IN THE HEARINGS AND MEDIATION GROUP OF

THE INTELLECTUAL PROPERTY OFFICE OF SINGAPORE

REPUBLIC OF SINGAPORE

Singapore Patent No. 126809
24 March 2016

IN THE MATTER OF A PATENT

IN THE NAME OF

FOSTA PTE LTD

AND

APPLICATION FOR REVOCATION THEREOF BY

CAMBRIAN ENGINEERING CORPORATION PTE LTD

Hearing Officer: Ms See Tho Sok Yee
Principal Assistant Registrar of Patents

Cur Adv Vult

GROUNDS OF DECISION

1 Singapore Patent No. 126809 (Patent Application No. 2005031588) ("the patent") was filed on 6 May 2005, in the name of Song Dong Qing ("the inventor"). The patent was granted on 29 June 2007. The invention under the patent ("the invention") relates to a sensor, and installation method thereof, for monitoring deformations in an object. The sensor is designed such that it is suitable for long term measurements.

2 The patent was assigned from the inventor to FOSTA Pte Ltd ("the proprietor") on 10 October 2012. It has been renewed on multiple occasions, but has lapsed twice, the first time on 6 May 2013, but was restored, upon application to the Registrar, on 16 December 2014. The proprietor did not renew the patent when renewal fell due on 11 February 2015, and therefore at the time of this decision the application is currently deemed to have lapsed for a second time. I note that

the proprietor sought to surrender the patent on 22 October 2015. However, this request was deferred by the Registrar, pending the outcome of these revocation proceedings.

Applicable Law and Burden of Proof

3 The applicable law is the Patents Act (Cap 221, 2005 Rev Ed) ("the Act") and the Patents Rules (Cap 221, 2007 Rev Ed) ("the Rules"). Unless otherwise specified, references to rules in these grounds of decision are references from the Rules. The burden of proof in the present case falls on the applicant.

Procedural History

4 An application for revocation of the patent was filed by Cambrian Engineering Corporation Pte Ltd ("the applicant") on 3 March 2015. The applicant cites the following in its statement of grounds ("the Grounds") in relation to the Act:

(i) The invention is not a patentable invention as it lacks novelty and inventive step (Section 80(1)(a));
(ii) Amendments to the claims of the patent went beyond the disclosure as filed (Section 80(1)(d));
(iii) Amendments to the claims should not have been allowed (Section 80(1)(e)); and
(iv) The patent was obtained fraudulently or on misrepresentation (Section 80(1)(f)).

5 By its extended deadline of 3 September 2015, the proprietor did not file any counter-statement, nor proposed any amendments to the specification of the patent in response to the application for revocation. On 7 October 2015, the proprietor informed the Registrar in writing that it would not be filing a counter-statement and requested the Registrar to make no order as to costs or, in the alternative, if the Registrar were minded to make any costs order, that such costs be taxed. In this regard, Rule 80(4) states the consequences of a counter-statement not being filed as follows:

> If the proprietor of the patent fails to file the counter-statement in accordance with paragraph (3), he shall not be allowed to take part in the subsequent proceedings, and the application for revocation shall be considered by the Registrar as if each specific fact set out in the statement were conceded, except in so far as it is contradicted by other document in the possession of the Registrar.

6 On 22 October 2015, the proprietor sought to surrender the patent, again requesting that the Registrar makes no order as to costs. However, this was strenuously objected to in writing on 9 November 2015 by the applicant as the effective date of the surrender (being later in time than the effective date of a successful revocation) would suggest that the patent was still valid before its surrender. Having considered the parties' representations, the Registrar held the surrender request in abeyance pending the outcome of these revocation proceedings against the patent. At the same time, on 25 February 2016, the Registrar directed the applicant to (1) provide labelled copies of the publications referred to in the Grounds; and (2) file a List of Issues for Consideration ("the List") to correlate alleged prior art with the issue in dispute set out in its Grounds. The Registrar also urged parties to reconsider settlement in view of the current deficiencies of the Grounds, the time required before there will be an adjudicated outcome to the dispute, as well as the applicant's business considerations. The Registrar

pointed out that negotiation and mediation were conducive for generating win-win outcomes at lower cost and within a shorter time. Preferring to pursue the revocation, the applicant filed the requested material on 24 March 2016.

7 I will therefore make an assessment on the validity of the patent taking into account the applicant's Grounds, including the documents provided in relation thereto. The proprietor will have no further role in these proceedings. In accordance with Rule 80(4), I shall accept the arguments set out by the applicant at face value and as uncontested, unless the documents in my possession contradict such arguments.

The Invention

8 The invention relates to a sensor which comprises a carrier that can be coupled to an object at two fixing positions, and an optical fibre that has at least one sensing element that is coupled to the carrier by two fixing means that are each proximal to one of the two fixing positions. When the sensor is coupled to the object, the deformational displacement or physical quantities of the object between the two fixing means can be measured by monitoring changes in the optical property of the sensing element. An installation method is also claimed for installing the sensor of the invention. The patent specification explains that there are various sensors available, including fibre optic sensors, that have a gauge length ranging from several millimetres to about 100 millimetres and that can measure physical quantities such as stress and pressure over the gauge length but are unable to directly measure over a length longer than the gauges. These sensors work by being fixed onto the object, and the fixing means transfers the physical quantities of the object to the sensor without distortion of the physical quantities; according to the specification, the fixing means of existing sensors may deteriorate over the years and thus compromise the transfer accuracy of the physical quantities between the object and the sensor, resulting in measurement errors.

9 The description states that the invention enables measurement of the physical quantities over a limited gauge length to the average physical quantities over a longer gauge length, as well as provides a means whereby the sensor is suitable for long-term measurement of the physical quantities. The sensor can be best illustrated by figure 4 of the specification, which is reproduced below for reference:

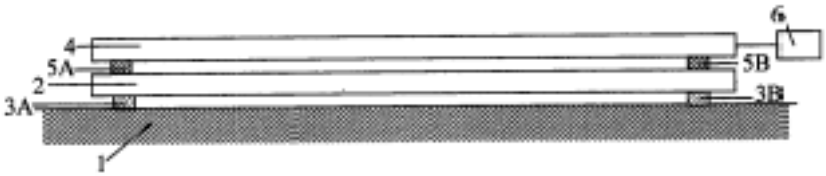


FIGURE 4

10 The sensor has a carrier (2) that is fixed to the object (1) at two fixing positions (3A, 3B), and a sensor assembly in the form of an optical fibre (4) that is fixed to the carrier at two fixing positions (5A, 5B).

11 There are three independent claims in the granted patent, claims 1, 8 and 15, which read as follows:

1). A sensor comprising:

a carrier having two fixing positions, the carrier being couplable to an object at the two fixing positions; and
an optical fibre having at least one sensing element, the optical fibre being coupled to the carrier by two fixing means, each of the two fixing means being substantially proximal to one of the two fixing positions,
wherein the carrier conveys deformational displacement of the object between the two fixing positions to a portion of the optical fibre between the two fixing means, and the at least one sensing element has an optical property that is reactive to the deformational displacement conveyed to the portion of the optical fibre between the two fixing means, and
wherein when the carrier is coupled to the object, the deformational displacement of the object between the two fixing positions is measurable by monitoring changes in the optical property of the at least one sensing element, the changes in the optical property of the at least one sensing element being substantially representative of the deformational displacement of the object between the two fixing positions.

8). A sensor installation method comprising the steps of:
providing a sensor comprising:
a carrier having two fixing positions; and
an optical fibre having at least one sensing element, the optical fibre being coupled to the carrier by two fixing means, each of the two fixing means being substantially proximal to one of the two fixing positions, and
coupling the carrier of the sensor to an object at the two fixing positions,
wherein the carrier conveys deformational displacement of the object between the two fixing positions to a portion of the optical fibre extending between the two fixing means, and the at least one sensing element has an optical property that is reactive to the deformational displacement conveyed to the portion of the optical fibre between the two fixing means, and
wherein the deformational displacement of the object between the two fixing positions is measureable by monitoring changes in the optical property of the at least one sensing element, the changes in the optical property of the at least one sensing element being substantially representative of the deformational displacement of the object between the two fixing positions.

15). A sensor comprising:
a carrier having two fixing positions, the carrier being couplable to an object at the two fixing positions; and
an optical fibre having at least one sensing element, the optical fibre being coupled to the carrier by two fixing means, each of the two fixing means being substantially proximal to one of the two fixing positions,
wherein the carrier conveys at least one physical quantity of the object between the two fixing positions to a portion of the optical fibre between the two fixing means, and the at least one sensing element has an optical property that is reactive to the at least one physical quantity conveyed to the portion of the optical fibre between the two fixing means, and
wherein the carrier is coupled to the object, the at least one physical quantity of the object between the two fixing positions is measurable by monitoring changes in the optical property of the at least one sensing element being substantially representative of the at least one physical quantity of the object between the two fixing positions.

