ASM Assembly Automation Ltd v Aurigin Technology Pte Ltd and Others [2009] SGHC 206

Case Number : Suit 163/2007

Decision Date : 16 September 2009

Tribunal/Court : High Court

Coram : Tan Lee Meng J

Counsel Name(s) : Dedar Singh Gill and Paul Teo (Drew & Napier LLC) for the plaintiff; Low Chai Chong, Lee Ai Ming and Alvin Lim (Rodyk & Davidson LLP) for the defendants

Parties : ASM Assembly Automation Ltd — Aurigin Technology Pte Ltd; Lim Ee Teoh; Tam Wing Wah

Patents and Inventions

16 September 2009 Judgment reserved.

Tan Lee Meng J:

1 The plaintiff, ASM Assembly Automation Ltd ("ASM"), a Hong Kong company that is in the business of manufacturing and selling semiconductor assembly and packaging equipment, is the registered proprietor of Patent No 104354 (the "patent"), which was granted on 30 December 2005. The priority date of the patent, which relates to an apparatus and method for automatically placing an array of solder balls onto a substrate, such as a ball-grid array ("BGA") substrate, is 8 January 2002. The said patent was granted pursuant to s 29(1)(c) and s 29(5) of the Patents Act (Cap 221, 2002, Rev Ed) ("the Act"), relying on its corresponding US patent application (US Patent No 6,766,938B2).

2 ASM alleged that the 1st defendant, Aurigin Technology Pte Ltd ("Aurigin"), a Singapore company, infringed the patent and that the 2nd defendant, Mr Lim Ee Teoh ("Mr Lim"), and the 3rd defendant, Mr Tam Wing Wah ("Mr Tam"), who are Aurigin's directors, directed, authorised, counselled or procured Aurigin to infringe the patent. Aurigin's allegedly infringing product, the AU800, is its flagship product. Invented by Mr Lim and Mr Tam, together with one Mr Ng Boon Chew, the AU800 is an automated BGA solder ball placement machine which houses a key solder ball placement module based on its patented solder ball placement module design. The said module was patented in Singapore (Patent No 111523) on 30 April 2007, with a priority date of 14 October 2002, and in the United States (Patent No 10/531,611) on 2 December 2008. The first 2 sets of the AU800 were sold by Aurigin on 19 November 2003.

3 ASM sought a declaration that its Singapore patent is valid and that the defendants' AU800 infringed claims 1-4, 6-7 and 11-12 of its amended patent. ASM also sought an injunction to restrain the defendants from infringing its Singapore patent and an inquiry as to damages or alternatively an account of profits made by Aurigin and its directors as a result of the alleged infringement of its patent.

4 Aurigin denied having infringed ASM's patent and sought an order that ASM's patent be revoked for lack of novelty and inventiveness. The defendants pleaded that even if ASM's patent is valid, they are entitled to rely on s 71(1) of the Act, which concerns the defence of having made serious and effective preparations to manufacture and to offer to sell the AU800 before the priority date of ASM's patent. They also pleaded the defence of innocent infringement and asserted that ASM is not entitled to any damages or account of profits prior to 6 December 2006.

5 Aurigin also sought an injunction to restrain ASM from threatening their customers with legal proceedings for infringing ASM's patent. Finally, Aurigin counterclaimed against ASM for having made groundless threats of infringement and sought an inquiry as to damages suffered.

The Expert Witnesses

6 ASM's expert witness was Assoc Prof Khong Poh Wah ("A/P Khong") from the Nanyang Technological University ("NTU") School of Mechanical and Aerospace Engineering. ASM also called Mr Robert Faber ("Mr Faber") , a patent lawyer and a partner of *Ostrolenk, Faber, Gerb & Soffen LLP*, the American intellectual property firm that was responsible for prosecuting ASM's United States Patent, to testify as an expert witness but he is, by his own admission, not a person skilled in the art. In *Ng Kok Cheng v Chua Say Tiong* [2001] 3 SLR 487, a case concerning the making of a lock, it was held that a patent attorney, who was called by the defendant as an expert, was not an expert as he was not a person skilled in the art of making locks. Likewise, Mr Faber's evidence as a patent attorney is not relevant to issues pertaining to the views of a person skilled in the art.

7 Aurigin called two expert witnesses to testify. The first was Assoc Prof Tay Meng Leong ("A/P Tay"), who, like A/P Khong, is from the Nanyang Technological University School of Mechanical and Aerospace Engineering. Aurigin's second expert, Mr Dennis Miller ("Mr Miller"), was, until his retirement in 2006, the senior director and vice-president of Motorola Inc in Illinois. Mr Miller has rather impressive credentials as an inventor and innovator. A mechanical engineer, he holds 11 patents, 5 of which relate to BGA technology. His evidence was most useful to the court.

