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Datasheet for the decision of 16 September 2019

Case Number: T 0905/17 - 3.2.05

Application Number: 01974060.4

Publication Number: 1325256

IPC: F16L11/14, F16L11/16, F16L11/04, F16L11/08

Language of the proceedings: EN

Title of invention:
Armoured, flexible pipe

Patent Proprietor:
National Oilwell Varco Denmark I/S

Opponent:
Technip France SA

Relevant legal provisions:
EPC 1973 Art. 56

Keyword:
Inventive step (yes)

Catchword:
No need for a hint to the claimed solution in the closest prior art (see point 3.2.3)

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Case Number: T 0905/17 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 16 September 2019

Appellant: (Opponent)	Technip France SA 6-8, Allée de l'Arche, Faubourg de l'Arche, ZAC Danton 92400 Courbevoie (FR)
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Respondent: (Patent Proprietor)	National Oilwell Varco Denmark I/S Priorparken 480 2605 Brøndby (DK)
Representative:	Hegner & Partners A/S Symbion Science Park Fruebjergvej 3 2100 Copenhagen Ø (DK)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 2 February 2017 concerning maintenance of the European Patent No. 1325256 in amended form.**

Composition of the Board:

Chairman	M. Poock
Members:	O. Randl
	C. Brandt

Summary of Facts and Submissions

I. The opponent filed an appeal against the decision of the opposition division on the amended form in which European patent No. 1 325 256 ("the patent") could be maintained.

The following documents cited by the opposition division are relevant for the appeal proceedings:

D4: DK 2000 00672
D4': English translation of document D4 filed by the opponent
D5: Extract from: American Petroleum Institute, "Recommended Practice for Flexible Pipe", API Recommended Practice 17B, Second Edition, dated 1 July 1998
D6: Extract from: American Petroleum Institute, "Specification for Unbounded Flexible Pipe", API Specification 17J, Second Edition, dated November 1999.

II. This appeal is the second appeal in this case. After the patent had been revoked by the opposition division in a first decision dated 18 May 2010, for lack of novelty over document D4, this board (in a different composition) set aside the decision and remitted the case to the department of first instance for further prosecution (decision T 1229/10 of 13 May 2014). The opposition division then decided that the patent could be maintained in amended form, which led to the present appeal.

III. The appellant (opponent) requested that the decision under appeal be set aside and the patent be revoked.

The respondent (patent proprietor) requested that the appeal be dismissed (main request) or alternatively, that the patent be maintained in amended form on the basis of one of the first to fourth auxiliary requests filed with the reply to the statement of grounds of appeal dated 5 October 2017.

IV. Claim 1 of the main request reads:

"A flexible armoured pipe for transporting a fluid substance, the flexible armoured pipe comprising an impermeable liner (2a), an outer armouring layer (3a) and an inner armouring layer (1a) consisting of one or more wound armouring elements, the inner armouring layer (1a) is placed on the inside of the liner (2a), such that it is in contact with the fluid, which is to be transported in the pipe, and the outer armouring layer (3a) is placed on the outside of the liner (2a) and consists of at least two layers of wound armouring elements which are completely or partly permeable for fluids, characterised in that the outer armouring layer (3a) including one optional outside permeable sheath against mechanical damages is the outermost layer, said outer armouring layer (3a) and the outer side of the impermeable liner (2a), in use, is in contact with the surrounding water, whereby the outer pressure act [sic] directly on the liner (2a) and applies a hydrostatic pressure to the liner (2a) and the inner armouring layer (1a) absorbs the hydrostatic pressure applied to the liner (2a)."

V. The appellant (opponent) argued as follows:

The subject-matter of claim 1 lacks inventive step over the combination of documents D4 and D5 (or D6),

regardless of whether scenario I or II (as outlined in the communication of the board) is envisaged.

(a) Scenario I

Document D4 does not disclose that the inner armouring layer is in contact with the fluid.

