Intellectual Property Office

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PATENTS ACT 1977

APPLICANT Silixa Ltd

ISSUE Whether patent applications GB1419116.7 and GB1419110.0 comply with section 1(1)(b)

HEARING OFFICER J E Porter

DECISION

Introduction

1 Patent applications GB1419116.7 ("116.7") and GB1419110.0 ("110.0") were filed on 27 October 2014 in the name of Silixa Ltd. Both are divisional applications which are derived from the earlier application GB1120619.0. This earlier application is the UK national phase application from international application PCT/GB2010/050889, which was filed on 27 May 2010 with priority dates of 27 May 2009 and 11 July 2009. As divisional applications, the applications in suit are deemed to have the filing and priority dates of that earlier application.

2 Following correspondence on both applications, the applicant has been unable to convince the examiner that the claimed inventions are inventive over the prior art and are therefore patentable under section 1(1)(b).

3 The matter therefore came before me at a hearing on 9 November 2015. Representing the applicant were Patent Attorney Mr Nicholas Wallin and his associate Ms Bethan Halliwell, both from Withers and Rogers LLP. The hearing was also attended by Dr Mahmoud Farhadiroushan, Chief Executive of Silixa and a named inventor, and Dr Fauzia Farooq, Patent Manager at Silixa. Attending from the IPO were the examiner Mr Colin Powys, his manager Dr Andrew Hughes, and Dr Hazel Craven, my assistant.

The law

4 Section 1(1) deals with the conditions for grant of a patent, and states that:

> *A patent may be granted only for an invention in respect of which the following conditions are satisfied, that is to say -*
>
> *(a) the invention is new;*
> *(b) it involves an inventive step;*
>
> *[other provisions not relevant]*

5 Section 3 then sets out how the presence of an inventive step is determined:

> *An invention shall be taken to involve an inventive step if it is not obvious to a person skilled in the art, having regard to any matter which forms part of the state of the art by virtue only of section 2(2) above (and disregarding section 2(3) above).*

6 Matter which "forms part of the state of the art by virtue only of section 2(2)" is all matter which was made available to the public before the priority date of the application in question.

7 It is well-established that the usual approach to adopt when assessing whether an invention involves an inventive step is to work through the steps set out by the Court of Appeal in *Windsurfing*[1] and restated by that Court in *Pozzoli*[2]. These steps are:

> *(1)(a) Identify the notional "person skilled in the art"*
>
> *(1)(b) Identify the relevant common general knowledge of that person;*
>
> *(2) Identify the inventive concept of the claim in question or if that cannot readily be done, construe it;*
>
> *(3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed;*
>
> *(4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?*

8 A further argument raised by the examiner was based on the collocation approach approved in *Sabaf*[3], where the court held that, before asking whether an invention involves an inventive step, it must first be determined whether there is a single invention or a collocation of separate inventions. The court endorsed the approach set out in the EPO Guidelines for making this determination. It follows that, where the invention concerns two or more integers, it must be determined if there is synergy between those integers such that they constitute a single invention. If so, section 3 must be applied to the combination as a whole. Conversely, if each integer performs its own proper function independently of the others, each must be considered as a separate invention for the purposes of section 3.

9 Where appropriate, the approach outlined in *Sabaf* may therefore be used as a first step to determine whether to apply the *Windsurfing/Pozzoli* test to the claimed invention as a whole, or separately to each integer making up the invention.

10 The applicant has made submissions on the application of *Sabaf* and the *Windsurfing/Pozzoli* test which I consider in my analysis below.

The inventions

11 The inventions are concerned with distributed acoustic sensor ("DAS") systems which use an optical fibre to determine acoustic signals by measuring properties of

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[1] *Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd* [1985] RPC 59
[2] *Pozzoli SpA v BDMO SA* [2007] EWCA Civ 588, [2007] FSR 37
[3] *Sabaf SpA v MFI Furniture Centres Ltd* [2005] RPC 10

backscattered or reflected light from along the fibre. In the systems described in the applications, pulsed laser light is sent down an optical sensing fibre. Acoustic signals incident on the fibre change the strain in the fibre and cause modulations in the backscattered or reflected light. Analysis of the backscattered or reflected light provides a measurement of the acoustic signal at different positions along the length of the fibre.

