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D E C I S I O N
of 25 October 1994

Case Number: T 0788/93 - 3.2.1

Application Number: 89830425.8

Publication Number: 0364413

IPC: F16L 15/06, E21B 17/042

Language of the proceedings: EN

Title of invention:
Hermetic metal pipe joint

Applicant:
DALMINE S.p.A.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (after amendment, yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0788/93 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 25 October 1994

Appellant: DALMINE S.p.A.
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Decision under appeal: Decision of the Examining Division of the
European Patent Office dated 1 April 1993 refusing
European patent application No. 89 830 425.8
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: F. J. Proels
Members: P. Alting van Geusau
J. C. M. de Preter

Summary of Facts and Submissions

- I. European patent application No. 89 830 425.8 (publication No. 0 364 413), which was filed on 29 September 1989 and claims priority from an Italian application filed on 3 October 1988, was refused by the Examination Division on 1 April 1993.
- II. The Examining Division was of the opinion that the subject matter of Claim 1 filed with letter dated 17 December 1992 lacked an inventive step having regard to the disclosures of in particular
- D1: US-A-4 736 967
D2: FR-A-2 324 973.
- III. The Appellant (Applicant), having paid the appeal fee on 22 May 1993, lodged an appeal against this decision on 26 May 1993. A Statement of Grounds of Appeal was filed on 8 July 1993.
- VI. In a communication for preparation for oral proceedings auxilially requested by the Appellant, the Board drew attention to the fact that the pipe joint defined in the precharacterising portion of Claim 1 comprised both tapered seal and seat surfaces without that such a combination of features was shown in any of the available prior art documents.

The Appellant was therefore requested to cite the prior art which served in fulfilling the provisions of Rule 29(1) EPC. In case such prior art was not available it was suggested to relate the independent claim to the closest prior art on file, which appeared to be disclosed in FR-A-1 564 218 (D4).

Taking into account the explanations in D4 as to the functioning of the sealing and seat surfaces and the fact that a sealing combination of a long female cone and a short male cone for reduced contact pressure in order to avoid galling was known from US-A-2 992 019 (D9), the question was posed whether an inventive activity was necessary to apply this teaching to the construction known from D4 and whether the selection of the parameters specified in Claim 1 was significant in this respect.

VII. At oral proceedings held on 25 October 1994 the Appellant submitted Claims 1 to 4 and adapted description pages 1 to 15. The Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of these new documents together with the originally filed drawings.

Claim 1 of this set of claims reads as follows:

"1. Hermetic metal pipe joint, comprising a male element with at least one tapered thread and a female element with complementary internal threads, the end part (1) of said male element beyond its thread (3) having a seal surface (4) with a mainly axial trend and an internal tapered seat surface (5), mainly transversal, said surfaces being interacting with tapered seal (9) and seat (10) surfaces on the female end part (2),

characterised in that said two seal surfaces (4, 9) of the male and female end part (1, 2) each have a taper of between 6.25 and 9.25%, the length of the seal surface (4) of the male end part (1) which comes in contact with the corresponding seal surface (9) of the female end part (2) is between 0.5 and 2.5 mm and that said seat surfaces (5, 10) on the male end part (1) and on the corresponding female end part (2) have a taper with an

angle between 5° and 10° to a plane perpendicular to the axis of the joint, whereby said seat surfaces (5,10) operate only after interaction and energization of the threads (3) and of the seal surfaces (4,9)".

VIII In support of his request the Appellant relied essentially on the following submissions:

Many types of hermetic metal pipe joints have been developed but the prior art joints in use have not reached the performances of the joint in accordance with the invention, in particular in respect of the number of the assembly and disassembly operations of the pipe ends without that galling occurs and ensuring maintenance of consistent sealing abilities.

The joint in accordance with Claim 1 is characterised by a very particular combination of features which are not simultaneously present in any of the cited prior art joints. This combination leads to improved sealing by providing a well defined contact pressure giving optimal sealing ability and reduced galling problems. The compression of the end of the male pipe end caused by energization of the seat surfaces reduces the tensile stresses of the inner surface of the pipe and provides higher resistance to plastic deformation of the pipe ends even in the case of overtorque and at the same time supports improved sealing ability to pressure from inside but also to pressure from outside of the pipe.

