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**Datasheet for the decision
of 23 September 2022**

Case Number: T 2467/18 - 3.4.01

Application Number: 11760590.7

Publication Number: 2594119

IPC: H05H1/34, B23K9/095

Language of the proceedings: EN

Title of invention:

FAILURE EVENT DETECTION IN A PLASMA ARC TORCH

Patent Proprietor:

Hypertherm, Inc.

Opponent:

Kjellberg Finsterwalde Plasma und Maschinen GmbH

Headword:

Plasma arc torch failure detection / HYPERTHERM

Relevant legal provisions:

EPC Art. 56

RPBA 2020 Art. 13(1)

Keyword:

Inventive step - (no)

Amendment to appeal case - amendment overcomes issues raised
(no)



Beschwerdekammern

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Case Number: T 2467/18 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 23 September 2022

Appellant: Hypertherm, Inc.
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
30 July 2018 concerning maintenance of the
European Patent No. 2594119 in amended form.**

Composition of the Board:

Chair C. Almberg
Members: B. Noll
P. Fontenay

Summary of Facts and Submissions

- I. The opposition against the European Patent 2 594 119 was based on the grounds of lack of novelty and inventive step, Article 100(a) EPC, and lack of sufficient disclosure, Article 100(b) EPC.
- II. The Opposition Division decided that the patent in amended form met the requirements of the EPC.
- III. Appeals against this decision were filed by the patent proprietor and the opponent.
- IV. With its statement of grounds of appeal, the proprietor requested maintenance of the patent as granted (main request) and submitted sets of claims as auxiliary requests 1-8. Auxiliary request 3 corresponded to the version which was considered allowable by the Opposition Division. In its corresponding statement, the opponent requested the patent's revocation.
- V. In response to the opponent's reply to appeal, the patent proprietor submitted further auxiliary requests 4a and 5a.
- VI. In a communication sent with the summons to oral proceedings, the Board gave a preliminary opinion on all claim requests, in particular regarding novelty and inventive step, and oral proceedings were conducted.

VII. The proprietor's final requests are that the decision under appeal be set aside and the opposition rejected (main request) or that the patent be maintained in amended form on the basis of one of auxiliary requests 1, 2, 3, 4, 4a, 5, 5a, 6, 7 or 8.

VIII. The opponent's final request is that the decision be set aside and the patent revoked.

IX. The following documents are relevant for the decision:

D1: DE 197 56 445 A1

D2: JP S61269975 A

X. Identical claim 1 of the main request and auxiliary request 1 reads (reference signs omitted):

*A method of determining a failure event of consumable for a plasma torch, the method comprising:
monitoring at least one of an operating current or an operating voltage during a transfer arc mode of the plasma arc torch;
determining when at least one parameter associated with the operating current or the operating voltage exceeds a tolerance threshold for a time period indicative of the failure event; and
shutting off at least one of the operating current or the operating voltage of the plasma arc torch when the at least one parameter exceeds the tolerance threshold for the time period.*

- XI. Claim 1 of auxiliary request 2 differs from claim 1 of the main request in that the determining step is worded as follows:

determining at least one parameter associated with the operating current or the operating voltage, determining when the at least one parameter associated with the operating current or the operating voltage exceeds a predetermined tolerance threshold for a predetermined time period, wherein the time period is set to less than 1 second and is indicative of the failure event.

- XII. Claim 1 of auxiliary request 3 adds to claim 1 of auxiliary request 2

wherein the failure event includes an absence of an emitter in an electrode, a large loss of consumable material, an arc emitting off of a part of the electrode other than the emitter, or a combination thereof, or wherein the failure event includes installing a wrong consumable for a type of operation of the plasma torch.

- XIII. Claim 1 of auxiliary request 4 differs from claim 1 of auxiliary request 2 by defining the time period as

from 1 millisecond to less than 1 second.

- XIV. Claim 1 of auxiliary request 4a differs from claim 1 of auxiliary request 4 by defining the time period as

from about 1 millisecond to less than 1 second.

- XV. Claim 1 of auxiliary request 5 differs from claim 1 of auxiliary request 3 by defining the time period as

from 1 millisecond to less than 1 second.