12 I note from the specification and the submissions made at the hearing that distributed optical fibre sensors offer various advantages over prior art point sensors, including continuous sensing over the length of the fibre, increased measurement flexibility and simpler, lower-cost installation.

13 At the hearing, Mr Wallin explained that the specification of the earlier "parent" application had included a large amount of detail, which had enabled the applicant to file no fewer than 19 divisional applications on the basis of the original specification. He informed me that the embodiment in figure 7 of the drawings represents the applicant's commercialised DAS system, the inventions claimed in 116.7 and 110.0 then relating to applications of that system. In the claims of 116.7, the detected acoustic signals are used to monitor fluid flow in a pipe by determining the speed of sound in the fluid. In 110.0, the claims relate to use of the DAS system to monitor the position of an object by measuring the time of flight of acoustic signals received from acoustic reference sources.

14 The latest set of claims for 116.7 was filed on 4 June 2015 and comprises 16 claims, including independent claims 1, 8, 15 and 16. Claim 1 reads as follows:

> *An apparatus comprising:*
>
> *a distributed acoustic sensor (DAS) system having a fibre optic cable deployed in use along a pipe to be monitored, the distributed acoustic sensor system receiving backscattered light from along the optical fibre and determining acoustic signals incident along the fibre optic cable therefrom;*
>
> *wherein the distributed acoustic sensor system is arranged to monitor fluid flow in the pipe by determining the speed of sound in one or both directions of fluid flow.*

15 Claim 15 is of nearly identical scope to claim 1, the only difference being that the term "backscattered light" is replaced with "reflected light". Claims 8 and 16 relate to analogous methods of distributed acoustic sensing – again the only difference between the two method claims being the reference to either backscattered or reflected light. At the hearing, Mr Wallin clarified this difference by explaining that reflective components such as fibre Bragg gratings may be added to the system to produce a stronger signal back to the detector than by backscattering alone. I accept his submission that such techniques are known in the art and that nothing turns on this difference. Mr Wallin also pointed me towards the embodiment shown in figure 17 and described in the paragraph bridging pages 15-16 of the specification as filed, as providing support for the claims.

16 The latest set of claims for 110.0 was filed on 26 January 2015 and comprises 8 claims, including independent claims 1 and 8. Claim 1 reads as follows:

> *A system for monitoring the position of a structure, the system comprising:*

a plurality of acoustic reference sources;

a distributed acoustic sensor system, the system including an optical sensing fibre to be deployed in use along the structure, and an interferometer arranged to receive in use backscattered light from along the optical sensing fibre, the interferometer comprising at least two optical paths with a path length difference therebetween, and being further arranged such that in use backscattered light interferes in the interferometer to produce interference components, the DAS system further comprising plural photodetectors to measure in use the interference components, and a processor arranged in use to determine optical phase angle data therefrom to provide quantitative measurements of acoustic perturbations along the length of the fibre;

wherein the distributed acoustic sensor system is further configured such that in use it measures the time of flight of acoustic signals received from the plurality of acoustic reference sources at a plurality of locations along the optical sensing fibre.

17 Claim 8 is of nearly identical scope to claim 1, the only difference being the substitution of the term “reflected light” for “backscattered light”. As for 116.7, I am satisfied that nothing turns on this difference.

18 At the hearing, Mr Wallin explained that the claims relate to the embodiment shown in figure 18 of the drawings, and briefly described in the third paragraphs on pages 16 and 21 of the description as filed. He pointed out that the claims of 110.0 are drafted narrowly in that they include features of the interferometer aspect of the DAS system, which are not present in the claims of 116.7, the additional details being included to distinguish the invention from well known prior art time-of-flight positioning systems such as GPS.