The objective technical problem solved by the invention consists of simplifying the pipe design (in particular by limiting of the number of layers) while maintaining the pipe's resistance to external pressure.

The skilled person would have noted that the pipe structure of document D4 is repetitive (*redondant*) insofar as there is not only the structure formed by layers 1 and 3, but also a second structure formed by layers 5, 6 and 9. They would have considered omitting layers 1 and 3, which would have resulted in layers 5 and 6 forming the carcass in contact with the fluid transported in the pipe. Those layers would no longer be able to absorb the radial forces related to the fluid any more, but the skilled person knows that spirally wound layers such as layers 7 and 8 can replace a pressure armour layer (see document D5, paragraph 4.3.1.2.d).

As a consequence, those skilled in the art wishing to simplify the design of pipe of document D4 would have been led by their common general knowledge to a solution according to claim 1.

It is necessary to qualify the objection that document D4 teaches that the pressure armour should always be located between the inner and outer liner of the pipe (page 2, lines 19 and 20) and that the entire teaching

of that document guides the skilled person to a solution that avoids contacts between the armour and the surrounding water.

Document D4 discloses that "the K-profiles can also be used advantageously as internal pressure armour in the inner liner, in cases where it is desired to armour the inner liner against substantial external compressive forces" (see page 10, lines 4 to 6). This is a clear incentive to make layers 5 and 6 play the role of a carcass. Thus, from a functional point of view, layers 5 and 6 are not to be considered as armouring layers any more.

The objection that, in practice, the skilled person would not have envisaged replacing an inner liner (which serves to transport hot hydrocarbon material under pressure) with an intermediate sheath (which serves to prevent fluid migration between armour layers) or an outer sheath (which serves to avoid contact of the armour with sea water) is unfounded. The skilled person is able to adapt the materials used to the specific conditions of use.

(b) Scenario II

Document D4 does not disclose that the outer armouring layer and the outer side of the impermeable liner, when in use, is in contact with the surrounding water, so that the outer pressure acts directly on the liner and applies hydrostatic pressure to the liner and the inner armouring layer absorbs the hydrostatic pressure applied to the liner.

The objective technical problem should correspond to an effect obtained by means of the distinguishing

features. This is not the case for the objective technical problem proposed by the respondent because document D4 already describes a pipe in which the gas components can diffuse towards the outside of the pipe.

Rather, the objective technical problem solved by the invention is how to modify the conduit of Fig. 2 of document D4 so that the hydrostatic pressure is absorbed by the inner armouring layer (i.e. carcass 1) alone.

The skilled person faced with this problem would have omitted the outer sheath 9 and the layers of profiles 5 and 6 because sheath 9 is the only obstacle the water has to overcome to reach the carcass 1 and because the omission of the sheath 9 would make the layers 5 and 6 superfluous.

In response to the board's objections to the above formulation of the objective technical problem, the appellant offered an alternative definition, i.e. simplifying the pipe design (in particular by limiting the number of layers) while maintaining the pipe's resistance to external pressure.

The layers 5 and 6 are provided to ensure that the tube is not crushed by external pressure ("anti-collapsing effect") and does not explode as a consequence of excessive internal pressure ("anti-explosion effect"). Carcass 1 already has an anti-collapsing effect. Moreover, the skilled person knows that spirally wound layers such as layers 7 and 8 can replace a pressure armour layer (see document D5, paragraph 4.3.1.2.d).

The skilled person would have been aware that layers 5, 6 and 9 are optional and only to be provided

if the conditions of use (depth, external pressure) require them. Such external layers are normally used in so-called "smooth bore pipes" in which the inner liner is not supported by armouring layers. In document D4 the carcass 1 is provided to prevent the collapse of the inner liner (see page 2, lines 1 and 2). Table 3 of document D5 (page 30) discloses design options to increase the pipe's resistance to collapse. The first option mentioned is to increase the thickness of the carcass strip.