BGA Technology

8 As the patent relates to BGA technology, the following primer on this subject by Aurigin's expert witness, Mr Miller, in his affidavit of evidence-in-chief ("AEIC") at [18] is helpful:

> Integrated Circuit ("IC") Packages are essentially computer chips commonly used in electrical devices such as cell phones, hand held computer games, computers etc, to perform electronic functions. They are advanced electrical circuits comprising of transistors, capacitors and resistors connected to each other in different ways and mounted on printed circuit boards ("PCBs"). Several methods can be used to mount the IC packages onto PCBs and form interconnects (to maintain electrical connections) between the IC and PCB. Such methods use different surface mount devices which include … BGA devices.… BGA is a type of surface mount technology which uses a device comprising an IC package with an array of solder balls soldered on the substrate of the IC package for mounting onto a PCB.

9 As the size of IC chips became smaller, newer technology was required to handle smaller solder balls. For instance, flux contamination, which was not a problem with larger solder balls, posed a serious problem for smaller solder balls. To negate this problem, Motorola developed equipment with a flux plate that contained flux. The solder balls on the pickup tool were partially immersed into the flux on the flux plate before being positioned on the substrate. Motorola obtained a patent for this invention on 8 February 1994.

10 In due course, solder balls became so miniscule that a table spoon might contain a million solder balls. The significant reduction in the size of solder balls created new problems. For instance, the pickup tool had difficulties picking up solder balls from the reservoir of balls. Debris, flux contamination and machining variations aggravated the situation. Solder balls were also subject to oxidation and damage. A solution to the problems posed by the miniscule size of solder balls was to separate the major elements (solder ball reservoir, solder ball filling, picking up of solder balls, substrate fluxing) into

independent processes. Thus, the pickup head would be presented with balls in a template, with one ball per vacuum hold and the filling of the template would be separated from the pickup head. The new fill process would involve flowing many solder balls over an array of apertures by running a ball reservoir over the apertures on the template.

11 Many solutions to the difficulties posed by the downsizing of solder balls were patented. As for ASM's patent, the abstract was in the following terms:

> The invention provides an apparatus and method for positioning solder balls in a desired array on a substrate. A positioning means is provided for positioning the solder balls in positions corresponding to the array of positions the solder balls are to take up on the substrate. A container for receiving a plurality of solder balls and which is movable between a first position remote from the positioning means and a second position directly thereover supplies solder balls to the positioning means. Means are provided to bias the solder balls in the direction of movement of the container from the first to the second position whereby to reduce or obviate damage to the solder balls during such movement.

12 The claims under ASM's patent, as amended during the trial, are as follows:

> *Claim 1*
>
> An apparatus for positioning solder balls in a desired array on a substrate, comprising:
>
> a positioning member which is constructed and configured to direct the solder balls to required positions corresponding to the array of positions the solder balls are to take up on the substrate,
>
> a container for a plurality of solder balls, the container being configured and operable to move in a first direction from a first end position remote from die positioning member to a second end position directly in communication with the positioning member to provide solder balls to the positioning member, and to move in a second direction opposite to the first direction from the second end position to the first end position to move the solder balls not in require dispositions away from the positioning member; and
>
> a *tilting* mechanism constructed and configured to apply a force to the solder balls in the container in the direction of movement of the container as the container moves between the first and the second position *in the first direction and the second direction respectively*;
>
> *wherein the tilting mechanism to apply a force to the solder balls comprises a tilting mechanism adapted to rotate the container about an axis perpendicular to the direction of motion of the container and thereby tilt it*.
>
> *Claim 2*
>
> An apparatus according to claim 1, wherein the container and positioning member are rotatable a plurality of times when the container is in position directly over the positioning member, so that the solder balls are repeatedly spread over the positioning member.

Claim 3

An apparatus according to claim 1 or claim 2 wherein rotational angles of the container and/or the moving speed of the container and/or the moving speed of the container are controllable to optimize the efficiency of the apparatus.

Claim 4

An apparatus according to claim 2 or claim 3, wherein there is a positioning rail and motor whereby the container is positioned and driven.

Claim 5

An apparatus according to any of the preceding claims, which includes a vibration-generating device to facilitate the separation of solder balls from surfaces they are in contact with and/or from one another.

Claim 6

An apparatus according to any one of the preceding claims, wherein the positioning member includes a ball template with a plurality of apertures each slightly larger than the size of a solder ball in order to capture solder balls within the ball template, and wherein the plurality of apertures are arranged in an order similar to the array of positions comprising solder pads on the substrate.

Claim 7

An apparatus according to claim 6, wherein solder balls captured in the plurality of apertures are removable by a pick-and-place device while retaining their respective positions, and placed onto corresponding positions of solder pads on the substrate.

Claim 8

An apparatus according to any one of claims 6 or 7, which includes means to rotate the container, ball template and substrate simultaneously.