12 There are 15 claims in total, wherein claims 2-7 are dependent upon claim 1, and claims 9-14 are dependent upon claim 8.

13 The invention may be applied in the context of structural health monitoring ("SHM"), particularly in the fields of construction and civil engineering. SHM systems provide information regarding the integrity of buildings and other structures. This is of importance as these structures are subject to damage from factors such as physical load, corrosion, aging and even seismic activity. When damage is detected through SHM, remedial action can then be taken.

PRELIMINARY COMMENTS

14 Before I begin to consider the issues at hand, I have some comments on the Grounds submitted by the applicant. It is clear that the applicant has invested time in preparing these Grounds, but they are not particularly clear or focussed. There are very few arguments provided that relate to the legal requirements for patentability, and it appears that the applicant does not have a great understanding of the process of granting a patent or the requirements to invalidate a patent once granted.

15 In particular, there is no clear discussion of what technical aspects of the cited documents directly correspond to the invention defined in the claims of the patent. For example, for a clear anticipation I would expect to see representations comparing the technical details of the system defined by the claims with the technical details of systems disclosed in the cited documents. However, except for a couple of statements such as "*page 4/10 of [D9] illustrated various components of the SOFO system which correspond to the features of granted claim* 1" ([11] of the Grounds), or *"[D4] also disclosed a drawing of the SOFO system which showed how the sensors were installed including the use of fixed positions*" ([14] of the Grounds), there is no indication of how these documents directly anticipate the claims.

16 I also need to make some observations regarding the cited documents in general. In the Grounds, the applicant has referred to a large number of documents purportedly relevant under the consideration of novelty and inventive step: in total, the applicant has referred to 40 documents to support its case. These documents vary between technical patent applications, journal articles, web pages, presentations and press releases, and are intended to support the applicant's claims for revocation. Some have very little technical detail regarding the systems used and are simply general disclosures of the use of SHM systems in construction, and particularly the "Surveillance d'Ouvrages par Fibre Optiques" ("SOFO") system and its use in construction projects in Singapore, such as the Punggol EC 26 project. The arguments presented by the applicant do not help in understanding how each of the documents cited are intended to be used in the arguments against the validity of the individual claims. This is most apparent where documents not discussed in relation to the independent claims are later discussed as impinging upon the novelty of the dependent claims: D16-D18 being cited against claim 3, for example, when there was no argument provided for their relevance to claim 1.

17 In addition, some of the documents relied on in the Grounds were published after the filing date of the patent and therefore do not form part of the state of the art at the filing date of the patent. Hence, such documents *prima facie* cannot be used to argue a lack of novelty or inventive step. That said, many of these documents appear to show the general use of SHM systems (but not necessarily the system of the patent) in construction works, and I acknowledge

that this general use is likely to have been ongoing prior to the filing of the patent, even if the documents disclosing this were published later.

18 Given that not all of the documents provided disclose any technical detail of the sensor system, I see no merit in referring to each and every document provided by the applicant. Therefore I will only refer to an individual document if it discloses some technical detail of the sensor system used which can be compared to the technical detail of the sensor system of the invention, and for efficiency's sake I will not list all of the documents cited. Instead, the documents that I will refer to are as follows (numbers according to the List):

> D6: PhD Thesis, Ecole Polytechnique Federale de Lausanne; *Fiber Optic Sensor Network for the Monitoring of Civil Engineering Structures* (1997); Inaudi,D
> D7: "*Fiber optic sensors for dynamic and long term structural monitoring*" (2003) Inaudi, D.
> D8: Paper presented at the Proceedings of the 1st International Conference on Structural Health Monitoring and Intelligent Infrastructure; pg 191-198 (2003); "*State of the art in fiber optic sensing technology and EU structural health monitoring projects*" Inaudi, D.
> D9: Paper presented at the Proceedings of the 1st FIG International Symposium on Engineering Surveys for Construction Works and Structural Engineering, Nottingham, U.K. (2004); "*SOFO sensors for static and dynamic measurements*"; Inaudi, D.
> D16: *Journal of Bridge Engineering*; Vol 8(6), pp 362-373 (2003). Casas, J. R., & Cruz P. J. "*Fiber optic sensors for bridge monitoring*".

19 Further, I have some comments on the List. I note that in the List, the applicant refers to certain legal provisions, some of which were not earlier referred to in the Grounds, and some of which are not in fact relevant to the validity issues being considered in the Grounds. For example, the legal provisions cited in the List under "Novelty" include Section 25(4), which relates to sufficiency and not novelty. In view of this discrepancy, I will address the issues and legal provisions raised in the Grounds only, and refer to the List only to understand the relevance of the documents cited to the specific arguments being presented.

20 I now turn to consider the grounds of revocation under Sections 80(1)(a), (d), (e) and (f). For ease of treatment only, they are grouped into three main headings entitled "1st Ground:…", "2nd Ground:…" and "3rd Ground:…" below.

MAIN DECISION

1st Ground: The invention is not a patentable invention as it lacks novelty and inventive step

Ground of Revocation under Section 80(1)(a)

21 Section 80(1)(a) of the Act reads:

> 80. —(1) Subject to the provisions of this Act, the Registrar may, on the application of any person, by order revoke a patent for an invention on (but only on) any of the following grounds:
> (a) the invention is not a patentable invention;

…

Section 13 of the Act reads:

> 13.—(1) Subject to subsection (2), a patentable invention is one that satisfies the following conditions:
> (*a*) the invention is new;
> (*b*) it involves an inventive step; and
> (*c*) it is capable of industrial application.

Section 14(1), (2) of the Act reads:

> 14.—(1) An invention shall be taken to be new if it does not form part of the state of the art.
> (2) The state of the art in the case of an invention shall be taken to comprise all matter (whether a product, a process, information about either, or anything else) which has at any time before the priority date of that invention been made available to the public (whether in Singapore or elsewhere) by written or oral description, by use or in any other way.

Section 15 of the Act reads:

> 15. 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 14(2) and without having regard to section 14(3).

22 An invention is considered to be a patentable invention if it is new, involves an inventive step and is capable of industrial application, as set out in Section 13(1) of the Act. Section 14 sets out that an invention is new if it does not form part of the state of the art, with state of the art comprising all matter made available to the public before the priority date of the invention. Likewise, Section 15 sets out the requirements for inventive step, in that the invention is not obvious to the person skilled in the art, also taking into account all matter made available to the public before the priority date of the invention.

Applicant's Representations

23 The applicant alleges that claims 1-15 of the patent are all invalid. Specifically, the applicant considers that claims 1-15 all lack novelty and inventive step, citing D1-D25 in its arguments. These documents disclose various different fibre optic sensors and their well known use in monitoring structures. For the most part, these documents refer to the SOFO system, and its use in SHM. The SOFO system is described in detail in D6, which is a PhD thesis detailing the development of the system, and its application. The applicant summarises the SOFO sensor as consisting of long gauge sensors, a reading unit and data acquisition and analysis software. The sensor contains two optical fibres, the measurement fibre and the reference fibre, both placed in the same protection tube. The measurement fibre is coupled with a host structure and follows its deformation, and the reference fibre is loose and independent from the structure deformations. The sensors of the SOFO system were installed in a number of constructions, including the Punggol EC 26 project, which is referred to by a number of the cited documents. The remaining documents disclose alternative SHM systems, including those using the fibre Bragg grating ("FBG") optical fibre system, and their installation.

Claim Construction

24 Before I consider whether the claims are novel and inventive, it is first necessary to determine their scope. Whilst the monopoly afforded by the patent is defined by the claims, Section 113(1) of the Act provides that the claims can be "*interpreted by the description and any drawings contained in that specification*". Nevertheless, it is not permissible to import gloss from the description such that the wording of the claims departs from its ordinary meaning.

Purposive Approach

25 The "purposive" approach to construction was first set out by the UK House of Lords in ***Catnic Components Ltd v Hill & Smith Ltd*** [1982] RPC 183 at 243 where Lord Diplock stated that "*A patent specification should be given a purposive construction rather than a purely literal one*", and this approach has been adopted in Singapore. The approach has been fine-tuned over the years. At present, the leading authority on claim construction is found in ***Kirin-Amgen v Hoechst Marion Roussel Ltd*** [2005] RPC 9 ("***Kirin-Amgen***"), where it was held, at [34], that when applying a "purposive construction", "*the question is always what the person skilled in the art would have understood the patentee to be using the language of the claim to mean"*. This has been endorsed by the Singapore Courts, most recently in ***First Currency Choice Pte Ltd v Main-Line Corporate Holdings Ltd*** [2008] 1 SLR(R) 335 at [27], where the starting point in patent construction "*is to ask the threshold question: what would the notional skilled person have understood the patentee to mean by the use of the language of the claims?*". Therefore, I will first construe the claims applying the principles laid down in ***Kirin-Amgen***. In doing so I will first need to identify the person skilled in the art and his requisite common general knowledge.