When asked by the board why Table 3 provided an incentive to remove layers 5, 6 and 9, the appellant explained that the table disclosed several ways of preventing the pipe from collapsing, such as increasing the thickness of the carcass strip or adding an intermediate sheath such as the one of document D4. There is therefore a whole set of alternative measures, each corresponding to a particular design choice.

Paragraph 4.3.1.1 of document D5 (see page 10) states that the pipes are designed and optimised specifically for each application. They are not off-the-shelf products.

A comparison of the product families II and III presented in Table 1 of document D1 shows that depending on the pressures encountered (see footnote 7), the skilled person would have omitted or provided pressure armour layers. Reference was also made to paragraph 3.1.32 of document D6 (see page 4), according to which a pressure armour layer increases the resistance of the flexible pipe to internal and external pressure and mechanical crushing loads.

Contrary to the respondent's assertions, the outer liner 9 of Fig. 2 is not an external sheath because such a sheath has to be provided outside the armouring layers (see the definition in paragraph 3.1.30 of document D6). Rather, layer 9 of Fig. 2 is an intermediate sheath that necessarily has an anti-collapsing effect.

Document D6 only presents the venting systems as optional. Considering the nature of the armouring layers and the length of the conduits, the pressure drop in the pipe would be considerable.

More fundamentally, as has been shown above, the skilled person would have omitted the outer sheath. This results in a situation where gas diffusion is no longer a problem. The respondent's arguments based on gas diffusion are therefore not relevant.

VI. The respondent (patent proprietor) argued as follows:

The subject-matter of claim 1 is inventive.

The key issue in document D4 is to produce a pressure armour (see page 3, lines 25 to 28). It is strange to start from this disclosure and argue that the skilled person would have eliminated the pressure armour, i.e. removed what is at the core of document D4.

In the pipe according to document D4, the gases would accumulate in the annulus between layers 3 and 9, and this is what the invention is about.

(a) Scenario I

There are many ways of simplifying the pipe of document D4, but no particular reason to choose the direction taken by the invention.

To obtain the claimed pipe, the skilled person would have had to completely break down the pipe of document D4 and build something very different. The appellant's reasoning is based on hindsight. The prior art did not envisage a pipe without an annulus and with only one liner.

(b) Scenario II

The appellant's arguments are based on hindsight.

Document D4 states that the key difference between the embodiments of Fig. 1 and Fig. 2 lies in the alternative positioning of the outer liner of the pipe (see page 7, lines 26 and 27). Thus, the outer liner is not just something that can be omitted. There is no good reason for the skilled person to do so.

The key issue in document D4 is to produce a pressure armour (see page 3, lines 25 to 28). The statement on page 10, lines 4 to 6, that the K-profiles can be used as internal pressure armour in the inner layer is not to be understood as teaching to remove the pressure armour. The idea that layer 9 should be removed is strange because the purpose of this liner is to avoid the entry of water.

Table 1 of document D5 (see page 11) shows different families of products, all of which comprise an outer sheath and an annulus.

The difference between claim 1 and the embodiment of Fig. 2 of document D4 is that the latter comprises layers 5 and 6 and the outer sheet 9. As can be seen from paragraph [0007] of the patent, this difference allows the acidic components to be removed by the water surrounding the pipe. As a consequence, the local corrosion of the outer armouring layers is reduced.

When asked by the board how the feature "impermeable liner" was to be understood in light of this formulation of the objective technical problem, which is based on the assertion that gases diffuse through the liner, the respondent explained that the liner had to be impermeable to the fluid to be transported in the pipe. There will always be a migration of gases through polymer layers, but this is not what is meant, as can be seen from paragraph [0011] of the patent.

The prior art solves this problem in another way, by means of venting systems (see document D6, paragraph 4.6.1.5: "a gas-venting system shall be required ..."; see also the test procedures described on page 33). Thus, the skilled person would have tried to improve the venting system or to avoid the aggressive gases from reaching the annulus of the pipe. The approach chosen by the invention is quite a radical step and had never been envisaged before. The prior art (D4, D5 and D6) exclusively discloses pipes having both an inner and an outer liner. The skilled person would have appreciated this and would not have deviated from this structure.