- XVI. Claim 1 of auxiliary request 5a differs from claim 1 of auxiliary request 5 by defining the time period as

from about 1 millisecond to less than 1 second.

- XVII. Claim 1 according to auxiliary 6 reads (reference signs omitted):

*A method of determining a failure event of consumable for a plasma torch, the method comprising:
determining whether the plasma torch is being operated in a transfer arc mode;
monitoring at least one of an operating current or an operating voltage;
performing, when the plasma torch is in the transfer arc mode, steps including:
using a high-pass filter to filter the operating current or operating voltage to remove direct current and low-frequency components of the operating current or operating voltage, thereby generating a filtered operating current or operating voltage;
determining, when the plasma torch is in the transfer arc mode, when at least one parameter*

*associated with the filtered operating current or the operating voltage exceeds a tolerance threshold for a predetermined time period indicative of the failure event; and
shutting off at least one of the operating current or the operating voltage of the plasma arc torch when the at least one parameter exceeds the tolerance threshold for the time period.*

XVIII. Identical claim 1 of auxiliary requests 7 and 8 differs from claim 1 of auxiliary request 6 in that the alternative of monitoring an operating voltage is deleted, and further defining

wherein the parameter is current amplitude.

XIX. The parties' submissions, insofar as they are relevant for this decision, are discussed in the Reasons, below.

Reasons for the Decision

General introduction

1. The patent relates to a plasma arc torch. It is about monitoring the instantaneous condition of a consumable component of the torch. A consumable component may be, for example, the electrode or the nozzle. These components gradually wear out during the normal operation of the torch when processing a workpiece until they fail. Operating the torch with a faulty component may damage the torch as a whole. It may also result in poor results of the processing of a

workpiece. The monitoring aims at detecting a failure of the component early and quickly enough to prevent damage to the torch or the workpiece under process (cf. the description in the patent specification, [0003]-[0006]).

Main request - novelty, inventive step

2. D1 is in the same field. Its purpose is to determine a wear condition of the nozzle of a plasma arc torch even before the plasma arc torch starts workpiece processing. D1 aims at ensuring a high quality of the workpiece processing (page 3, lines 1.3).
3. D1 discloses that for detecting whether the torch is in an acceptable condition, the voltage of the plasma arc is monitored. D1 suggests monitoring a pilot plasma arc, as this has already been established between the electrode and the nozzle even before the actual processing of the workpiece begins. However, D1 is not restricted to monitoring only the pilot plasma arc. It is suggested (D1, page 3, lines 7-9) that instead of monitoring the voltage between the electrode and the nozzle, i.e. the voltage associated with the pilot plasma arc, that of an arc between the electrode and the workpiece may likewise be monitored. A plasma arc between the electrode and the workpiece indicates that the torch is operated, in the wording of the patent, in a transfer arc mode.
4. For monitoring the arc voltage, D1 discloses that a mean or an effective voltage is determined, and that the ratio between the mean / effective voltage and a reference parameter, or its inverse, is considered (page 3, lines 11-14). This ratio is, in the wording of the patent, a parameter associated with the operating

voltage. Further, the ratio is compared with a tolerance threshold. When the ratio exceeds the threshold, the voltage supply for the plasma torch is switched off (page 3, lines 36-41).

5. The skilled person would have understood from D1 that considering a mean / effective voltage instead of a single instantaneous voltage value reduces the noise in the measurement. This reduces the risk of an erroneous judgement which would be considerably higher if only a single, noisy voltage value were considered. The skilled person would further have known from common knowledge in signal processing that the calculation of the mean or effective value becomes more exact when considering a higher number of measured values, but that this is inherently linked with an increase in acquisition time for detecting a "true" fault condition.
6. Since D1 discloses reducing the noise by calculating a mean / effective value and comparing this with a threshold, it does not disclose the feature of claim 1 that one parameter associated with the operating current or the operating voltage exceeds a tolerance threshold for a time period indicative of the failure event.
7. Having found a distinguishing feature, and thus claim 1 to be novel over D1 (Article 54 EPC), the Board moves to see what technical effect, if any, that feature brings.
8. The proprietor argued that the claimed method would lead to a reliable and effective way of suppressing false-positive alarms, since the monitored voltage would have to continuously exceed the threshold during

a time period before generating an alarm and not merely once as in D1. Exceeding the threshold only once as in D2 would also generate false positive alarms.