The Person Skilled in the Art

26 There are a number of relevant authorities, from both the Singapore and the UK Courts which lay down who the person skilled in the art should be. A summary of the indicators of a person skilled in the art was provided by Prakash J in ***Ng Kok Cheng v Chua Say Tiong*** [2001] SLR(R) 326 at [21], where the person skilled in the art is someone who:

(i) possesses common general knowledge of the subject matter in question;
(ii) has a practical interest in the subject matter of the patent or is likely to act on the directions given by it; and
(iii) whilst unimaginative is reasonably intelligent and wishes to make the directions in the patent work.

27 The applicant has provided no indication of who the person skilled in the art would be, and therefore I cannot make any assumptions who it would consider the skilled person to be. In my view, the skilled person would be a structural engineer with an interest in fibre optic sensors and their use in structural health monitoring in the construction industry.

The Common General Knowledge of the Skilled Person

28 The common general knowledge of the skilled person is essentially what makes the skilled person skilled. As pointed out by Laddie J in ***Raychem Corp's Patents*** [1998] RPC 31 at 40, common general knowledge "*includes all that material in the field he is working in which he*

knows exists, which he would refer to as a matter of course". In this case, I consider that the common general knowledge of the skilled person would lie in both the field of fibre optic sensors and the field of structural health monitoring.

29 Again the applicant has not directly given any indication of what the common general knowledge would be, but a number of the documents provided in the list demonstrate that, at the priority date, the skilled person would be aware of the application of fibre optic sensors in monitoring the structural health of constructions. Whilst these are not provided as evidence of common general knowledge *per se*, many of these provide an overview of the use of fibre optic sensors in SHM, and it is clear that the different types of fibre optic sensors available, and their use in monitoring factors such as temperature and strain, would be well known to the skilled person. They would also be aware that these sensors can be either embedded in the structures, sometimes attached to a rebar, or can be attached to the surface of the structure, as well as how the sensors can be attached. Their knowledge of fibre optic sensors would also make them aware of their fragility and the need for some protection, particularly when embedded into concrete.

Analysis and Conclusion on Claim Construction

30 As discussed above, there are three independent claims, 1, 8 and 15, and from what I can see, the key features in the claims that require a detailed construction are the carrier and its coupling to the object so that it can convey the deformational displacement (claims 1 and 8) or a physical quantity (claim 15) of the object to the optical fibre.

31 At [10] of the Grounds, the applicant states that claim 1 is "*a listing of parts used in an SHM system:- a carrier having two fixing positions; and couplable to an object; and an optical fibre coupled to the carrier by two fixing means, having at least one sensing element*", and goes on to refer to the explanation of the amendments made by the inventor during prosecution and in response to the examiner's written opinion. This passage of the Grounds seems to be particularly concerned with the "carrier" and its fixing to the object and the fibre optic. Whilst it is not particularly clear why the applicant has referred to this passage from the inventor's response, the applicant does not seem to dispute this explanation and moreover offers no further explanation of its own. Therefore, even though it may be inadvertent, the applicant does seem to appreciate the importance of these terms when construing the claim. However, he does not elaborate on this and therefore I cannot really determine what was in the mind of the applicant when he construed the claims.

32 Starting with the carrier, I need to consider what the person skilled in the art would understand the term to mean. Ordinarily, a carrier would be a means of support or for the transport of something. Given that the carrier of the claims attaches to both the object and the sensor, then I see no reason to assume that the carrier actually deviates from this ordinary meaning. Even when reading the description, which states that the carrier may be a tube for the sensor to sit inside, or a solid bar for the sensor to sit upon, the skilled person would not assume the carrier to be anything else.

33 SHM sensors are in contact with the structures that they are to monitor either by attachment to a surface, or by embedding within the concrete. However, the wording of the claims is quite specific: the carrier is **couplable to** an object **at the two fixing positions**, and the measurements are taken between these two positions. Throughout the description the references are to fixing on an object, and the method of claim 8 involves installation by coupling to an object at the

two fixing positions. When something is coupled to a structure, this would suggest some kind of attachment at a surface, and from the wording of the claims, it is clear that there is no other coupling of the carrier to the object, other than at the fixing positions so as to enable changes to be measured between these positions. In particular, the use of the terms "[coupled]… at the two fixing positions" suggests that the only means of attachment necessary to couple the carrier to the object is via the two fixing positions, although I do note however that there is no limitation on *how* the carrier is coupled to the object at these fixing positions.

34 If I therefore take the ordinary meaning of the term "coupled to", and/or if I read the claims in light of the description, I am of the opinion that the carrier only needs to be coupled to the surface of the object by some means of attachment at the two fixing positions only, wherein the surface may be external or formed by a cavity inside the structure. This would therefore appear to exclude the use of the sensor of the invention when **directly embedded** in any structure because embedding within concrete to measure the properties of the concrete would result in coupling to the concrete along the length of the sensor and not at two fixing positions. When coupled to the object, the carrier conveys deformational displacement/physical quantities of the object between the two fixing positions to a portion of the optical fibre between the two fixing means.

35 The fixing means need to be substantially proximal to the fixing positions. My first observation here is that the fixing means for the optical fibre to the carrier and the fixing positions of the carrier to the object would therefore be distinct. In other words, the suggestion that they are proximal to each other suggests that the fixing means for coupling the optical fibre to the carrier is not also intended to be the fixing position used to couple the carrier to the object. I will also consider the term "substantially" which, in its ordinary meaning, means "to a large extent". This was considered in ***PLG Research v Ardon*** [1993] FSR 197 at 210, where Aldous J held (and was upheld on appeal) that "substantially uniplanar" would encompass an insubstantial departure from uniplanarity; this would take into account minor alterations that would occur during manufacture, for example. The same reasoning can be applied to the present case, and therefore I consider that the skilled person would understand the term "substantially proximal" to mean that the fixing means and positions are essentially next to each other (and again, suggesting that the fixing means cannot be the fixing position *per se*), with deviation only being slight to encompass minor, unintentional manufacturing changes and not to materially affect the way the invention works. In other words, the fixing positions must be close enough to the fixing means to enable the carrier to convey the deformational displacement of the object to the fibre optic sensor, but the fixing position of the carrier to the object is not the same as the fixing means used to coupling the fibre optic sensor to the carrier.

36 In summary, claim 1 defines a sensor comprising a carrier which can be coupled to a surface of an object by two fixing positions, and an optical fibre that is coupled to the carrier by two fixing means, wherein the fixing means are close enough to the fixing position such that the carrier can convey the deformational displacement of the object between the two fixing positions to a portion of the optical fibre between the two fixing means. Claim 8 defines a method of installing this sensor, and claim 15 defines the same sensor but wherein the carrier conveys at least one physical quantity of the object, rather than deformational displacement, to the optical fibre.

37 Now that I have construed the key features of the claims I am able to proceed with my assessment of novelty and inventive step.

Novelty

38 The Singapore courts have taken guidance from the UK when considering novelty, and I likewise follow this approach. As laid down in the House of Lords in ***Smithkline Beecham Plc's (Paroxetine methanesulfonate) Patent*** [2006] RPC 10, both prior disclosure and enablement are required for anticipation. Prior disclosure must necessarily result in infringement of the patent; this "reverse infringement test" was set out by the UK Court of Appeal in ***General Tire & Rubber Company v Firestone Tyre & Rubber Company Ltd*** [1972] RPC 457 ("***General Tire***") at 485-486. The test was followed in the Singapore decision of ***Muhlbauer AG v Manufacturing Integration Technology Ltd*** [2010] 2 SLR 724, where Phang JA summarised the decision of Sachs LJ in ***General Tire*** at [17] as follows: "…*in seeking to establish anticipation for the purposes of discounting (or even ruling out altogether) novelty, the directions contained in a prior publication (which constitutes part of the state of the art) must be so clear that following those directions must inevitably lead to something that would, if the patentee's patent were valid, infringe the patentee's claim.*"

39 As noted above, the documents provided by the applicant do not all disclose technical details of the sensor system used in the SHM systems discussed therein, and many of the documents refer to the same system, the SOFO system. The applicant has not provided much in the way of technical comparison between the claims and the prior art, and so I have not found the representations in the Grounds to be of much use in this regard either.