Arguments and analysis

19 The examiner maintains that the inventions defined in the claims of both applications do not involve an inventive step when considered in the light of certain prior art. His position was set out most recently in his pre-hearing reports of 5 August 2015. The applicant’s arguments in relation to 116.7 are contained in their responses of 4 June, 25 June and 14 July 2015, with further arguments being set out at the hearing. Arguments in relation to 110.0 were put forward in the applicant’s responses dated 26 January and 9 July 2015 and at the hearing.

20 What I must do is determine whether the inventions involve an inventive step within the meaning of the legislation. To do so, I will work through the steps of the *Windsurfing/Pozzoli* test set out above, in the light of the arguments before me. However, before I do so, I must consider the examiner’s argument that the claimed inventions relate to no more than a mere collocation of known features.

Collocation

21 In his pre-hearing reports, the examiner has argued that the claims of both applications relate to a collocation of features which do not interact synergistically, referring to the case law set out in *Sabaf*. In relation to the claims of 116.7, he has identified one feature as the use of the continuous DAS system to determine acoustic signals. He has identified another feature as the monitoring of fluid flow by measuring the speed of sound in the fluid. He regards these as being separate features, arguing that “the monitoring of flow is no better than when the prior art

method is operated on its own" and so these features do not interact synergistically to deliver an additional effect that goes beyond the sum of their effects when taken in isolation. He has made a similar argument for application 110.0, in which he has identified the feature of measuring position using the time of flight of acoustic signals as being separate from the feature of using the DAS system to detect those signals by determining acoustic events along its length.

22 Having reflected carefully, I find it difficult to accept that the claimed steps for determining the desired parameters can properly be regarded as independent and separate from the claimed steps for detecting the acoustic signals used to determine those parameters. In *Sabaf*, the features under consideration were two distinct parts of a gas burner, each functioning independently with no interaction with the other. In contrast, clearly it is the case here that the acoustic signals being detected by the feature of the continuous DAS system are the very signals which are then used to determine flow or position.

23 Furthermore, at the hearing Mr Wallin and Dr Farhadiroushan clearly explained the complexities of the claimed systems, including the various parameters that must be considered and optimised to obtain the desired measurements from those signals e.g. the antenna effect, the spatial resolution and phase/frequency dependence. It therefore seems clear to me that, for each case, the steps of using a continuous DAS system to measure the acoustic signals, and then determining the desired parameters from those signals, are inextricably linked and have a combined effect, and so together form the claimed invention. I do not accept the examiner's argument that there is no synergy between them.

24 I therefore conclude that I must proceed by applying the *Windsurfing/Pozzoli* test to each of the claimed inventions as a whole. I note that the examiner did not see a need to apply the test to the invention claimed in 110.0, having already concluded the invention was obvious as a mere collocation of known features. However, since I have rejected the collocation argument, I will consider the claims of both applications under the *Windsurfing/Pozzoli* test.

Application 116.7

Step 1 – identify the notional skilled person and their common general knowledge

25 In his examination report of 22 June 2015, the examiner identifies the skilled person as one working in the area of pipeline monitoring and having knowledge of the various technologies available for flow monitoring. He goes on to assert that techniques involving the use of the speed of sound through a fluid to determine details of flow, as detailed in three of the cited prior art documents WO 2006/130499 A2 (Cidra), WO 0246737 A2 (Weatherford) and US2006/212231 A1 (Bailey), would form part of the skilled person's common general knowledge.

26 The applicant agrees with the examiner's definition of the skilled person, but submits that that person's common general knowledge would not include the above prior art disclosures. In the applicant's view, the common general knowledge would be a basic knowledge of sensing technologies with the appreciation that distributed sensing systems are significantly different from the point sensing systems of the prior art, with entirely different physical principles underpinning their operation. In support

of this, Mr Wallin referred me to an extract from a text book[4] on optical fibre sensors, published in 2015 (some 6 years after the priority date of the application) which states that "the sensing principles and practical implementation [of distributed fibre-optic sensors] are significantly different from those used for point sensing".