9. This argument is not convincing. The processing according to claim 1, by considering and evaluating a sequence of measured values together, avoids that a single measured value alone is decisive for the detection of a fault condition. However, a consideration and evaluation of a sequence of measured values is equally carried out in D1, albeit by using a different mathematical operation. The patent proprietor has not convincingly shown that a separate comparison of each measured value of a sequence with a threshold leads to a better reduction of false positive alarms than a consideration of the mean or effective value.
10. Therefore, the Board concludes that the signal processing defined in claim 1 merely relates to an alternative calculation to that of D1 for detecting a fault condition from the measured voltage values with some reliability. The use of the alternative calculation does not result in a particular technical effect. For the person skilled in the art and familiar with mathematical calculations for reliably detecting a fault condition from measurement values, the method defined in claim 1 would have been an obvious alternative.
11. The proprietor further argued that D1 was about monitoring the plasma arc torch before processing a workpiece. The patent was about monitoring the plasma arc torch during processing a workpiece.
12. This argument is not convincing either. The claim only defines that the voltage is monitored during a transfer

arc mode of the plasma arc torch. This is equally suggested in D1, see above, Reasons, point 3. The method is, therefore, not distinguished from D1 in this respect.

13. For the reasons above, the Board concludes that the method of claim 1 lacks an inventive step (Article 56 EPC). The ground for opposition pursuant to Article 100(a) EPC prejudices the maintenance of the patent as granted.

Auxiliary request 1 - inventive step

14. Claim 1 of auxiliary request 1 is identical in wording to claim 1 of the main request and lacks an inventive step for the above reasons. Auxiliary request 1 is, therefore, not allowable (Article 56 EPC).

Auxiliary request 2 - inventive step

15. As regards the additional feature of setting the time period for considering the measured values to less than 1 second, the proprietor argued that this further limitation was to set a safety interval so as not to cause damage to the torch. D1 did not hint at restricting a time period to such a duration.
16. The Board does not agree. D1 suggests a range for taking measurement samples between 0.2s and 1.5s (D1, page 3, line 45). Setting an upper limit for a measurement duration to 1s was an arbitrary selection and obvious to the skilled person knowing the range suggested in D1. This selection does not contribute to

an inventive step. The auxiliary request 2 is, therefore, not allowable (Article 56 EPC).

Auxiliary request 3 - inventive step

17. As regards the types of failure events defined in claim 1, the proprietor argued that the definition of types was a further limitation of the technical framework of the invention, as the skilled person would have to associate a specific time period to each type.
18. The Board considers that there is no plausible association between a particular type of defect and a particular duration of a time period required to recognize this type. It is in particular not linked to the method for defining the time period, as there is no plausible association between these failure events and the length a time period has to be set. The list of events does, therefore, merely mention types of possible failure events which may occur and which were known to the skilled person. The list does not further limit the claimed method. Consequently, claim 1 lacks an inventive step for the reasons set out for auxiliary request 2. The auxiliary request 3 is, therefore, not allowable (Article 56 EPC).

Auxiliary request 4 - inventive step

19. As regards the further feature of setting a lower limit of the time period to 1ms in claim 1, the proprietor argued that this setting was to assure that the measurement values to be considered were for a sufficiently large time interval. The choice of this setting was not obvious from D1.

20. The Board is not convinced. D1 suggests a lower and an upper limit for the duration of a measurement interval (0.2 and 1.5s, see point 16, above). A duration of 1ms is extremely short. Assuming a realistic sampling rate for taking voltage measurement samples, the claimed duration would not have guaranteed a reasonable number of measured values sufficient for reliably suppressing false positive alarms. The choice of 1ms as the minimum measurement duration appears thus to be arbitrary. It cannot, therefore, justify the existence of an inventive step. The auxiliary request 4 is, therefore, not allowable (Article 56 EPC).