D9: Measurement using the SOFO sensors

40 The only specific reference to any technical detail is to page 4 of D9; however even this reference falls short of the technical detail required to demonstrate anticipation of the claim and is indicative of the problems that the Registrar faces in correlating the documents cited with the assertion of lack of novelty and inventive step. This part of D9 refers to the setup of the SOFO sensors, best illustrated by Figures 3 and 4, reproduced below, and whilst it discloses how these sensors are installed, it provides no technical detail of these systems, and more importantly, does not point towards how this system actually contains each of the individual features of claim 1. In addition, the configuration shown in these figures appears to show a sensor system that appears to be embedded within the structure, and not coupled to the structure. Therefore, contrary to the assertion of the applicant, I cannot see how this sensor system, as it is depicted in D9, would anticipate the claims.

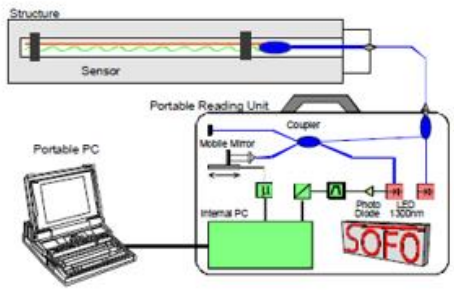


Fig. 3: Setup of the SOFO system used for static measurements.

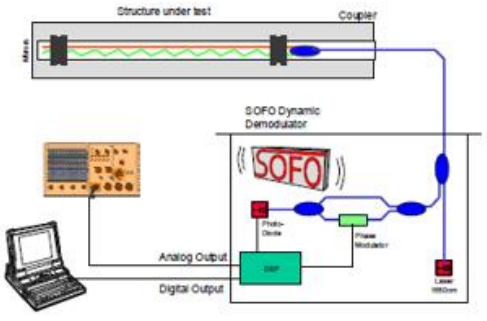


Fig. 4: Setup of the SOFO system used for dynamic measurements.

41 Even though the technical features of the system of D9 above is not clearly disclosed in this document, I believe that the SOFO system itself warrants further discussion. The SOFO system, referred to as the preferred SHM system in a number of the submitted documents, is actually disclosed in detail in D6, which is a PhD thesis that outlines the conception and development of this system, as well as various generations that led to the industrial version manufactured by SMARTEC SA. Chapter 6 of D6 details the specifics of this sensor, and outlines the pros and cons of distributed and local coupling of sensors onto the objects that are to be monitored: distributed coupling is where the fibre optic cable comprising the fibre optic sensors is attached along its length to the structure to be monitored, and local coupling is where the fibre optic cable comprising the fibre optic sensors is attached at each end to the structure by two points, and it is stretched between these points such that the cable is tensioned. From this it is clear that distributed and local coupling are tried and tested methods in the art.

42 Local coupling is the coupling method that most closely resembles the coupling method of claim 1. This is described in detail in the passage 6.6.6 of D6. In such an arrangement, the fibre is contained in a pipe along its length, where it is stressed in its active region. The passage goes on to state that the fixation points provide the desired mechanical contact between the fibre and the structure to be measured. Various embodiments of local coupling methods are discussed, including the evolution of the system that resulted in the commercially available SOFO system. There are several generations of the SOFO system described in D6, but in my mind there are two that are the most closely related to the claimed invention and I will discuss these individually.

D6: The surface coupling method

43 The first of these is the surface coupling method, which comprises a fibre optic sensor within a plastic tube, with two metallic plates, one at either end of the sensor/tube system. One part of each metallic plate is attached to the structure to be monitored (which would be considered to be the fixing position), and another part of the plate is attached to the fibre optic sensor by an adhesive (the fixing means). The metallic plate is an inverted "L" shape, with the fixing position and fixing means on the vertical and horizontal part of the "L" respectively. As such, these fixing points can be considered to be substantially proximal to each other. The system is best illustrated by Figures 6.13 and 6.14, which are reproduced below:

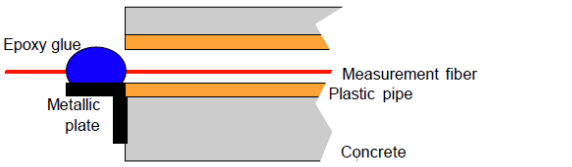


Figure 6.13 Surface coupling sensor. The same system is installed on the other end of the structure.

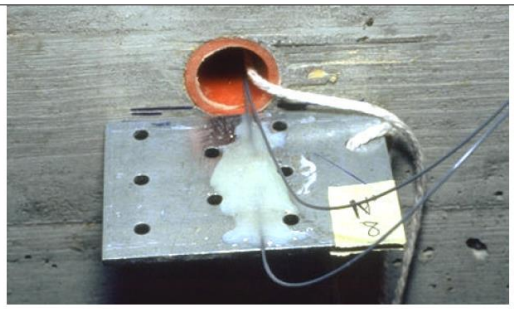


Figure 6.14 An example of surface coupling sensor.

44 This system utilises two separate metallic plates (i.e. two carriers), and not a single carrier with two fixing positions, as is required by claim 1, and therefore, such a configuration cannot anticipate this claim. Alternatively, if the plastic pipe was to be considered as the single carrier, then the fibre optic sensor is not coupled to the carrier; instead it is coupled to the metallic plates, and therefore the direct coupling of the fibre to the plastic pipe by two fixing means is also not disclosed and therefore again cannot be used to destroy the novelty of claim 1. Therefore, by virtue of these features alone, this specific system does not anticipate claim 1 and therefore I do not see any need to assess the further features of claim 1 in view of this particular generation of the SOFO system. Claims 8 and 15 also require the same features of the carrier and the fixing positions and therefore, for the same reasons as claim 1, are new in view of this disclosure.

D6: The junction piece coupling system

45 The second system that I will address is the commercialised SOFO system, which is described in paragraph 6.6.6.3 of D6 as a junction piece coupling sensor, and appears to be used in the monitoring of a number of structures described in several of the cited documents. This system is marketed by SMARTEC SA. The technical features of this system are best illustrated in Figure 6.17:

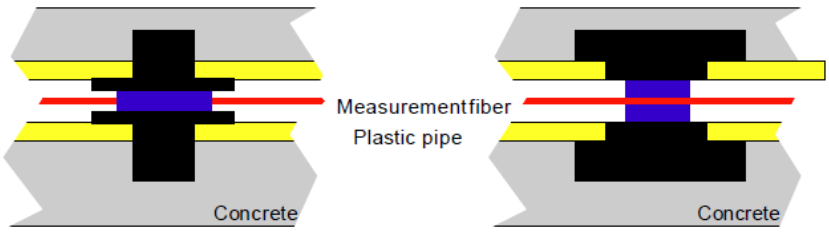


Figure 6.17 Junction piece coupling sensor. Two possible setups.

46 In this system, the fibre optic cable is installed within a plastic pipe to enable its protection. An anchorage point is provided, enabling the pre-stressing of the fibre optic sensor whilst at the same time providing a junction between two pipes. The commercial product is shown below:

Figure 6.19 Junction piece sensor.

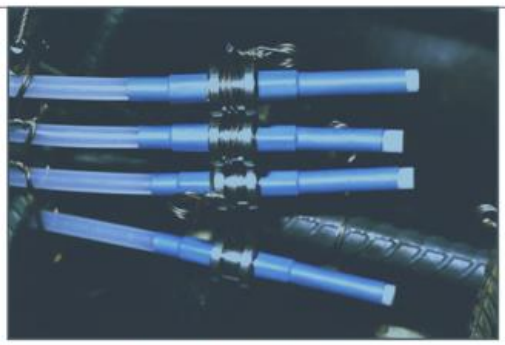


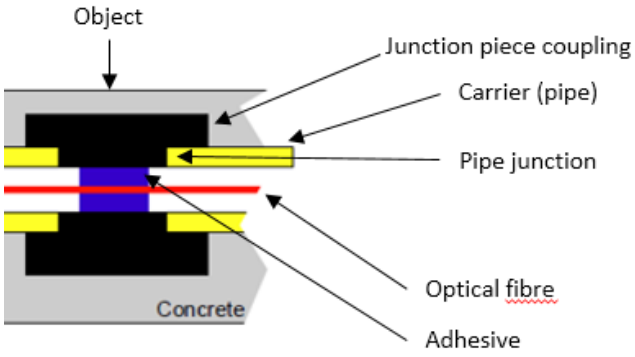
Figure 6.20 The IMAC-DIAMOND sensor.