It is quite common to provide an armour outside the outer sheath. The layer 9 is provided with the purpose of preventing the entry of sea water into the armouring

layers 5 and 6. It is legitimate to consider it as an outer sheath as defined by document D6.

Reasons for the Decision

1. Applicable law

The application on which the patent is based was filed on 3 October 2001. In application of Article 7 of the Act revising the EPC of 29 November 2000 (Special edition No. 4, OJ EPO, 217) and the Decision of the Administrative Council of 28 June 2001 on the transitional provisions under Article 7 of the Act revising the EPC of 29 November 2000 (Special edition No. 4, OJ EPO, 219), Article 56 EPC 1973 applies in the present case.

2. Claim interpretation

2.1 "in contact with"

In point 3.2.2 of decision T 1229/10, this board has explained that "in contact with the fluid/the surrounding water" is to be understood as expressing the act or state of physically touching the fluid or water, and that it does not encompass indirect contact. This statement constitutes *res iudicata* and binds the board.

2.2 "outermost layer"

The feature "the outer armouring layer ... including one optional outside permeable sheath against mechanical damages is the outermost layer" is understood to mean that the outer armouring layer is

the outermost layer, with the possible exception that a permeable sheath, the purpose of which is to protect the pipe against mechanical damages, may (but does not have to) be provided radially outside the outer armouring layer.

2.3 Meaning of the characterising part

The characterising part of claim 1 of the main request comprises different types of features, i.e. structural features (the outer armouring layer is the outermost layer), features related to the behaviour of the claimed pipe in the context of a particular use (when used in water, the outer armouring layer and the outer side of the impermeable liner are in contact with the surrounding water), and features that seem to express the technical consequences of the feature related to the particular use, in terms of forces acting on different components of the pipe (the hydrostatic pressure acts directly on the liner and is absorbed by the inner armouring layer).

The board understands the characterising part to structurally define the claimed pipe in the following way.

- There is no impermeable layer outside the outer armouring layer.
- The outer armouring layer is permeable to water and configured such that when the tube is used in water, it does not absorb the hydrostatic pressure.
- The impermeable liner is such that it transmits the hydrostatic pressure to the inner armouring layer.

3. Inventive step (Article 56 EPC 1973)

3.1 Starting point

The opposition division used document D4 as the starting point for its assessment of inventive step. This choice was not contested by the appellant.

Document D4 discloses a pipe comprising a carcass 1 made of a spirally-wound metal band (*metalbånd*) 2, an inner liner (*indre liner*) 3, layers of profiles (*lag af profiler*) 5 and 6, an outer sheath (*ydre kappe*) 9, and spirally wound layers (*lag*) 7 and 8. Such a pipe is shown in Fig. 2:

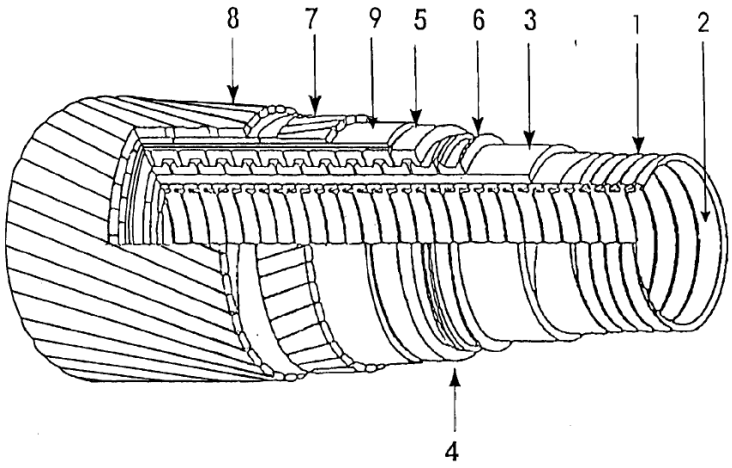

Fig 2

In point 3.2.1 of decision T 1229/10, this board explained that claim 1 can be read in two different ways onto the pipe disclosed in document D4, depending on whether the sheath 9 or the inner liner 3 are understood to correspond to the "impermeable liner" of claim 1. In the following, those alternatives will be referred to as "scenario I" and "scenario II", respectively.

