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Datasheet for the decision of 26 July 2007

Case Number: T 0511/05 - 3.2.05

Application Number: 95933616.5

Publication Number: 0786616

IPC: F16L 15/00

Language of the proceedings: EN

Title of invention:
Steel pipe joint having high galling resistance and surface treatment method therof

Patentee:
NIPPON STEEL CORPORATION

Opponent:
SUMITOMO METAL INDUSTRIES, LTD.

Headword:
-

Relevant legal provisions:
EPC Art. 56, 111(1)

Keyword:
"Inventive step, main request (no), auxiliary request 1 (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0511/05 **-** 3.2.05

D E C I S I O N
of the Technical Board of Appeal 3.2.05
of 26 July 2007

Appellant: (Opponent)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 23 February 2005 rejecting the opposition filed against European Patent No. 0786616 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: W. Zellhuber
Members: W. Widmeier
C. Rennie-Smith

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal against the decision of the Opposition Division rejecting the opposition against European patent No. 0 786 616.

Opposition was filed against the patent as a whole based on Article 100(a) EPC in combination with Article 56 EPC.

The Opposition Division held that this ground of opposition did not prejudice the maintenance of the patent as granted.

II. Oral proceedings were held before the Board of Appeal on 26 July 2007.

III. The appellant requested that the decision under appeal be set aside and that the European patent No. 786616 be revoked.

IV. The respondent (patent proprietor) requested that the appeal be dismissed (main request) or that the decision under appeal be set aside and the patent be maintained on the basis of one of auxiliary requests 1 and 1A filed during the oral proceedings, auxiliary requests 2 and 3 filed on 23 November 2005 and auxiliary requests 4, 5 and 6 filed on 26 June 2007.

V. The following documents were in particular referred to in the appeal proceedings:

E1: US-A-4,414,247

E3: JP-A-61-136087, English translation

E11: Journal of Japan Society of Lubrication Engineers, Vol. 31, No. 8, 1986, English translation "Surface Modification Using Organic and Inorganic Resin-Bonded Dry Films", pages 1 to 14

E24: Military Specification, DOD-P-16232F, 7 November 1978

E25: Proceedings of the J S L E International Tribology Conference, July 8-10, 1985, Tokyo, pages 197 to 202

E31: "Solid Lubricants and Self-Lubricating Solids", Francis J. Clauss, Academic Press 1972, New York, pages vii to ix, 14 to 41 and 74 to 113

E33: Declaration of Mr. Kunio Goto of 30 June 2005

E34: Declaration of Mr. Hideo Yamamoto of 27 June 2005

VI. Claim 1 of the main request reads as follows:

"1. A threaded joint of an oil well steel pipe having high galling resistance comprising: a pin composed of an external thread and a metal contact portion having no thread; and a box composed of an internal thread and a metal contact portion having no thread, wherein a phosphate chemical formation coating layer of 5 to 30 μm thickness, or a nitriding layer of 1 to 20 μm thickness and a phosphate chemical formation coating layer of 5 to 30 μm thickness are provided on a contact surface of the box or the pin, and a resin coating layer of 10 to

45 μm thickness in which powder of molybdenum disulfide or tungsten disulfide is dispersed is formed on the phosphate chemical formation coating layer, and the thickness of the resin layer is larger than the thickness of the phosphate chemical formation coating layer."

Claims 1 and 6 of auxiliary request 1 read as follows:

"1. A threaded joint of an oil well steel pipe having high galling resistance comprising: a pin composed of an external thread and a metal contact portion having no thread; and a box composed of an internal thread and a metal contact portion having no thread, wherein a nitriding layer of 1 to 20 μm thickness and a phosphate chemical formation coating layer of 5 to 30 μm thickness are provided on a contact surface of the box or the pin, and a resin coating layer of 10 to 45 μm thickness in which powder of molybdenum disulfide or tungsten disulfide is dispersed is formed on the phosphate chemical formation coating layer, and the thickness of the resin layer is larger than the total thickness of the phosphate chemical formation coating layer and the nitriding layer."