47 The question to be asked is whether the sensor depicted in Figures 6.17, 6.19 and 6.20, the SOFO sensor, does in fact contain each of the technical features required of the sensor in claim 1? As noted when construing the claim, the key features are the presence of a carrier, which is attached to the object at two fixing positions, an optical fibre that is attached to the carrier by

two fixing means in close proximity to the fixing positions, and wherein the carrier conveys deformational displacement of the object between the two fixing positions to the optical fibre.

48 The SOFO sensor comprises an optical fibre with a sensing element, located within a plastic pipe, and the optical fibre is fixed to the junction coupling by an adhesive (see paragraph 6.6.6.3 of D6). The purpose of the junction coupling is to provide a connection between two pipes. The optical fibre is stressed within the pipe, between the two junction couplings, and measurement takes place in this stressed region, between the two ends of the fibre that are adhered to the junction couplings.

49 Taking the plastic pipe as the carrier, the coupling of D6 could be viewed as follows:

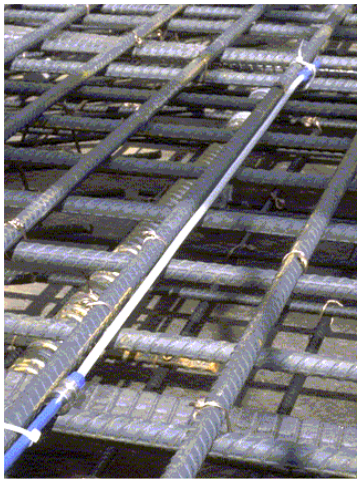


In this system, the optical fibre is not coupled to the carrier. Instead it is coupled, via adhesive, to the junction piece coupling, which in turn is coupled to both the carrier and the object. This *prima facie* does not appear to be the invention as defined in claim 1 of the patent. At the very best, I can see that the optical fibre is indirectly coupled to the carrier using the junction piece coupling as the fixing means, but I think that this is a stretch on the interpretation of "coupled".

50 In addition, whilst the junction piece couplings also serve as a means to couple the carrier to the object at the pipe junctions (which could be considered to be the fixing positions), it is clear that, when embedded, the carrier would also be in contact with the object along its length, and so arguably could be coupled at more than two fixing positions. Most importantly, it is not clear from D6 that the carrier itself conveys deformational displacement of the object, via the fixing means, to the optical fibre. From my understanding of D6, it is the junction piece couplings that directly convey the information of structural changes to the object; the carrier is merely there as a means of protection from the environment into which it is placed. In particular, Chapter 6 of D6 as whole is concerned with achieving a more reliable coupling between the optical fibre and the object to improve measurement, and the generation of the junction piece couplings allows such a coupling. Hence, from what I have read of D6, it does not appear that the pipe itself conveys the deformational displacement to the optical fibre, and therefore, even if an indirect coupling of the optical fibre to the carrier was considered to fall within the scope of the claim, in view of the material before me I do not think that the carrier in D6 would be capable of functioning in the manner required of the carrier of claim 1 of the patent.

51 However, in addition to being embedded into a concrete structure, it is clear from the other documents provided, that the sensor may be attached to a rebar prior to being embedded into the concrete structure. The intention of the rebar is to strengthen a concrete structure and help to keep it in compression, and monitoring systems have been used to measure the strain in the

rebars as well as in the concrete into which they are embedded. Fixing the sensor to a rebar requires the use of fixing positions, and can be used to measure physical parameters of either or both of the rebar and concrete structure. This is best described in D7, from which the image below is reproduced:

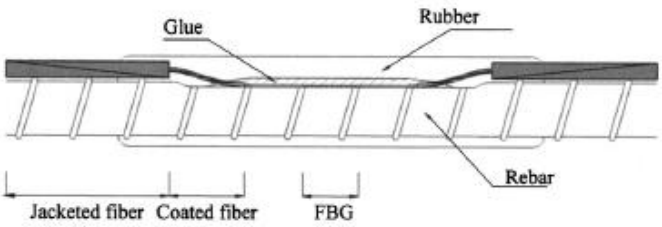


52 In such a system, the SOFO sensor is locally attached to a rebar at two positions, the attachment being depicted in the above figure as by two plastic cable ties, on either side of the two junction couplings. Therefore, the SOFO system depicted in the above figure would appear to consist of an optical fibre coupled to a carrier by two fixing means (the junction pieces), with the system being coupled to an object at two fixing positions (i.e. the cable ties as depicted above). However, firstly I am not convinced that the cable ties depicted above are in fact substantially proximal to the junction pieces, but then there is the possibility that, when in use, these ties could be closer to the junction pieces without affecting the function of the sensor. Secondly, and most importantly, I note that the cable ties are not attached to the carrier (the pipe) *per se.* Rather, they are attached to separate pipe structures that are joined to the carrier via the junction piece couplings. Therefore, it does not appear to me that the carrier itself is coupled to the object, and I do not think that in use, the skilled person would couple the carrier directly to the object because this could lead to an undesirable and unpredictable deformation in the plastic pipe, which would in turn affect the readings by the optical fibres. Therefore, I cannot see how, even when coupled at two points to a structural rebar, the SOFO system would anticipate claim 1. Consequently, claim 1 is novel in view of the SOFO system, whether directly embedded or attached to a rebar. As claims 8 and 15 also require coupling of optical fibre to the carrier and the coupling of the carrier to the object at two fixing positions, these claims are also new.

53 Therefore, the sensor of claims 1, 8 and 15 is not disclosed in D6, and these claims are novel over this document. By virtue of their dependence, claims 2-7 and 9-14 are also new in view of D6.

D16: Fibre Bragg grating / rebar sensor

54 The only other sensor disclosed in the cited documents that teaches the technical details of a sensor system that closely resembles that of the claimed sensor is the FBG sensor of D16. The sensor of this system is coupled directly to a rebar, which could be considered to be the carrier, and is demonstrated by Figure 5 below:



55 Although it is not explicitly stated, it appears that the rebar with the sensor attached can then be tied into the structural rebars that are already in place in the structure to be monitored. However, the sensor is attached to the carrier rebar by glue along the length of the monitoring portion of the fibre, and not by two fixing means as required by claim 1. Therefore, whilst the sensor system itself, which consists of the sensor attached to a carrier, does appear to be locally coupled to the structure to be monitored, the optical fibre is not attached by two fixing means to the carrier. In addition, I cannot see any disclosure in this document that suggests that the carrier rebar is intended to convey any physical quantity, or the deformational displacement information of an object to be monitored, to the optical fibre. In fact, it appears that the carrier rebar allows for convenience of transportation, and the document states (at page 366) that the rebar carrying the sensor is tied *into* the structural rebars already in place. This suggests that the sensor of D16 measures properties of the carrier rebar itself, which would then presumably be taken to be representative of the properties of the structural rebars and/or of the concrete that surrounds it, and therefore it is not the carrier rebar conveying information from the structural rebars into which it is tied to the optical fibre. Consequently, as the sensor of D16 does not attach to the carrier by two fixing means, and because the carrier does not appear to be for conveying deformational displacement or any physical quantity from the object to the optical fibre, it does not anticipate claim 1. Again, as with D6, claims 8 and 15 will also be novel over the disclosure of D16. Dependent claims 2-7 and 9-14 are also considered to be new in view of D16.

56 Consequently, there is nothing in documents D1-D41 that appears to disclose the SHM sensor system of claims 1, 8 or 15. Furthermore, there is nothing in the applicant's arguments that would persuade me otherwise, as the arguments appear to focus upon the usage of these sensors to monitor various structures, and not on the actual technical features of these sensors in relation to the sensor of the invention. Therefore, contrary to the assertion of the applicant, I consider claims 1-15 to be novel.

Inventive Step

57 As I have found the claims novel, I now need to consider whether they lack an inventive step in view of the cited documents. As with novelty, the arguments in relation to inventive step put forward in the applicant's Grounds are not well formulated and comprise sweeping statements such as "*the entire arrangement of the components in granted claim 1 is obvious*", or "*fixing two points to measure displacement and the spatial proximity of each of the fixing means to one of the two fixing positions is also obvious*": [20] of the Grounds. Therefore, in the absence of any substantive reasoning I am unable to clearly ascertain why the applicant considers the claims to be obvious.