3.2 Scenario I - sheath 9 as "impermeable layer"

3.2.1 Differences

In point 3.2.2 of decision T 1229/10 the board found:

> "If sheath 9 of document D4 is taken to correspond to the impermeable liner 2a, the inner armouring layer 5, 6 must be taken to correspond to the inner armouring layer (1a) of claim 1 of the main request. In that case the feature of the preamble of claim 1 of the main request, viz "the inner armouring layer (1a) is placed on the inside of the liner (2a), such that it is in contact with the fluid, which is to be transported in the pipe", is not disclosed, since the inner liner 3, which is in contact with the fluid transported by the pipe, prevents the flow of fluids to or from the inside of the pipe ...".

Accordingly, the subject-matter of claim 1 differs from the disclosure of document D4 in that the inner armouring layer is placed on the inside of the liner such that it is in contact with the fluid that is to be transported in the pipe.

3.2.2 Objective technical problem

The opposition division defined the problem solved by the invention as "to simplify the construction of the pipe by reducing the number of layers" (see point 4.1 of the decision under appeal).

This formulation is flawed insofar as it contains a pointer to the solution, namely the reduction of the number of layers.

A more appropriate formulation of the objective technical problem is "to simplify the construction of the pipe". This formulation does not provide any indication of how the simplification is to be obtained.

3.2.3 Obviousness

The appellant argued that the skilled person contemplating the pipe of Figure 2 of document D4 would have noted that its structure was repetitive: there is a first structure formed by layers 1 and 3 and a second structure formed by layers 5, 6 and 9.

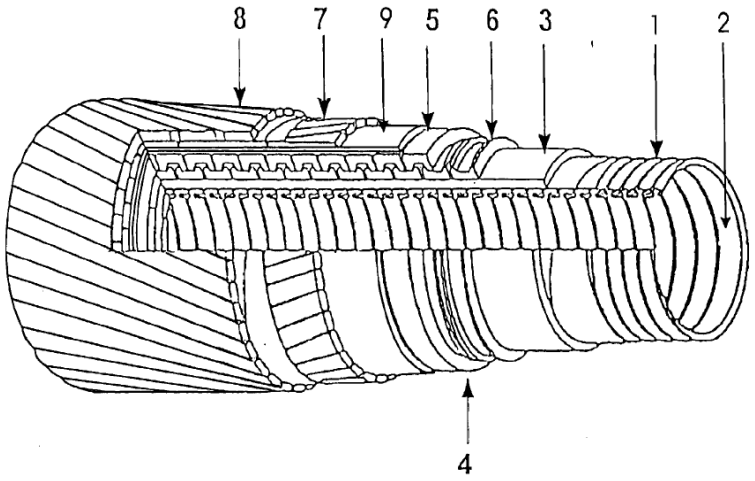

Fig 2

The argument goes on to say that the skilled person trying to simplify the pipe design would have eliminated this repetition of structures by removing both the carcass 1 and the inner liner 3. Sheath 9 would then replace inner liner 3 and layers 5 and 6 would play the role of the carcass 1. As they are in

direct contact with the fluid to be transported, said layers would be unable to bear the radial force exerted by the internal pressure of the fluid. However, document D5 provides a solution that would have led the skilled person in an obvious way to a pipe according to claim 1.

The opposition division dismissed this line of argument by pointing out that there was no "hint in document D4 to suppress the liner (3) and then to search for appropriate material in the prior [sic] for the pressure armours (5,6) then subjected to corrosion" (see page 5, first paragraph, of the decision under appeal).