"6. A method of conducting surface treatment on a joint of an oil well steel pipe for providing a three layer type coating layer comprising the steps of: providing a nitriding layer, the thickness of which is 1 to 20 μm, on a thread portion or a metal seal portion of the joint of an oil well steel pipe made of alloy steel, the Cr content of which is not less than 10 weight %; providing a surface treatment layer of an iron plating layer, the thickness of which is 0.5 to 15 μm, or an

iron alloy plating layer containing one of Ni and Co or both Ni and Cr, the weight % of which is not more than 10% and also providing a manganese phosphate chemical formation coating layer, the thickness of which is 5 to 30 μm; and coating a solid lubricant containing powder of molybdenum disulfide or tungsten disulfide and also containing one of epoxy resin, furan resin and polyamideimide resin, the composition of which satisfies the following expression,

0.2 ≤ {quantity of (powder of molybdenum disulfide or tungsten disulfide)} / {quantity of (one of epoxy resin, furan resin and polyamideimide resin)} ≤ 9.0 (weight ratio);

and conducting heat treatment to form a solid lubricant coating layer of 10 to 45 μm thickness."

VII. The appellant's arguments can be summarized as follows:

Main request

Document E1 is considered closest prior art. The difference between this document and the subject-matter of claim 1 is that the contact surface is pre-treated according to document E1 by sandblasting and according to claim 1 by a phosphate chemical formation layer. Comparative test no. 9 in Table 1 of the patent in suit, however, shows that the results with a pre-treatment by a phosphate layer are not much better with respect to galling than with a pre-treatment by sandblasting. This is confirmed in paragraph [0046] of the patent in suit, where it is stated that, when the surface roughness is reduced by sandblasting, it is possible to obtain a "considerably high effect". The reasons why the surface

preparation according to the patent in suit is specified to be a phosphate chemical formation coating layer is described in paragraph [0047] of the patent in suit, namely that a change with time is seldom caused when the phosphate chemical formation is closely contacted with a resin layer, and further the workability of the phosphate chemical formation is "high". It thus follows that one of the reasons for replacing sandblasting by phosphating is corrosion resistance rather than galling resistance.

Document E31 reflects general technical knowledge and on pages 27 and 28 and Tables 6 and 7 compares the effects of sandblasting-treatment and phosphating treatment with respect to the wear life of surface coatings of steels. This comparison shows that a phosphating treatment results in a higher wear life. Furthermore, Table 7 shows that phosphating is mentioned to be used for steels, except stainless steels, whilst sandblasting is used for stainless steel. Actually, it is known in the art that a phosphating treatment is not appropriate for high alloy steels, cf. document E34, paragraph (6). The passage in column 2, lines 1 to 3 of document E1, saying that phosphating has been found to be unreliable for one reason or another, has to be seen in the light of that common general knowledge. Consequently, in combination with low alloy steels or carbon steels, which are not excluded by the wording of claim 1 of the main request, phosphate coating is to be considered an obvious alternative to the sand-blasting pre-treatment suggested in document E1. Document E25 also compares phosphating and sandblasting treatments. Table 5 on page 201 shows the improvement obtained using a

combination of sandblasting and phosphating compared with only sandblasting. This is confirmed by document E11, cf. the paragraph bridging pages 5 and 6.

The prior art further shows that thicknesses of the phosphate layer between 5 and 30 μm and of the resin coating layer between 10 and 45 μm specified in claim 1 correspond to normal values (cf. document E24, Table VI on page 24; document E33, paragraph (6); and document E1, claim 1). The thickness of the resin layer must necessarily be greater than the thickness of the phosphate layer. Otherwise it cannot fill the gaps of the phosphate layer. It follows that the subject-matter of claim 1 does not involve an inventive step.

Auxiliary request 1

The total thickness of the phosphate chemical formation layer and the nitriding layer is not clearly defined. δ_C and δ_M in Figure 9 of the patent in suit do not seem to relate to average thicknesses. Claim 1 is also not supported by the description because only example 1 matches the definition in this claim. The other examples do not relate to a surface coating including a nitriding layer.