27 In my view, the examiner is right to identify the skilled person as someone working in the area of pipeline monitoring. It seems to me that the common general knowledge of such a person would include common sensing technologies, with their associated advantages and disadvantages, and common techniques for monitoring flow.

28 I note that it is well established from case law that individual patent specifications and their contents do not normally form part of the common general knowledge. The exception is that "there may be specifications which are so well known amongst those versed in the art that upon evidence of that state of affairs they form part of such knowledge"[5].

29 In the absence of such evidence, I am not convinced that the skilled person's common general knowledge would extend to the specific patent documents identified by the examiner or the techniques disclosed in those documents. Therefore, on the balance of probabilities, I conclude that techniques for determining fluid flow from speed of sound measurements do not form part of the common general knowledge.

Step 2 – identify the inventive concept

30 I do not think this step causes any difficulties as the examiner and the applicant broadly agree in their assessment of the inventive concept. I consider the inventive concept to be the use of a distributed acoustic sensing system to monitor fluid flow in a pipe by determining speed of sound measurements.

Step 3 – identify the differences between state of the art and the inventive concept

31 The examiner cited four prior art documents in support of his inventive step objection against the claims of 116.7. I have already mentioned three of these – Cidra, Weatherford and Bailey – in my consideration of step 1. Cidra is referenced in the specification of both applications, and discloses determining the flow rate of fluid in a pipe by measuring the speed of sound in the fluid using point sensors. Weatherford and Bailey provide similar disclosures and do not appear (for the purposes of the matter before me) to add anything beyond what is disclosed in Cidra. There appears to be agreement that none of these documents discloses the use of continuous distributed sensing techniques to obtain the speed of sound measurements, although the use of an array of optical fibre point sensors is disclosed.

32 The fourth document referred to by the examiner in support of his objection is US 2009/114386 A1 (Hartog). This document discloses an optical fibre distributed acoustic sensor which, like the claimed DAS system, enables continuous sensing over the full length of the fibre. It appears to be undisputed that there is no disclosure in Hartog of determining flow by measuring the speed of sound.

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[4] *Optical Fiber Sensors: Advanced Techniques and Applications*, CRC Press, Florida, USA, March 2015, pages 14-15.

[5] See *General Tire & Rubber Co v Firestone Tyre & Rubber Co Ltd* [1972] RPC 457 and (for example) the discussion of this point in the *Manual of Patent Practice* at paragraph 3.32

33 Thus the prior art discloses the use of point sensors to obtain speed of sound measurements, and also discloses a continuous fibre optic distributed acoustic sensor – but not used to make such measurements and determine flow. In the light of that, I consider the difference between the state of the art and the inventive concept to be the application of a fibre optic distributed acoustic sensor to flow monitoring by measuring the speed of sound.

Step 4 – is the difference obvious to the skilled person?

34 The examiner says that, in considering the DAS system disclosed by Hartog, the skilled worker would appreciate the benefit of applying such a system to the techniques disclosed by Cidra, Weatherford and Bailey, where an array of point sensors is used to measure the speed of sound to determine fluid flow. He concludes it would be obvious to replace the point sensors of the prior art systems with the optical fibre DAS disclosed by Hartog – thus arriving at the claimed invention.

35 I have rejected the examiner's contention that the prior art point sensor techniques for determining flow from speed of sound measurements form part of the common general knowledge. That being the case, in considering whether the difference between the invention and the prior art is obvious, there are two possible approaches to take. One approach is to start with the disclosures of Cidra, Weatherford and Bailey, and ask whether it would be obvious to substitute the point sensors that are used to measure sound and determine fluid flow with the continuous DAS system of Hartog. The other approach is to start with the Hartog continuous DAS system and ask whether it would be obvious to use it to determine the fluid flow parameters in the way that Cidra, Weatherford and Bailey describe for point sensor systems. I was addressed on both approaches and so I shall consider both in my analysis below.