The closest prior art disclosed in D4 indeed shows the use of a combination of seal and seat surfaces but in this joint the convex sealing surface on the male end is likely to give galling problems. Moreover this document leads the skilled person away from using a tapered seal surface in view of the reference on page 2, lines 13 to 17 to certain problems arising from the use of a tapered

sealing surface. Documents D1, WO-A-8402948 (D3), US-A-2 893 759 (D8) and US-A-2 992 019 (D9) show tapered seal surfaces but none of them proved to be satisfactory. The joint disclosed in D2 has a seat surface but for sealing it relies on a sealing ring of an elastic material.

The cited prior art already indicates that any variation or combination of elements in the design of hermetic metal joints is not a simple routinely choice of the designer but it implies a long search and specific experimentation to evaluate the unforecastable behaviour of the combination of the different elements of the joint and in the absence of any teaching of the prior art in the direction of the claimed combination the subject matter of Claim 1 is based on an inventive activity.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. It is admissible.
2. *Amendments*
 - 2.1 Claim 1 is based on the combination of the originally filed Claims 1 and 2. Reference numerals were inserted in accordance with Rule 29(7) EPC and some features were redrafted for clarification.

For reasons of clarity the feature "the length of the seal surface of the female element along the main generatrix being greater than that of the corresponding seal surface of the male element" as set out in the precharacterising part of Claim 1 was deleted because, in accordance with the subject matter of Claim 1, in the

assembled state of the joint both the seal surfaces on the male end female pipe ends are equal in size. For the rest the length of the seal surface of the male end part is precisely defined in the characterising part of Claim 1.

The precharacterising part of the claim is now correctly based on the closest prior art disclosed in D4.

Claims 2 to 4 are essentially repetitions of the originally filed Claims 3, 4 and 6.

In view of these assessments no objections under Article 123(2) or 84 EPC and Rule 29(1)(a) EPC arise against the present set of claims.

- 2.2 The originally filed description was amended to include a reference to the closest prior art (D4) and further contains some adaptations to bring it in line with the subject matter claimed. Further amendments concern only linguistic corrections. Therefore no formal objections arise against the present description.

3. *Novelty*

Novelty of the subject matter of Claim 1 can be concluded since none of the cited documents discloses the combination of tapered seal and seat surfaces and their specified lengths and angles.

Novelty was also not disputed in the examination proceedings and therefore further elucidations are considered unnecessary.

4. *Inventive Step*

4.1 The closest prior art (D4) concerns a hermetic metal pipe joint comprising the combination of features of the precharacterising part of Claim 1. In detail D4 discloses a metal pipe joint comprising tapered and convex seal surfaces (unlike the tapered surfaces on both the male and the female elements of the claimed joint) combined with tapered seat surfaces (as present in the claimed joint).

In accordance with the explanations given by the Appellant in the oral proceedings, such a joint is prone to galling because of the very small sealing contact area due to the (theoretical) line contact between the tapered female element and convex male element with resulting high stresses of the seal surfaces (see also the description of the present application on page 8, lines 20 to 27). Such joints are therefore not suitable for frequent assembly and disassembly operations.

4.2 The problem to be solved by the subject matter of the present application can therefore be seen in the provision of a pipe joint which overcomes the drawbacks of the prior art pipe joints, in particular as regards the improvement of consistent sealing ability after many make-up and unscrew operations and thereby prolong the useful life of the pipes (cf. page 9, lines 21 to 24 of the description).

4.3 In accordance with the characterising features of Claim 1 this object is met by providing a sealing combination of two tapered surfaces with a specified taper and contact area (see also the description page 9, lines 1 to 10) which surfaces come into contact just before the tapered seat surfaces abut to allow for further but definite increase of the contact pressure

(see page 9, lines 11 to 20) thereby reducing the risk of galling during make-up of the joint. The specified taper of the seat surfaces offers high resistance to plastic deformation even in case of overtorque and, when the joint is assembled, generates a state of tangential stress in the nib, which increases the contact pressure between the seal surfaces without causing permanent deformation (see the description page 8, lines 10 to 16).

4.4 Considering the cited prior art in search of any suggestions in the direction of the characterising features of Claim 1 it is noted that D4 expressly states on page 2, lines 13 to 17 that a tapered male element should not be used in the joint arrangement of D4 because then a cutting edge formed on the male end part could damage the seal surface on the female element. D4 thus leads away from the sealing solution proposed in Claim 1 under consideration.