58 Inventive step in Singapore is assessed using the four-step approach laid down by the UK Court of Appeal in ***Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd*** [1985] RPC 59 at 73, which has been adopted in a number of Singapore decisions, most recently in ***Main-***

Line Corporate Holdings Ltd v DBS Bank Ltd [2012] 4 SLR 147 and ***Martek Biosciences Corporation v Cargill International trading Pte Ltd*** [2012] 2 SLR 482. What is now known as the "Windsurfing" test was formulated by the UK Court of Appeal in order to reduce the risk of the use of hindsight when assessing obviousness, and I will use this test in my assessment. The "Windsurfing" test is as follows:

> (1) Identify the claimed inventive concept.
> (2) Assume the mantle of the normally skilled but unimaginative addressee in the art at the priority date and to impute to him what was, at that date, common general knowledge of the art in question.
> (3) Identify what, if any, differences exist between the matter cited as being "known or used" and the alleged invention.
> (4) Decide, without any knowledge of the alleged invention, whether these differences constitute steps which would have been obvious to the person skilled in the art or whether they require any degree of invention

59 Step 1 requires that I construe the claims to identify the inventive concept. I have already construed the claims (at [30]-[36] above), and will apply the same construction for inventive step. In summary, the inventive concept lies in the attachment of the optical fibre to a carrier by two fixing means, wherein said two fixing means are in close proximity to two fixing positions that couple the carrier to the object to be monitored. The carrier is capable of conveying deformational displacement of the object to the optical fibre. Similarly, with regard to Step 2, I have also identified the person skilled in the art and his common general knowledge at the priority date of the invention (at [26]-[29] above), so there is no need for me to repeat this here.

60 The third step requires me to identify the differences between the matter cited and the alleged invention. As with the novelty assessment, I do not intend to assess the inventive step of the claims based upon each and every document provided by the applicant. Instead, I will make the assessment based upon the disclosure of the SOFO system in D6 and its installation in or on the various structures as illustrated in the various other prior art documents, including D1-D5 and D7-D9, and on the disclosure of the FBG sensor in D16.

D6: The surface coupling method

61 As I discussed under novelty above, the features of the surface coupled sensor of D6 can be construed in one of two ways: either each metal plate is considered to be an individual carrier, or the plastic pipe can be considered to be a carrier. Therefore, the difference between the surface coupled sensor of D6 and claim 1 of the granted patent depends on what is considered to be the carrier in D6.

62 Taking the first interpretation, with each metal plate as the carrier, the difference would lie in the use of two separate carriers, rather than a single carrier for claim 1. Alternatively, for the second interpretation, the difference would lie in the fibre optic sensor not being attached to the carrier (or plastic pipe) but instead being attached to the metal structure that is then attached to the object. For each interpretation, there would need to be an indication that the carrier can be used to convey information about the health of the structure directly to the fibre optic cable.

63 I think I can dismiss the second interpretation straight away. The purpose of the plastic pipe is to protect the fibre optic cables from damage when pouring the concrete; there is no suggestion

anywhere that the optical fibre should be fixed to the pipe as it is already fixed to the metal plate, and moreover there is no suggestion that the pipe could be used to convey deformational displacement or a physical quantity of the object to the optical fibre. Therefore there would be no motivation for the skilled person to modify this arrangement to arrive at the sensor of claims 1, 8 and 15.

64 The interpretation where the metallic plates act as two individual carriers requires more consideration. The metallic plates are installed at either end of the structure to be monitored, and the sensors are installed within plastic pipes that run the length of the structure such that the sensors are threaded through and then secured at each end to the metallic plate using an epoxy glue. This surface coupling method is a form of local coupling, whereby the changes in the structure are conveyed to the fibre through the anchorage points. Therefore, it does appear that each individual carrier does in fact convey deformational displacement of the object to the fibre optic sensor, thereby performing the same function of the carrier of claim 1. The question to consider under Step 4 of the "Windsurfing" test, therefore, is whether it would be obvious to change this system of D6 from two individual carriers to a single carrier with two fixation points.

65 The applicant does not provide any argument within the Grounds, other than to say that fixing two points to measure displacement and the spatial proximity of the fixing means to one of the fixing positions is obvious. No reason or elaboration was given in support of this bare assertion, not even in the applicant's reference to the response of the proprietor to the written opinion issued by IP Australia. In particular, the applicant refers to the submission of the proprietor that "*the carrier and the optical fibre forms a unitary measurement device. The carrier provides structural support and rigidity to the optical fibre to enable it to be easily attached to an object to be measured. The carrier further acts as an interposer for structurally conveying deformational displacement (i.e. strain/ compression) to the optical fibre"*. It is not entirely clear what point the applicant is trying to make by referring to this passage. If anything, this actually goes some way to explain more clearly the role of the carrier, and this helps to distinguish the carrier of the invention from the surface coupled sensor disclosed in D6.

66 From what I can see, the carriers of D6 are intended to couple the sensor to the object, they do not provide any support along the length of the optical fibre; this support is provided by the plastic pipe. I do not see any motivation for the skilled person to extend the carriers of D6 such that they form a single structure, particularly as these carriers are placed externally to the structure and are not intended to be present along the length of the fibre optic cable. Likewise, I do not see any motivation for the skilled person to directly attach the fibre optic cables to the pipe by two fixing means, and then locally attach the pipe to the object at two fixing positions in close proximity to the fixing means. This would make installation unnecessarily difficult when the system already in use appears to function adequately. Therefore, on balance, I cannot see how the sensor arrangement of claims 1, 8 and 15 would be obvious over the surface coupled sensor of D6.

D6: The junction piece coupling system

67 I now turn to the commercially available, junction piece coupled SOFO sensor, which is described in paragraph 6.6.6.3 of D6. The main difference between this system and that of the invention, as identified above in my discussion on the novelty of the claims, is the optical fibre is coupled to the junction pieces and not the carrier as such, and that it is these junction pieces, acting as anchor points between the fibre and the object, that convey the deformational

displacement/physical quantities to the fibre optic sensors. Furthermore, D6 and the remaining documents provided show that the SOFO sensor is embedded within the object and therefore is not necessarily coupled *to* the object. Would it therefore be obvious to modify the SOFO sensor such that the changes to the structure are conveyed through the carrier (i.e. the pipe), via fixing means, to the optical fibre, rather than via the junction piece coupling, and also would it be obvious to couple the sensor to an object and not embed it within the structure?

68 Taking the coupling of the sensor to the surface first, even though the documents referring to the use of the SOFO sensor demonstrate that it is embedded within a concrete structure, it is also clear from some of the documents cited that other fibre optic sensors are sometimes attached to the surface of structures (see, for example, D20). In addition, the sensor can also be attached to a rebar (although admittedly it will likely then be embedded). Hence, I see no reason why the skilled person would not consider the attachment of the SOFO sensor to the object in addition to embedding it within a concrete structure. Therefore, the main question to ask is whether the skilled person would consider adapting the SOFO sensor such that the changes in the object to be measured were conveyed through a carrier rather than through the junction piece couplings?

69 It is clear that the purpose of the pipe in D6 is to provide protection for the fibre from the environment, and given that the use of such pipes is common to protect fibre optic sensors, I do not think that the skilled person would consider any alternative purpose for the pipe. There is also no suggestion that the optical fibre could be directly coupled to the pipe itself rather than to the junction piece coupling, and as I discussed under novelty above, it is clear from D6 that it is the junction piece couplings, through their contact with the structure to be monitored, that convey the information on the deformational displacement/physical properties of the object to the fibre optic sensors. In fact, D6 seems primarily concerned with solving the problem of providing a reliable mechanical coupling between the fibre and the mechanical piece used to anchor it to the structure (see 6.6.6, first paragraph), thereby suggesting that changes in the structure/object are monitored by directly fixing the optical fibre to the structure, via the coupling, without the need for any additional carrier. This feature of the SOFO system is in fact referred to in D8 and D9, where the measurement fibre is described as being in mechanical contact with the structure itself, by its two anchorage points, thus allowing it to follow the deformation of the structure. In summary, D6 solves the problem of conveying reliable information from the structure to the fibre optic sensor by directly attaching the fibre optic cable to the junction piece couplings, and it is these couplings that are in direct contact with the object to be monitored and that convey the relevant structural information. The pipe is simply there to protect the optical fibre cables from the environment.

70 In fact, the SOFO system itself appears to address many of the problems in the art, including providing a well-protected SHM system using optical fibres, and providing a reliable mechanical coupling between the optical fibre and the piece used to anchor it to the structure. Local coupling using the junction pieces provides the necessary tensioning and the use of an effective adhesive prevented creeping effects commonly seen with distributed coupling and inadequate adhering to the structure. Through pre-tensioning the fibre by adhering it to the junction piece at the manufacturing stage, this alleviates the problem of having to tension the fibre on site, as well as providing an effective means to transport the sensor. However, this does beg the question, what is the advantage of the invention of the patent over the SOFO sensor system? In other words, is the provision of the carrier a mere workshop variation?