There is no indication that the nitriding layer may contribute to solve the problem of the patent in suit (galling resistance). Nevertheless, document E25 (cf. page 199, left column, 2nd full paragraph, and table 5 on page 201) suggests soft-nitriding, sand-blasting and Mn-phosphating combined and refers to the harder surface provided by the soft-nitriding which means an improved wear rate for the substrate. There was thus a

hint to apply this teaching to a threaded joint of an oil well pipe and in doing so a person skilled in the art would automatically arrive at layer thicknesses as specified in claim 1. Thus, the subject-matter of claim 1 of auxiliary request 1 also does not involve an inventive step.

Document E31 discloses on page 101 under the heading "Ratio of Binder to MoS_2" for resin-bonded films a ratio of one part binder (resin) to two parts of MoS_2, thus falling within the range specified in claim 6. Thus, the method of this claim also does not involve an inventive step.

VIII. The respondent's arguments can be summarized as follows:

Main request

Document E1 teaches away from a phosphate coating layer because it considers such a layer unreliable (cf. column 2, lines 1 to 3). It teaches sand-blasting before depositing a resin layer including MoS_2. The invention however teaches a phosphating treatment instead of a sandblasting treatment which results in significantly better galling resistance. In Table 1 on page 17 of the patent in suit the frequency of the occurrence of galling is indicated as not less than 20 times for a surface treatment according to the invention and 12 times as best value of a sandblasting treatment. Thus, the subject-matter of claim 1 meets the object of the patent in suit which is to reduce galling. Documents E11, E25 and E31 do not relate to threaded joints of oil well pipes. Document E31 is also

a very old document which has never been taken into consideration in the technical field of oil well pipes. The requirements for surfaces of joints of oil well pipes are very special due to the high loads they have to carry and due to the extreme environmental conditions whilst assuring perfectly sealing and permitting repetitive re-opening of the joint. A person skilled in the art thus would not have considered these documents when confronted with the object of the patent in suit. Documents E33 and E34 are personal opinions expressed ten years after the filing date of the patent in suit and are therefore clearly based on hindsight. Claim 1 offers an improved solution for both low and high alloy steels. In combination with high alloy steels the additional nitride layer is advantageous. Also the thicknesses of the coatings specified in claim 1 are not obvious. Document E3 relates to joints for oil well pipes and mentions in claim 1 on page 1 that the thickness of the resin layer may be lower than the surface roughness of the layer underneath. It follows that the appellant's argumentation as a whole is based on hindsight and that the subject-matter of claim 1 involves an inventive step.

Auxiliary request 1

It is clear to a person skilled in the art that the term "total thickness" means the average thickness. Document E25 relates to a different technical field. The surface treatment shown in this document is for high speed applications such as camshafts of motors. Even if document E25 is combined with document E1 nothing is revealed with respect to the thicknesses of the layers. Moreover, document E25 is silent about the

problem of galling, and a harder surface achieved by a nitriding treatment is not an object of the present invention. Thus, the subject-matter of claim 1 is not rendered obvious and involves an inventive step for this reason.

If the subject-matter of claim 1 involves an inventive step then, consequently, the method of claim 6 also involves an inventive step.

Reasons for the Decision

1. *Main request*

Document E1 is to be considered the closest prior art. This document discloses a threaded joint of an oil well pipe having high galling resistance comprising a pin composed of an external thread and a metal contact portion having no thread, and a box composed of an internal thread and a metal contact portion having no thread (cf. column 1, lines 9 to 28, and column 2, lines 6 to 14), wherein a resin coating layer of 5 to 20 μm in which powder of molybdenum disulfide is dispersed is formed on the surfaces of the contact portions (cf. column 2, lines 22 to 28). Thus, the subject-matter of claim 1 differs from this prior art in that a phosphate chemical formation coating layer of 5 to 30 μm thickness is provided between a contact surface of the box or the pin and the resin layer, the thickness of the latter being up to 45 μm and larger than the thickness of the phosphate layer.

Although document E1 designates various surface treatment methods for joints of oil well pipes as unreliable (cf. column 1, line 49 to column 2, line 3) it does not present a general obstacle to the use of those methods. It just considers them "unreliable for one reason or another" without explaining the reasons and uses the sandblasting method instead. From his or her general technical knowledge a person skilled in the art is aware of the reason why the phosphating method is unreliable (cf. page 12, lines 3 to 6 of the patent in suit and document E34, point 6, first and second sentences), namely that it is difficult to form a phosphate chemical formation layer directly on a high alloy steel surface. For this reason the joint according to claim 1 optionally has a nitriding layer between the contact surface and the phosphate layer. Although document E34 is dated 27 July 2005, the first and second sentences of point 6 reflect just this general technical knowledge based on chemical facts.