D9 discloses the use of tapered sealing surfaces having an angularity being around 14° (column 4, line 35) unlike that claimed by the invention (6.25 to 9.25% i.e. about 3.5 to 5.5°) and that the axial length of the sealing area should be between $5/64$ to $7/64$ inch (2 to 2,7 mm, see column 6, lines 12 to 17), in order that the increased sealing pressure will not produce galling between the sealing surfaces. However, the joint in this prior art document relies on the use of three high pressure seals at locations 17, 18 and 19. The tapered inside and outside seals 17, 19 are completed by the centre seal 18 formed between the stepped thread sections (column 4, lines 10 to 18). Furthermore, no seat surfaces are used. Thus, apart from the tapered seal surfaces, no lead to any of the other

characterising features of Claim 1 under consideration or the concept of the functioning of the joint now claimed, is derivable from D9.

D1 considered to be particularly relevant by the Examining Division concerns tubular connections including a shallowly tapered conical surface in which the pin taper is slightly less than the box taper (see column 6, lines 26 to 30 and Claim 1 of D1). This known joint is developed for improving repeated make-up and unscrewing of the joint without that galling occurs.

Indeed taper angles of the seal surfaces on the pin and box members (2.5° varying up to 14°) are disclosed (see column 5, line 36, column 6, lines 12 and 13) which include the range claimed in Claim 1 of the present application but no disclosure or hint is derivable from this document to the use of equal tapers for both surfaces in combination with a specific length of the sealing area or any of the other characterising features of Claim 1.

D2, also relied upon by the Examining Division, discloses a pipe joint with tapered seal and seat surfaces, but to provide the seal, extra sealing elements (cf. page 5, lines 30 to 33 and page 6, lines 23 to 33) are used. Moreover double seat surfaces, one on the inside and one on the outside are provided. In view of the fact that this pipe joint is not only structurally different but also in that the tapered sealing surfaces do not come into contact with each other, there is no teaching derivable from this document that could help the skilled person in finding a solution to the underlying problem of the present application e.g. the problem of galling of the sealing surfaces.

D8 discloses a pipe joint with tapered seal surfaces and a single not tapered, flat seat surface. Again, no lead to the specific details of the sealing and seat surfaces defined in Claim 1 of the present application for achieving the wanted effects, is derivable from this prior art.

The further documents cited in the European search report do not show more than the documents discussed above and since these documents do not disclose any hint to the specific combination of the features defined in Claim 1 or to a similar functioning of the assembled joint in accordance with this claim it is not considered necessary to give a detailed analysis of this further prior art.

- 4.5 As follows from the assessments in point 4.3 above the combination of the features defined in Claim 1 under consideration interact in a particular manner for achieving the stated object (see point 4.2 above) and as such this combination must be considered as an entity rather than a simple aggregation of features.

Therefore, although some of the prior art values for the taper angle of the sealing surfaces (D1) and the length of the sealing surfaces to avoid galling (D9) fall within the claimed ranges, in the absence of any teaching for combining these known features with further features contained in Claim 1 but not specifically disclosed in the cited documents, the skilled person was not led in an obvious manner to the combination of the features claimed in the present Claim 1.

Also in view of the diversity of the prior art solutions and functioning of the sealing, such as is for example extensively discussed in D9, any variation or combination of elements in the design of hermetic pipe

joints cannot be seen as a simple routine choice of the engineer but, in particular in the present case where the combination of features interacts in a particular manner to meet the wanted object, must be considered to imply an inventive activity.

- 4.6 Summarising, in the Board's judgment, the proposed solution to the stated technical problem defined in the independent Claim 1 is inventive and therefore this claim as well as its dependent Claims 2 to 4, relating to particular embodiments of the invention in accordance with Rule 29(3) EPC, can form the basis for grant of a patent (Article 52(1) EPC).
5. The description and drawings are also in agreement with the requirements of the EPC so that these documents are likewise suitable for grant of the patent.

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 grant a patent with the following documents:

Claims 1 to 4 and description (pages 1 to 15) as filed at the oral proceedings, and the drawings as originally filed.

The Registrar:


S. Fabiani

The Chairman:


F. Pröls