36 In respect of the first approach, the applicant submits there are significant technical differences between distributed acoustic sensors and point sensors which the skilled worker would be aware of. At the hearing, Mr Wallin and Dr Farhadiroushan explained that an optical fibre DAS exhibits an "antenna effect" whereby the sensitivity of the fibre depends on its orientation with respect to the incoming acoustic waves, and its response depends on the frequency and phase of the incoming acoustic wave. The applicant submits that none of these effects are present in point sensors. Furthermore, for continuous sensors of the type disclosed by Hartog there are also synchronisation and timing issues to be considered in processing the optical signals received from different parts of the fibre.

37 It is therefore the applicant's view that the skilled person would appreciate the significant differences in the operation of DAS systems and would not know how to apply point sensor techniques to a fibre optic DAS. As further evidence, the applicant has referred to the text book extract I have already mentioned in my consideration of step 1, which highlights the significant differences between distributed and point fibre optic sensors. The textbook was published in 2015 and the applicant argues that it shows an ongoing technical prejudice that distributed sensors and point sensors are significantly different, which (they argue) would have been even greater at the priority date in 2009, thus pointing the skilled person away from the interchangeability of such sensors.

38 I found Mr Wallin and Dr Farhadiroushan's submissions at the hearing, backed up by the witness statement provided by Dr Farhadiroushan, to be helpful and thorough in explaining the various technical complexities that have to be considered in implementing the claimed fibre optic DAS system to make the required measurements of fluid flow.

39 On the basis of these submissions, and having considered the prior art, I am satisfied on the balance of probabilities that fibre optic DAS systems are part of a highly specialised and technically complex field, with particular technical issues needing to be addressed in detail in order for them to be used in the manner claimed. I am therefore content to find, on the balance of probabilities, that replacing an array of point sensors with a DAS is not a straightforward or routine task which would be within the ambit of the unimaginative skilled person.

40 On the contrary, I consider that he would appreciate they are not equivalent to point sensors and would require quite different technological considerations in order to apply them to the measurement of properties of a fluid in a pipe, and would have a degree of prejudice against such a substitution. It is my view that, in considering the disclosures of Cidra et al, the skilled worker would not find it obvious to use the DAS system disclosed by Hartog in place of the disclosed array of point sensors.

41 I now turn to the alternative argument, which is to start from the DAS system disclosed by Hartog and question whether it would be obvious to use that system to determine flow by measuring the speed of sound. In countering this argument at the hearing, Mr Wallin pointed me towards paragraph 65 of Hartog. He contended that the teaching in this part of the document leads the skilled reader away from the invention in suit, as it discloses a different method of determining flow by inserting vortex shedders in the pipe and measuring the frequency of vortex shedding. He explained that Hartog is one of the three leading experts worldwide in the field of DAS (the inventor in this present case being one of the others) so, in the applicant's view, there would be no reason for the skilled worker to backtrack on Hartog's solution and seek alternative ways to determine flow using a DAS system.

42 I agree with the applicant that Hartog provides clear direction on how the disclosed DAS system may be used to determine flow by measuring the frequency of vortex shedding, and that there is no disclosure of measuring the speed of sound. I can find no suggestion in Hartog of using any alternative methods to measure flow, or any obvious impetus for doing so.

43 I conclude, on the balance of probabilities, that the unimaginative skilled worker would not be motivated to reject the teaching of Hartog in this respect, and to use the Hartog DAS to seek alternative ways of determining flow, by adopting the approach suggested in Cidra et al. I am also mindful of the significant technical differences in distributed and point sensing systems that I have already discussed, which support the conclusion that the skilled worker would not find it obvious to combine the Hartog DAS with techniques disclosed in relation to point sensors.

44 Having found the invention is not obvious either from the starting point of Cidra et al or Hartog, I conclude that the invention claimed in 116.7 involves an inventive step in light of those various disclosures.

Application 110.0

45 The discussion of application 110.0 at the hearing was fairly brief as there was general agreement that the points at issue are in many ways analogous to those in 116.7. Although the examiner did not explicitly apply the *Windsurfing/Pozzoli* test to the claims of 110.0, I will consider the points he raised in his collocation argument where appropriate. The applicant's attorney, in his skeleton argument and at the hearing, helpfully gave his view of the *Windsurfing/Pozzoli* test as applied to 110.0, as well as considering the collocation objection.