Thus, a person skilled in the art was not hindered by document E1 to use the so called phosphating method as a pre-treatment of low alloy or carbon steels, see also document E31, page 28, Table 7.

Document E31 further discloses that a phosphate chemical coating layer results in a highly wear-resistant surface of the treated steel (cf. page 25, last paragraph, the paragraph bridging pages 27 and 28, and Tables 6 and 7) in combination with a resin lubricant layer. This document is a general handbook about solid lubricants not limited to any one specific application, and as such it also would be considered by

a person skilled in the art working in the field of joints for oil well pipes.

It is therefore obvious to use the advantageous phosphate layer as a pre-treatment for the contact surface of a joint of an oil well pipe if this contact surface is not made of a high alloy steel. It is further obvious, if no additional grease is used, to make the solid lubricant coating in the form of the resin layer thicker than the phosphate layer because only then it is possible to completely cover the rough phosphate layer and to prevent peaks of the surface of this layer projecting above the resin layer. Document E3 does not contradict this. While in the embodiment described in claim 1 of this document the resin layer is thinner than the surface roughness of the metal portion, a person skilled in the art would consider that grease is then additionally applied in order to achieve a reliable seal (cf. document E34, point 9).

As claim 1 does not specify the type of steel used for the surface of the contact portions of the joint, the obvious combination of document E1 with the teaching disclosed in document E31 results in the subject-matter of claim 1 which for this reason does not involve an inventive step, contrary to the requirement of Article 56 EPC.

2. *Auxiliary request 1*

2.1 The definition of a layer thickness of a surface coating normally relates to the average thickness of a layer. Thus, a person skilled in the art would interpret claim 1 such that the total thickness of the

phosphate chemical formation layer and the nitriding layer is meant to be the average thickness of both layers. The Board is therefore satisfied that claim 1 is clear.

2.2 The subject-matter of claim 1 comprises the combination of a nitriding layer and a phosphate chemical formation layer. Documents E1 and E31 are silent about an additional nitriding layer between the contact surface and the phosphate layer. Document E25 discloses, inter alia, a surface treatment using a combination of soft-nitriding, sandblasting and Mn-phosphating (cf. page 198, right column, last but one paragraph of chapter 3, and page 201, Table 5, right column). However, document E25 relates to high speed applications with conventional oil lubrication (cf. title of the document and page 198, chapter "Operating Procedure"). Furthermore, document E25 reveals that the combination of a nitriding layer and a phosphating layer does not result in an improvement compared with other treatments (cf. page 199, second full paragraph and page 201, Table 5) and that it results in a long life under oil lubrication (cf. page 199, left column, last sentence). Thus, document E25 would not prompt a person skilled in the art to use this combination in a low speed application such as a joint of an oil well pipe and with a solid lubricant (the resin coating layer of the subject-matter of claim 1) instead of an oil lubricant.

The Board is therefore satisfied that the subject-matter of claim 1 of auxiliary request 1 involves an inventive step and thus meets the requirement of Article 56 EPC.

2.3 Claim 6 specifies a method of conducting surface treatment on a joint of an oil well pipe in which a nitriding layer, a phosphate layer and a resin layer are provided on this surface. For the same reasons as the subject-matter of claim 1 this method also involves an inventive step.

2.4 Claims 2 to 5 and 7 to 9 are dependent claims of claims 1 and 6, respectively, so that these claims also meet the requirement of Article 56 EPC.

3. Under these circumstances it was not necessary to consider auxiliary requests 1A and 2 to 6.

4. Due to the restriction of claim 1 of auxiliary request 1 with respect to claim 1 of the main request, the description needs extensive adaptation. For this reason the Board considers it appropriate to remit the case to the first instance (Article 111(1) EPC).

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 with the order to maintain the patent on the basis of claims 1 to 9 of auxiliary request 1 filed during the oral proceedings and description and drawings to be adapted thereto.

The Registrar: The Chairman:

D. Meyfarth W. Zellhuber