 42 to 49). Therefore, the term "near" is not inconsistent with the expression "at a safe distance".

Moreover, the last feature of Claim 1 referred to above is introduced by the terms "such that" and, as such, is confined to giving a functional indication, in the form of a result. Such piece of information is perfectly clear to a skilled person having to perform the claimed method as both the resonance circuit and the frequency range are specified in the pre-characterising portion of Claim 1 and thus already considered as known from the prior art. Besides, it is to be noticed that document (12) states with similar wordings (see page 24, first paragraph) that the resonance circuit operates near the resonance frequency ("nahe seiner Resonanzfrequenz betrieben"). Therefore, the subject-matter of Claim 1 is clear enough within the meaning of Article 84 EPC.

4. *Invention*

The subject-matter of Claim 1 relates to a method for induction heating of a roll used in the manufacture of paper or some other web-formed product, in particular a method in which the heating power can be rapidly and accurately controlled so as to better control the thickness profile and the surface properties of the web to be calendered. It is thus important that the temperature profile at the surface of the roll in its axial direction be controlled. For that reason, a plurality of heating elements each consisting of a magnetic core excited by a magnetizing coil are disposed along the full length of the roll. In the first

embodiment of the contested patent, with reference to Figures 1 and 6, each magnetic core is provided with a separate induction coil, while in the second embodiment, with reference to Figure 2 to 5, all cores are excited by a common induction coil.

The heating power, i.e. the quantity of heat dissipated in the roll because of eddy currents induced by the magnetic field is given by the relation $P \hat{=} B^{1.54} \cdot f^{0.5}$ mentioned in the patent (see column 6, lines 32 to 37), whereby control of the heating power is dependent on the control of both the frequency and the intensity of the magnetic field, the latter being in its turn related to the magnitude of the air gap between the heating element and the roll surface.

The claimed method, therefore, comprises two closed control systems according to features (i) and (ii), respectively:

- an air gap control based on measurements of the temperature profile of the roll surface and/or of the thickness profile of the web. To this end, the detected values in unit 41 are compared with set values in unit 42 so as to generate signals S_{1-N} for adjusting the positions of the magnetic cores through stepping motors 29.
- an operating frequency control based on the impedance detection of the resonance circuit made either directly by measuring the magnetizing current (line b) or indirectly by measuring the air gap (line c).

Although in Claim 1 wordings such as "adjustment" and "adjusting" are used for characterising the preceding steps, the present method is actually concerned with

real control systems since closed loops and feedback signals are used. For instance, control signals (line d) from the control unit 47 are applied to the converter 34 for controlling its frequency, as it is rightly specified in the contested patent (see column 2, line 32: "adjusted in a controlled way" and column 7, line 47: "automatic closed control system").

5. *Novelty*

5.1 Document (1) describes a control method and apparatus for controlling the profiles of a nip through which a web of material is passed, whereby the temperature profile of the roll surface and the thickness of the web-formed product are measured, comprising a localized induction heating arrangement having all the features recited in the pre-characterising portion of Claim 1 in suit and also the first portion of characterising feature (i). A variable magnetic flux is directed to the roll 5 by a magnetizing device 9, through air gap, said magnetic flux inducing in the roll eddy currents which in turn generate heat. The magnetic field generating device comprises a plurality of induction coils 13 mounted on slidably adjustable cores 15 so that the position of the magnetizing device, i.e. the air gap, can be adjusted with respect to the roll surface.

However, air gap adjustment is not automatically controlled in the sense of the contested patent since once the desired position of the coil relative to the surface of the roll has been obtained, the slidable supporting arm 17 is locked in position (see column 4, lines 52 to 55).

According to an alternative embodiment using permanent magnets, energy is said to be varied by varying the distance of the magnet from the roll (see column 7,

lines 1 to 3). This does not mean, however that adjustment of the air gap is made in a controlled way, the more since a control circuit and measuring parameters are not described.

The magnetizing current is provided by a resonance circuit shown only schematically in Figure 4 and operating at frequencies ranging from 0 to several 100 kHz, preferably in the range of 1 to 10 kHz. Although the frequency is made variable, i.e. adjustable, this does not mean, again, automatic control of said frequency. Moreover, operating the resonance circuit at a frequency close to its resonance frequency is not specified. The only control circuit contemplated in document (1) relates to controlling the power applied to the coils at regular time intervals as determined by the operation of the timer 33, by means of sensing devices measuring a property of the web, e.g. its thickness (see column 6, lines 17 to 35). Therefore, neither air gap control nor control of the operating frequency is disclosed by document (1).