Auxiliary request 5 - inventive step

21. As regards claim 1 of auxiliary request 5, the proprietor argued that the combination of features was not rendered obvious by D1.
22. Claim 1 of auxiliary request 5 includes the additional features considered in relation to claim 1 of auxiliary requests 2 and 3 which were found to not contribute to an inventive step, see points 16 and 18, above. These features relating to a maximum duration of the measurement time and types of failure events, do not lead to any synergistic effect as they are technically unrelated. Therefore, they do not contribute to an inventive step for the same reasons set out in respect to auxiliary requests 2 and 3. Auxiliary request 5 is, therefore, not allowable (Article 56 EPC).

Auxiliary requests 4a and 5a - admissibility

23. Auxiliary requests 4a and 5a were filed in response to the opponent's reply to appeal prior to notification of the summons to oral proceedings before the Board. Their admission is, therefore, subject to Article 13(1) RPBA 2020.
24. The amendment in claim 1 is directed to overcome an objection of added subject-matter but does *prima facie* not overcome the grounds for lack of inventive step against claim 1 of auxiliary requests 4 and 5.
25. For this reason, the Board did not admit auxiliary requests 4a and 5a into the appeal proceedings.

Auxiliary request 6 - inventive step

26. D1 does not disclose that it is expressly determined whether the plasma torch is operated in a transfer arc mode and that it is specifically in the transfer arc mode the parameter exceeds a tolerance threshold indicative of the failure event. Including this feature, it is certain that a failure detection is active during the processing of a workpiece. The partial problem is therefore to provide a failure detection during the processing of a workpiece.
27. In order to provide for monitoring during processing a workpiece, the skilled person would have further considered D2. D2 aims at monitoring the torch in particular during workpiece processing, by monitoring the voltage (fig. 2-I) and frequency filtering the voltage to remove DC and low-frequency components so as to obtain a filtered voltage (fig. 2-II). D2 further discloses that the voltage is rectified and integrated (fig 1, circuit 7; fig. 2-iii) to obtain a parameter

which is compared with a threshold (fig. 1, level determination circuit; fig. 2-IV). so as to provide an alarm. Thus, D2 discloses a method of monitoring the plasma art torch which is essentially the same as that of D1 but for monitoring the plasma arc torch while it is processing a workpiece.

28. The skilled person, starting out from D1 and further considering D2, would therefore have arrived at the method of claim 1.
29. The proprietor argued that D1 and D2 related to different and mutually exclusive ways of monitoring the torch. D1 was only about monitoring before workpiece processing and would not have given any hint to the skilled person to consider it in combination with D2.
30. This argument is not convincing. D1 and D2 concern detecting the state of a plasma art torch during different states, namely before and after the start of processing a workpiece. The skilled person would have been well aware that initial monitoring before the start of the process served to determine whether the nozzle was in a good condition to start workpiece processing at all. However, this would not have led the skilled person to exclude monitoring the plasma arc torch during workpiece processing as being superfluous or even impossible. The skilled person was aware that wear of the nozzle progresses continuously just because the plasma arc torch is operating while processing the workpiece by plasma, which continuously affects the plasma arc torch as well. Therefore, the skilled person would have considered monitoring the plasma arc torch before starting processing as suggested in D1, to know whether the plasma arc torch is in a good condition for processing, as well as during operation as suggested in

D2. Contrary to the proprietor's argument, the teachings in these documents are not mutually exclusive.

31. In conclusion, the method of claim 1 lacks an inventive step (Article 56 EPC). The auxiliary request 6 is, therefore, not allowable.

Auxiliary requests 7 and 8 - inventive step

32. Claim 1 of auxiliary requests 7 and 8 is identical and defined in that monitoring is carried out solely on the operating current.
33. The processing for monitoring current amplitude is the same as for voltage. For the skilled person starting from D1, it would have been obvious, based on general technical knowledge, to monitor the operating current as an alternative to the operating voltage for monitoring the plasma arc torch, in particular as the current is directly related to the voltage.
34. Furthermore, D2 explicitly refers to the alternative possibility of observing the plasma arc voltage or plasma arc current for monitoring the plasma arc torch.
35. Therefore, claim 1 of auxiliary requests 7 and 8 lacks an inventive step (Article 56 EPC). Auxiliary requests 7 and 8 are, therefore, not allowable.

Order

For these reasons it is decided that:

1. The appealed decision is set aside.
2. The patent is revoked.

The Registrar:

The Chair:



D. Meyfarth

C. AlMBERG

Decision electronically authenticated