71 Workshop improvements were found to lack inventiveness in ***ASM Assembly Automation Ltd v Aurigin Technology Pte Ltd and others*** [2010] 1 SLR 1. However, these are notoriously difficult to ascertain, and even more so in the present case as I have no arguments from either party disputing or suggesting this. Nevertheless, for a modification to be a mere workshop variation, I would expect that modification to play no technical role in the working of the invention. In the present situation, on the material before me and the disclosure of the patent itself, I do not think that this is the case. Page 3 of the patent describes, albeit briefly, that the fixing positions that couple the carrier to the object are intended to measure average physical quantities of the object between these fixing positions, and that this is transferred to the optical fibre by the fixing means. Admittedly, there are no examples demonstrating that this is indeed advantageous, but likewise I have no arguments from the applicant suggesting that the use of a carrier itself is not. Nevertheless, by conveying information regarding the object to be monitored to the optical fibre, the carrier does play a technical role in the working of the invention, and therefore in my opinion does extend beyond a mere workshop variation. Therefore, I conclude that the provision of a carrier that conveys deformational displacement/physical quantities of the object to be measured does appear to provide an inventive step over the disclosure of D6, and over the known uses of the SOFO system disclosed in the other documents provided by the application. As such, claim 1 is not obvious over the disclosure of D6, and as the methods and system of claims 8 and 15 also require the use of a carrier to convey information to the sensor, these claims are also considered to be inventive.

D16: Fibre Bragg grating / rebar sensor

72 For completeness I will assess whether the claimed invention displays an inventive step over the system of D16. However, the sensor of this system is connected to the carrier (the carrier rebar) along its length (the distributed coupling means) and not by two separate fixing means (the local coupling means) as required by claim 1. Even though local coupling and distributed coupling are both known mechanisms for attaching a fibre optic sensor to the material to be monitored, I cannot see why the skilled person would consider changing the attachment means of D16 to a local coupling method as this would result in a less secure attachment of the optical fibre to the rebar.

73 In addition, whilst D16 states that the carrier rebar is to be tied into existing structural rebars, there is no indication that this would be by two fixing positions. Nevertheless, I am willing to accept that fixation at either end of the rebar would be the most likely and thus there is a likelihood that in use the carrier rebar would be attached at two fixing positions. However, even if the carrier rebar was attached to structural rebars in this way, it is not clear that the carrier rebar itself is intended to convey information regarding the deformational displacement/physical quantities of the structural rebars into which it is tied to the optical fibre. From my understanding of D16, the purpose of the sensor system depicted in Figure 5 and discussed on page 366 is to enable assembly of the fibre optic sensor onto a carrier rebar prior to incorporation of the carrier rebar into the structural rebar system of the object to be monitored. Whilst I acknowledge that the sensor can monitor changes in a rebar, it appears to me that it monitors local changes in the carrier rebar to which it is coupled and not changes in the structural rebars that the carrier rebar is tied into. This is a significant difference from the system of the invention, and in view of this I cannot see the motivation for the skilled person to arrive at the role of the carrier of the invention from the reading of D16 alone. However, even if I am wrong and the carrier rebar of D16 is capable of conveying deformational displacement/physical quantities from the structural rebars to the fibre optic sensor, I still see

no motivation for the skilled person to adapt the fixing of the fibre optic sensor to the carrier rebar from the distributed to a local coupling fixing means, with those fixing means at two points in close proximity to where the carrier rebar would be tied into the structural rebar. Therefore, I still fail to see how the sensor of the invention is obvious in view of this document.

74 In summary, I consider that, on balance, independent claims 1, 8 and 15 are inventive in view of the disclosures of D6, D16 and the other documents provided by the applicant. By virtue of dependence, claims 2-7 and 9-14 also involve an inventive step.

Conclusion

75 The ground of revocation under Section 80(1)(a) of the Act therefore fails.

2nd Ground: Amendments to the claims of the application for the patent went beyond the disclosure as filed and such amendments should not have been allowed

Grounds of Revocation under Section 80(1)(d), (e)

76 Section 80(1)(d),(e) of the Act reads:

> 80. —(1) Subject to the provisions of this Act, the Registrar may, on the application of any person, by order revoke a patent for an invention on (but only on) any of the following grounds:
> …
> (d) the matter disclosed in the specification of the patent extends beyond that disclosed —(i) in the application for the patent, as filed;
> …
> (e) an amendment or a correction has been made to the specification of —
> (i) the patent; or
> (ii) the application for the patent,
> which should not have been allowed

Section 84(2) of the Act reads:

> (2) No amendment of an application for a patent shall be allowed under section 31 if it results in the application disclosing any matter extending beyond that disclosed in the application as filed.

77 The applicant has cited Sections 80(1)(d) and 80(1)(e) as grounds for revocation. I can deal with these together as the only amendments made to the specification were pre-grant, in response to the examiner's written opinion with the accompanying PF13. There are no corrections that would be unallowable and there are no amendments post-grant that would extend the scope of protection. Therefore, the consideration is whether the amendments made in response to the examiner's written opinion should have been allowed.

Applicant's Representations

78 The applicant, in the Grounds, considers that granted claims 1 and 8 extend beyond the application as filed. In particular, the applicant contends that the amendment of the claims during the examination process from "average physical quantities" to "deformational

displacement" went beyond the scope of the original disclosure and widens the scope of coverage of the invention. The applicant also argues that this amendment should not have been allowed and constitutes added matter, which is another ground for revocation. The applicant refers to a number of documents D26-D32, as well as D8, D16, D18, D21-D23 in the List to support this assertion, although it is not immediately apparent how these documents can relate to an allegation of added matter.

Analysis

79 With regard to the applicant's contention that amendment of the term "average physical quantities" to "deformational displacement" in claims 1 and 8 is broader that the scope of disclosure as filed and widens the scope of protection of the invention, I think this is incorrect. This amendment was made pre-grant, and it is commonplace for the scope of the claims to legitimately change, either by narrowing or by broadening, during the examination process, as long as basis for the amendments is found in the specification as filed. Furthermore, as the term "deformational displacement" is a narrower parameter than "average physical quantities", it would not broaden the scope of the coverage of the invention, as alleged by the applicant. Therefore, this argument is completely unfounded. However, I do need to give some consideration as to whether the term "deformational displacement" is considered to be new matter, and therefore extends beyond what was disclosed in the specification as filed.

80 The applicant is correct in that the term "deformational displacement" was not found in the specification as filed. The specification generally refers to the sensors as measuring physical quantities, and as page 2 refers to these as including "strain, displacement, stress and pressure etc.", I agree that the term "deformational displacement" was not explicitly disclosed.

81 Singapore adopts the test for added subject matter as set down in ***Bonzel and Schneider (Europe) AG v Intervention Ltd*** [1991] RPC 533 at 574, which applied the following three-step test:

(1) To ascertain through the eyes of the skilled addressee what is disclosed, both explicitly and implicitly in the application;
(2) To do the same in respect of the granted patent;
(3) To compare the two disclosures and decide whether any subject matter relevant to the invention has been added whether by deletion or addition.

82 This was elaborated further in ***European Central Bank v Document Security Systems Incorporated*** [2007] EWHC, and followed by the Singapore High Court in ***Novartis AG and another v Ranbaxy (Malaysia) Sdn Bhd*** [2013] 2 SLR 117. I am guided by these decisions when assessing whether amendment of "average physical quantities" to "deformational displacement" constitutes added matter.

83 I think the important factor to consider here is what the skilled person would consider to be disclosed in the specification, both explicitly and implicitly. Implicit disclosure was considered in ***DSM NV's Patent*** [2001] RPC 35 at [197]-[200], where something that the skilled person would take for granted as being part of the description would not amount to added matter. In this case, it is necessary to determine what the skilled person would take for granted as being measured by the SHM system disclosed in the specification as filed. In other words, does the limitation of the measurement parameters to "deformational displacement" teach the skilled person something new?

84 I have already outlined who the skilled person would be and what his common general knowledge would be at the filing date of the patent. In essence, the skilled person would be a structural engineer familiar with structural health monitoring using fibre optic sensors, and with those parameters that are to be measured. It appears that SHM systems are known to measure displacement (i.e. the movement of individual points in a structure), and this was listed in the application as filed as a parameter measured by the system of the invention, as well as stresses and strains which are also disclosed. Therefore, the limitation of the physical quantity to displacement is disclosed in the specification as filed and therefore this amendment of the claim is allowable.