The board does not find this reasoning persuasive because the skilled person starting from one element of the state of the art and faced with the need to solve a given problem does not necessarily need a "hint" associated with that element. Otherwise, it would never be possible to establish a lack of inventive step based on the object of a prior public use, which usually does not come with any hints. In the absence of a hint, the skilled person might still take the steps leading to the claimed subject-matter on the basis of their common general knowledge or documents belonging to the state of the art that explicitly teach a solution to the problem to be solved.

Considering the fact that document D4 teaches that the pressure armour would "always" be located between the inner and outer liner of the pipe (see document D4', page 2, lines 19 and 20), it is at least doubtful that the skilled person contemplating a simplification of the pipe of document D4 would have eliminated one of those liners.

The counter argument based on the penultimate paragraph of the description of document D4:

> "... the K-profiles can also be used advantageously as internal pressure armour in the inner liner, in cases where it is desired to armour the inner liner against substantial external compressive forces" (see document D4', page 10, lines 4 to 6)

is not persuasive because this passage would naturally be understood to mean that the K-profiles may constitute an additional (as opposed to: alternative) internal pressure armour.

Incidentally, the board fails to see why the layers 5 and 6 should not be considered as armouring layers in an embodiment based on this suggestion. This interpretation ignores the very wording of the passage ("used ... as internal pressure armour", "armour the inner liner").

There is also merit in the argument that the skilled person would not have envisaged replacing an inner liner (which serves to transport hot hydrocarbon material under pressure) with an intermediate sheath (which serves to prevent fluid migration between armour layers) or an outer sheath (which serves to avoid contact of the armour with sea water). It is true that the skilled person is capable of adapting the materials used to the specific conditions of use, but they would not modify an existing structure in a very substantial way without any clear incentive to do so.

In summary, the appellant has shown that the skilled person starting from the teaching of document D4 and

wishing to simplify the design of the pipe disclosed in that document could have reached the subject-matter of claim 1. However, they have not established in a persuasive manner that the skilled person would have done so. Their argumentation appears to be based on hindsight.

As a consequence, this line of attack fails.

3.3 Scenario II - inner liner 3 as "impermeable layer"

3.3.1 Differences

In point 3.2.3 of decision T 1229/10 the board found:

> "If the inner liner 3 of document D4 is taken to correspond to the impermeable liner 2a, the carcass 1 must be taken to correspond to the inner armouring layer (1a) of claim 1 of the main request. In that case the feature of the characterizing part, viz "the outer side of the impermeable liner (2a), in use, is in contact with the surrounding water" is not disclosed, since the impermeable sheath 9 surrounds the inner layers and prevents the surrounding water from entering the inner armouring layer 5, 6 and being in contact with the outer side of the inner liner 3."

The question is whether there are any further differences. The layers of profiles 5 and 6, which arguably constitute the outer armouring layer placed on the outside of the liner 3, are not the outermost layer. Consequently, the entire characterising part of claim 1 distinguishes its subject-matter from document D4.

3.3.2 Objective technical problem

When interpreted as explained in point 2.3 above, the distinguishing features (i.e. the features of the characterising part of claim 1) have the technical effect that the hydrostatic pressure is transmitted to and entirely absorbed by the inner armouring layer.

Based on paragraph [0010] of the patent, the appellant defined the objective technical problem as being "how to modify the pipe according to figure 2 of D4 so as to cause the hydrostatic pressure to be absorbed by the single inner armouring layer, namely the carcass 1 of the pipe" (see page 3 of the statement of grounds of appeal, fifth paragraph, translation by the respondent), which is similar to the problem defined by the division, i.e. "how to modify the pipe according to D4 so as to let the carcass (1) absorb hydrostatic pressure" (see point 4.2 of the decision under appeal).