Step 1 – identify the notional skilled person and their common general knowledge

46 I agree with the applicant's submission that the skilled person would be an engineer in the field of position monitoring, with knowledge of the technologies available for such monitoring.

47 I could not see an explicit identification by the examiner of the skilled person, but in his pre-hearing report dated 5 August 2015 the examiner asserts that the fibre optic DAS system with continuous distributed sensing forms part of the common general knowledge. He also states that using time-of-flight techniques to monitor position is well known.

48 For similar reasons to 116.7, I am not satisfied that the disclosure of the Hartog patent specification would be within the skilled person's common general knowledge. Neither do I think there is evidence provided to support an assertion that the DAS system more generally would form a part of the common general knowledge of the skilled person as identified. However, it does seem entirely reasonable to conclude on the balance of probabilities that the skilled person as identified above would have, within his common general knowledge, knowledge of the sensing technologies commonly used in position monitoring including time-of-flight techniques generally.

Step 2 – identify the inventive concept

49 As for 116.7, there seems to be general agreement between the examiner and the applicant in their assessment of the inventive concept. I therefore consider the inventive concept to be the use of an interferometer-based optical fibre DAS system to monitor position by measuring the time of flight of signals from acoustic reference sources along the length of the optical fibre.

Step 3 – identify the differences between state of the art and the inventive concept

50 The examiner cited a single document WO 2008/060719 A3 (Geco) in support of his argument that the claimed invention relates to a collocation of known features and is therefore obvious. Geco discloses a system in which an array of point acoustic sensors is attached to a seismic cable. The cable's position is monitored by measuring the time of flight of signals from acoustic reference sources to each point sensor. There appears to be agreement that the document does not disclose the use of a fibre optic DAS to perform the acoustic sensing. It is also agreed that there is no disclosure in Hartog of using a fibre optic DAS to perform position measurement.

51 Thus the prior art discloses the use of point sensors in a distributed optical fibre sensor to obtain acoustic time of flight measurements to determine position, and also discloses a continuous distributed acoustic sensor – but not used to make such measurements or determine position.

52 I consider the difference between the prior art and the invention to be the application of a fibre optic DAS to position monitoring using acoustic time of flight techniques.

Step 4 – is the difference obvious to the skilled person?

53 There is no suggestion in Geco that the disclosed array of point sensors may be replaced with a fibre optic DAS system. My finding above is that a fibre optic DAS system (as in Hartog) does not form part of the common general knowledge. Thus I will simply consider whether the skilled person would find it obvious to reach the claimed invention by combining the disclosure of Geco and the DAS system disclosed by Hartog.

54 I note that Geco and Hartog lie in very different technical fields – Geco is concerned with acquisition of seismic data whereas Hartog lies in the field of pipeline monitoring. Furthermore, I have already considered in my discussion of 116.7 various points concerning the different technical complexities which arise from using a DAS system as opposed to point sensors. On that basis, I have already concluded on the balance of probabilities that fibre optic DAS systems are part of a highly specialised and technically complex field, with particular technical issues needing to be addressed in detail in order for them to be used in the manner claimed. I have also already found that, on the balance of probabilities, replacing an array of point sensors with a DAS is not a straightforward or routine task which would be within the ambit of the unimaginative skilled person.

55 Consistent with my findings on 116.7, this leads me to conclude that the skilled worker would not find it obvious to combine the Geco and Hartog disclosures, and in particular would not find it obvious to replace the point sensors of the Geco system with a fibre optic DAS system.

56 It follows that I consider the invention claimed in 110.0 to be inventive in light of the prior art under consideration.

Conclusion

57 For the reasons set out above, I conclude that the inventions claimed in 116.7 and 110.0 involve an inventive step over the prior art in issue, as required by section 1(1)(b). I remit both applications to the examiner for consideration of any outstanding matters.

Dr J E PORTER
Deputy Director acting for the Comptroller