85 I do note, however, that the phrase in issue is "*deformational* displacement", which is not necessarily a term known in the art (although the applicant has not disputed the clarity of this term), and this parameter is not clearly disclosed in the specification as filed. Even though the specification only referred to measurement of "displacement", it also referred to other factors such as stress or strain, both of which would result in deformation of the structure. As deformation is the change in the structure by application of stress associated with displacement, it therefore appears that by using the term "deformational displacement", the proprietor was trying to convey that the measurement parameter is the displacement measured as a result of deformation of the object upon application of stresses, and that this would be implicitly disclosed as part of the physical quantities intended to be measured by the sensor in the application as filed. Therefore, even though this term is not explicitly disclosed, I consider that, on balance, the deformational displacement would be something that the skilled person would assume to fall within what is meant by "physical quantities", particularly as these are disclosed as being "strain, displacement and stress" in the description as filed.

Conclusion

86 Therefore, contrary to the assertions of the applicant, I do not consider that the subject matter of claims 1 and 8 extends beyond the disclosure as filed. The grounds of revocation under Section 80(1)(d), (e) of the Act therefore fail.

3rd Ground: The Patent was obtained fraudulently or on misrepresentation

Ground of Revocation under Section 80(1)(f)

87 Section 80(1)(f) of the Act reads:

> 80. —(1) Subject to the provisions of this Act, the Registrar may, on the application of any person, by order revoke a patent for an invention on (but only on) any of the following grounds:
> …
> (f) the patent was obtained —
> (i) fraudulently;
> (ii) on any misrepresentation; or
> (iii) …

Applicant's Representations

88 The applicant argues that the patent was obtained fraudulently and on misrepresentation. The inventor was working for CPG laboratories at the time of filing of the patent, and therefore the patent should have been filed in the name of his employer. Furthermore, the applicant argues that the inventor was aware of the various SHM projects and therefore, in view of this, was aware that the invention was not his own intellectual property. The applicant also argues that the proprietor claimed on its website that it had installed a SHM system for a bridge in 1997, which was whilst the inventor was still in the employ of the public sector. As the proprietor and/or the inventor knew that SHM systems were available prior to the filing of the patent application, the applicant considers this further evidence of misrepresentation. The applicant refers to passages from the inventor's response to the examiner's written opinion which stated that the invention was novel and inventive, as well as additional documents demonstrating that the patent was obtained fraudulently. In addition, as the patent was granted under the "self-assessment" system in Singapore, the applicant opined that the onus was on the inventor to ensure his patent met the requirements of patentability, yet the inventor knew that the invention was not new as he was involved in SHM work, and knew of its use in the Punggol EC 26 project. Furthermore, any intellectual property rights arising from this project should belong to HDB and/or SOFO or SMARTEC SA, and not the proprietor. This also results in misrepresentation.

Analysis

89 The applicant provides a number of reasons as to why he considers the patent was obtained fraudulently and/or on misrepresentation. Misrepresentation was considered in ***Trek Technology (Singapore) Pte Ltd v FE Global Electronics Pts Ltd and Others*** [2005] 3 SLR 389 ("***Trek Technology***"), where, at [107] Lai J, in reference to Whitford J in ***Intalite International N.V, v Cellular Ceilings Ltd (No 2)*** [1987] RPC 532, considered that the onus is on the defendants to show that the misrepresentation must actually have deceived the Registrar of Patents into granting the patent.

90 A number of the assertions made by the applicant appear to be based upon the fact that as SHM systems were known, and in particular the invention was known, to the inventor as early as 1997, and the inventor that carried out SHM for a bridge at that time. However, even if SHM systems were known, this is not enough to demonstrate that the actual system of the invention was being used prior to the filing date. I have already considered that the system is new over the known systems provided in the prior art documents and therefore there is not sufficient evidence here for me to agree with the applicant's assertion that the inventor was aware that his system was already known and in use.

91 The applicant also refers to the patent system at the time of grant of the patent as being the "self-assessment" system. He is correct in that it is for the inventor to decide whether he wishes to proceed with grant in spite of unfavourable findings in the search and examination process; this is a known risk to patent proprietors who pursue grant even when the examination process suggests that the patent may not be valid. However, in this case the patent was examined, and the inventor amended his application to address the objections raised by the examiner in his written opinion. The amendments were then re-examined and the patent was granted on the basis of a fully positive examination report as the examiner had deemed it to meet all requirements of patentability. Therefore, this was not a case where the inventor had pursued

grant of a patent that he knew was not new. Therefore, this assertion of the applicant also does not hold.

92 The final assertion is in relation to the employment of the inventor at the time of filing that patent. According to the applicant, the inventor was a public servant at the time of filing of the patent as he was employed by CPG Laboratories Pte Ltd, which was a subsidiary of CPG Corporation, the corporatized entity of the former Singapore Public Works Department. The applicant claims that the inventor used the knowledge obtained as part of this employment in CPG Laboratories to develop the sensor of the patent. Therefore, according to the applicant, the application for the patent should have been filed in the name of CPG Laboratories, or CPG Corporation, and not in the name of the inventor.

93 Section 49 of the Act states that an invention made by an employee shall be taken to belong to his employer if made during the course of his normal duties or if it results from carrying out his duties, or as part of his obligation to further the interests of the employers undertaking. I have no evidence before me of what the duties of the inventor were during the course of his employment with CPG Laboratories. Admittedly, the arguments from the applicant are weak and unsubstantiated. I also admit that I find it strange that, when taking ownership of the patent, the proprietor did not perform sufficient due diligence to ensure that the inventor was correct in filing the patent as an individual and not as an employee of CPG Laboratories. I have no details of the transfer of rights, other than the required forms, but I do note that this was a direct transfer between the inventor and the proprietor, and there does not appear to be any patent attorney involved. Moreover there does not appear to be any attorney involved during the prosecution of the patent application pre-grant, therefore there may have been a lack of understanding from both parties regarding the requirements of the Act. This is all hypothesising on my part though, and so really I cannot draw any conclusions over what was in the minds of the inventor at the time of filing the patent, or the proprietor at the time of transfer of the rights, or what their knowledge would be. Whether or not they were aware of the requirements of Section 49 of the Act is also irrelevant as ignorance of the legislative provisions would not provide a valid argument. The lack of submissions from the proprietor or the inventor means that I cannot gain any further insights from them into what the role of the inventor was during the course of his employment with CPG Laboratories, or whether the inventor applied for the patent for the invention when it should really have belonged to hisemployer.

94 So the question I need to ask, in view of ***Trek Technology***, is whether the applicant has provided enough evidence to show that the inventor misrepresented himself to the Registrar of Patents, and if this is the case, whether this misrepresentation deceived the Registrar into granting the patent? The misrepresentation hinges on the fact that the patent, at the time of filing, should have belonged to CPG Laboratories, and not the inventor, if the invention was conceived during the normal course of employment of the inventor. If this is the case, then the inventor would have led the Registrar to grant a patent to an individual who was not the true owner of the invention.

95 From the submissions of the applicant, it appears that the inventor was involved in SHM monitoring, and that his employer, CPG Laboratories, was involved in SHM projects in Singapore, which include installation of SHM and testing of fibre optic sensors. There is therefore a likelihood that given that the invention is also directly related to SHM projects and fibre optic sensors, it was developed as part of the duties of the inventor. It is here that I note again that neither the inventor nor the proprietor have countered the arguments of the applicant, and therefore according to Rule 80(4), in the absence of any evidence to the contrary, I am to

take it that the facts before me are conceded. I have no documents before me that would contradict the assertions of the applicant, and therefore, on balance I accept the arguments of the applicant that the invention of the patent was developed during the course of the inventor's employment, and as part of his normal duties, with CPG Laboratories. As such, I consider that the rightful owner of the invention at the time of filing of the patent application was CPG Laboratories, and therefore the inventor did misrepresent himself to the Registrar as the owner of the invention. This would have led the Registrar to grant the patent to a person to whom, by virtue of Section 49, the invention did not belong.

96 Consequently, I agree with the applicant that the inventor obtained the patent by misrepresenting himself as the owner of the invention, when it should have belonged to his employer, CPG Laboratories.

Conclusion

97 The ground of revocation under Section 80(1)(f) of the Act therefore succeeds.

Overall Conclusion

98 For the reasons stated above, I find that claims 1-15 are both novel and inventive in view of the cited prior art and common general knowledge. In addition, no amendments were made to the patent application during the examination process that were unallowable or went beyond the disclosure as filed. However, on the balance of the representations before me from the applicant, and in the absence of any representations from the proprietor to the contrary, I consider that the inventor obtained the patent by misrepresenting himself to the Registrar. I therefore allow the application for revocation under Section 80(1)(f)(ii) of the Act. The applicant is entitled to costs for drawing and filing its application for revocation together with its statement of case, to be taxed if not agreed.

Dated this 30th day of November 2016

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See Tho Sok Yee

Principal Assistant Registrar of Patents

Hearings and Mediation Group

Intellectual Property Office of Singapore