In its communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA), the board explained that this formulation could not be endorsed because it directly expresses the solution according to the invention. A suitable objective technical problem should correspond to a goal that the skilled person would have pursued, such as obtaining a certain advantage or avoiding a drawback of the state of the art. The board invited the parties to define the objective technical problem accordingly.

The respondent referred to paragraph [0007] of the patent, which reads:

> "It is the object of the present invention to provide a flexible pipe where the resistance

against crushing and collapse of the liner as a result of the surrounding pressure is retained, while at the same time the pipe's outer armouring is protected against the damaging effect of fluids which diffuse from the inside of the liner and out to the surroundings."

The distinguishing feature ensures that the aggressive gases that have migrated outwards from the bore through the pressure sheath (i.e. the gases that in conventional pipes fill the space between the inner and outer sheath, the so-called "annulus") are washed away by sea water.

Based on this finding, the respondent asserted that this general object of the invention presented in paragraph [0007] of the patent also constituted the objective technical problem.

The appellant objected to this formulation of the objective technical problem by pointing out that document D4 discloses a pipe in which the gas components can diffuse towards the outside of the pipe.

According to the appellant, the objective technical problem solved by the invention consists of simplifying the design of the pipe while maintaining its resistance to external pressure.

The board does not need to decide which of those two competing definitions is more appropriate because even if the problem as defined by the appellant is retained, the skilled person is not led to the claimed subject-matter in an obvious way. This will be shown in the following.

3.3.3 Obviousness

According to the appellant, the skilled person starting from the pipe of Fig. 2 of document D4 and wishing to simplify the design of the pipe while maintaining its resistance to external pressure would have been led by their common general knowledge (as expressed in documents D5 and D6) to a pipe according to claim 1.

To obtain such a pipe, the skilled person would have had to strip the pipe of Fig. 2 of document D4 of its layers 5 and 6 and of the outer liner 9.

Document D5 - which can be said to express the skilled person's common general knowledge before the priority date of the invention - comprises the following statement:

> "... Where no pressure armour layer is used the tensile armour layers are crosswound at an angle close to 55 degrees to obtain a torsionally balanced pipe and to balance hoop and axial loads." (see point 4.3.1.2.d)

This passage refers to the flexible pipe shown in Fig. 6:

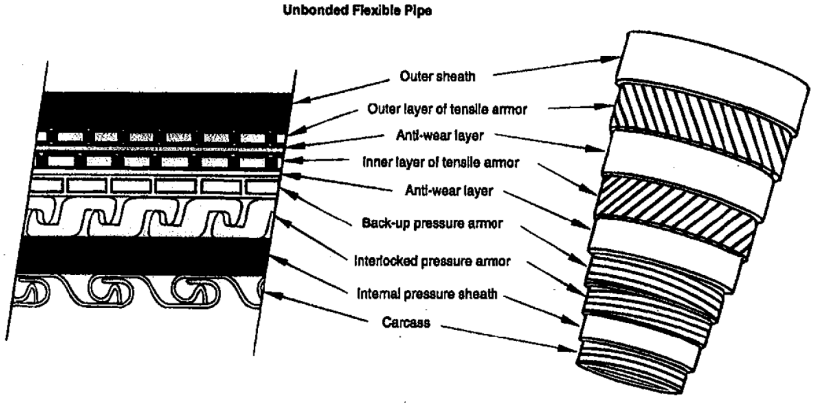

Figure 6—Schematic of Typical Flexible Riser Cross-sections

and discloses that there are flexible pipes in which there is no pressure armour layer and that in such a configuration the tensile armour layers are modified.