- 5.2 Document (2) describes an apparatus for heating portions of rollers according to which U-shaped cores 16₁ are positioned relative to the rollers 11 to modify the temperature of the end portions thereof. In the embodiment according to Figures 3 and 4, the rotation of a handwheel 39₁ causes a slide 29 and consequently the cores to move to and from the roller for continuously varying the air gap between them and thus the heating power transferred to the roll. Since the air gap is adjusted manually, no automatic control is provided. Document (2) is also silent as to the possibility of adjusting the operating frequency of the coils which are normally supplied through a source of alternating current using industrial frequencies.

5.3 Document (12) describes induction heating systems in general, using either parallel or series resonance circuits operating near the resonance frequency in the range from 0.5 to 10 kHz so as to limit the reactive energy consumption (see page 24, first paragraph). However, a more specific application of this basic circuit in a heating system incorporating automatic control of operating parameters is not disclosed in this document.

5.4 With respect to the teaching of the closest prior art document (1) the subject-matter of Claim 1 differs in that:

- signals are provided for carrying out said air gap width adjustment so as automatically to control the distribution of the heating effect in the axial direction (K-K) of the roll (part of feature (i)),

- the quantity representing and/or determining the impedance of the resonance circuit (37) or each resonance circuit, that is the current flowing in the resonance circuit, or any other electrical quantity, or the width of the air gaps, is measured to provide a return signal (b and/or c) or return signals ($e_1 \dots e_N$) for adjusting the operating frequency (f_s) of the magnetizing current(s) of the cores automatically, such that this frequency is provided near above or below the resonance frequency (f_r) and at a safe distance therefrom (feature (ii)).

5.5 Since none of the cited documents reveals the combination of all the features of Claim 1, its subject-matter must be regarded as novel within the meaning of Article 54(1) EPC.

6. *Inventive step*

The differences mentioned above (see point 5.4) form the solution of the technical problem underlying the present patent, providing a method by which the heating effect can be adjusted in a controlled way, rapidly in the axial direction of the calender roll, with the view to controlling the thickness profile and/or the surface properties of the webs to be calendered (see patent, column 2, lines 29 to 35).

In the Board's opinion even with the simultaneous consideration of all cited documents the skilled person would not be able to arrive at the heating method as claimed since, as was demonstrated before, none of these documents actually describes either of the two control systems used in the present patent and, a fortiori, the double-acting control circuit as claimed, namely:

- air gap control based on the temperature profile measurements of the roll surface and/or on measurements of the thickness profile of the web and, at the same time,
- control of the operating frequency based on impedance measurements of the resonance circuit.

Only document (1) made use of one control circuit of a different type in which the controlled parameter was the time of application of the heating power.

Thus the different controls performed in the contested patent were not only novel per se over the prior art, but also the skilled person was not prompted by any of the prior art documents to look for a new induction

heating method with the view to achieving better control over the heating effects and thus improving the quality of the paper webs.

In the present case the contribution of the inventor was not confined simply to supplementing a known method with some constructional details on the basis of common general knowledge. Here in response to a specific problem a solution of principle has been proposed which required the use of means not disclosed until the time when the invention was made. The inventive step of the solution must therefore be recognised. Though common general knowledge must be taken into account when assessing the inventive step of a solution, care is required not to select at random from general knowledge so as to decide that the solution is obvious to the skilled person. A solution may be patentable when based on the application of common general knowledge if it is applied in a way which had not been suggested by the state of the art.

7. For all the foregoing reasons the subject-matter of Claim 1 according to the main request is not obvious to a person skilled in the art and thus involves an inventive step as required by Article 56 EPC. Consequently, Claims 2 to 8 which depend from Claim 1 can also stand.

Order

For these reasons it is decided that:

1. The contested decision is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the following basis:
 - Claims 1 to 8 received on 15 October 1992.
 - Description: - columns 1 to 4 filed during the oral proceedings,
 - columns 5 to 10 of the patent as granted.
 - Figures 1 to 7 of the patent as granted.

The Registrar:



S. Fabiani

The Chairman:



H. Seidenschwarz