Table 1 of document D5 (see page 11) shows that this configuration is normally used in rough bore pipes belonging to "Product Family II", which, according to footnote 7, are used for lower pressures than the rough bore reinforced pipes of "Product Family III":

Table 1—Description of Standard Flexible Pipe Families—Unbonded Pipe

Layer No.	Layer Primary Function	Product Family I Smooth Bore Pipe	Product Family II Rough Bore Pipe	Product Family III Rough Bore Reinforced Pipe
1	Prevent collapse		Carcass	Carcass
2	Internal fluid integrity	Internal pressure sheath	Internal pressure sheath	Internal pressure sheath
3	Hoop stress resistance	Pressure armor layer(s)		Pressure armor layer(s)
4	External fluid integrity	Intermediate sheath		
5	Tensile stress resistance	Crosswound tensile armors	Crosswound tensile armors	Crosswound tensile armors
6	External fluid integrity	Outer sheath	Outer sheath	Outer sheath

Notes:
1. All pipe constructions may include various nonstructural layers, such as anti-wear layers, tapes, manufacturing aid layers, etc.
2. An external carcass may be added for protection purposes.
3. The pressure layer may be subdivided into an interlocked layer(s) and back-up layer(s).
4. The number of crosswound armor layers may vary, though generally is either two or four.
5. Thermal insulation may be added to the pipe.
6. The internal pressure and outer sheaths may consist of a number of sublayers.
7. Product family III is generally used for higher pressure applications than II.
8. The intermediate sheath for smooth bore pipes is optional when there is no external pressure or external pressure is less than the collapse pressure of the internal pressure sheath for the given application.

The pipe according to Fig. 2 of document D4 is provided with pressure armour layers 5 and 6 and therefore belongs to Product Family III.

In view of the above, the skilled person starting from the pipe of Fig. 2 of document D4 and wishing to simplify the design of the pipe while maintaining its resistance to external pressure would have expected the omission of layers 5 and 6 to reduce the pipe's

resistance to external pressure. Although the use of crosswound tensile armour layers would make it possible to obtain a torsionally balanced pipe and to balance hoop and axial loads, those skilled in the art would not have expected it to compensate for the losses in terms of resistance to external pressure. On the contrary, the skilled person would have been aware that the presence of a pressure armour layer increases the resistance of the flexible pipe to internal and external pressure and mechanical crushing loads (see document D6, page 4, paragraph 3.1.32). Therefore, they would have understood that the omission of layers 5 and 6, although it simplifies the pipe design, would not solve the objective technical problem. As a consequence, they would not have pursued this way of simplifying the design of the pipe of document D4.

The argument that Table 3 of document D5 (see page 30) would teach the skilled person several alternative ways of preventing the collapse of a flexible pipe needs to be qualified. Table 3 is a check list providing design solutions or variables related to particular failure mechanisms. For instance, when the collapse of the carcass is due to excessive tension, it is proposed to increase the thickness of the carcass strip. In case of collapse due to excessive external pressure, Table 3 only offers the general advice that the "configuration or installation design [could be modified] to reduce loads". In case of a collapse of smooth bore pipes "because of installation loads", the table proposes adding an intermediate leak-proof sheath.

It is, therefore, not correct to say that Table 3 would have led the skilled person, having simplified the pipe according to document D4 by omitting layers 5 and 6, to compensate for the resulting loss of resistance to

external pressure by increasing the thickness of the carcass strip or adding an intermediate sheath. Again, the appellant's argument appears to be based on hindsight.

Moreover, the appellant has not persuaded the board that the skilled person striving for a simplification of the design of the pipe disclosed in Fig. 2 of document D4 would have omitted the outer liner 9. All product families presented in Table 1 of document D5 have an outer sheath. The board cannot endorse the argument that the outer liner 9 is not an outer sheath according to the definition given in paragraph 3.1.30 of document D6 (see page 4). The outer liner 9 protects the pipe against the penetration of seawater and therefore, at least partially, fulfills the role of an outer sheath.

As a consequence, this second line of attack also fails.

3.3.4 Conclusion

The arguments presented by the appellant have not persuaded the board that, with regard to the state of the art presented to the board, the subject-matter of claim 1 of the main request is obvious to a person skilled in the art. As a consequence, the invention is considered to involve an inventive step (Article 56 EPC 1973).

Consequently, the appeal has to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

N. Schneider M. Poock

Decision electronically authenticated