Claim 9

An apparatus according to any one of claims 6 to 8, wherein the apertures comprise through-holes which allow solder balls to fall through the ball template directly onto a substrate placed below it.

Claim 10

An apparatus according to any one of claims 6 to 9, wherein there is a separator capable of separating the ball template from the substrate in use, and the separator is movable from a first position where passage of solder balls from the ball template onto the substrate is prevented and a second position where passage of the solder balls from the ball template onto the substrate is permitted.

Claim 11

> An apparatus according to any of the preceding claims, wherein the container is closed at the top to reduce oxidation of the solder balls and open at the bottom for direct entry of the balls to the positioning member substantially throughout the bottom of the container.

Claim 12

> An apparatus according to any one of claims 6 to 11, wherein the plurality of apertures are located substantially toward one end of the positioning member whereby the container is in communication with the apertures on the positioning member only while the container is in the vicinity of the second end position.

Whether ASM'S Singapore Patent Is Valid

13 As ASM sought a declaration that its Singapore patent is valid while Aurigin sought a declaration that it be revoked, the validity of ASM's patent will first be considered.

Section 13(1) of the Act

14 For the purpose of determining the validity of ASM's patent, reference must be made to s 13(1) of the Act, which provides that 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.

As condition (c) is not in issue, what matters is whether the invention is new and whether it involves an inventive step.

Newness or novelty

15 Section 14 of the Act provides that an invention "shall be taken as new if it does not form part of the state of the art". Section 14(2), which explains the meaning of "state of the art", provides as follows:

> 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.

16 In regard to the issue of novelty, in *Trek Technology (Singapore) Pte Ltd v FE Global Electronics Pte Ltd (No. 2)* [2005] 3 SLR 389, Lai Kew Chai J explained as follows:

(a) the issue is determined by asking whether an invention forms part of the state of the art;

(b) the prior art must, in order to invalidate the patent, be such that a person of ordinary skill and knowledge of the subject would at once perceive and understand and be able to practically apply the discovery without the necessity of making further experiments;

(c) the prior art documents must be construed as at the date of publication and it is not permissible to perform an ex post facto analysis;

(d) each prior art document has to be considered separately and not combined into a mosaic to arrive at the invention;

(e) the person skilled in the art is an unimaginative person of competent but average technical skill;

(f) the prior art document must contain clear directions to do what the patent claims to have invented.

17 As issues of novelty and inventiveness are viewed in relation to the prior art, the following summary by Mr Miller of the prior art at the time ASM obtained its patent is helpful:

(a) *Mullen* … taught a method of forming solder bumps on solder pads in order to provide a pad array, chip carrier package that is easily soldered to a main circuit board.

(b) *Kirby* … teaches an invention whereby solder balls are poured in bulk over the template. The weakness of Kirby was that the speed of movement of the balls as they flowed over the template could not be controlled.

(c) *Tondelli* … teaches an apparatus which provides two templates that can be mutually shifted over the other to align the apertures in both templates. A bottomless container of solder balls is movable from a position away from the apertures to a position over the apertures to provide the solder balls to the apertures;

(d) *Lim Ee Teoh* … teaches a positioning rail and motor to drive a container for solder balls over a template to provide the solder balls to the template. It also teaches a pickup tool to remove these solder balls while retaining their respective positions to be placed onto corresponding positions of solder pads on the substrate.

(e) *Stumpe* ... teaches a container which is closed at the top and open at the bottom movable over a template to provide solder balls to the template.

(f) *Kasai* … teaches a container which is closed at the top and open at the bottom, and movable over a template to provide solder balls to the template. The template can be tilted in two opposite directions by a tilting mechanism to move the container over the template to fill the template with solder balls.

(g) *Ooroku* … teaches a container which is closed at the top and open at the bottom, movable over a template to provide solder balls to the template. The template is tilted by a tilting mechanism to move the container over the template to fill the template with solder balls.

(h) *Inoue* ... teaches a tool formed by a frame and a stencil whereby the solder balls are charged into the stencil by amongst other things, vibration and tilting of the tool.

(i) *Oguro* … teaches an apparatus to provide solder balls to a tool having a template of apertures as a base and raised walls as a frame. The substrate is positioned below the tool to receive the solder balls that are positioned and fall through the apertures. Solder balls are placed in the tool and positioned in the apertures by sweeping the solder balls, vibrating the tool or tilting the tool and substrate.

18 Also included but not explained in Mr Miller's list of prior art are *Cobbley* and *Fjelstad*. In regard to these two, A/P Tay explained as follows:

(a) *Cobbley* … discloses a method of placing conductive solder balls on refluxed bond pads of a substrate using a stencil plate with a pattern of through-holes positioned over the bond pads.

(b) *Fjelstad* … discloses a method of placing solder balls onto the contacts of a semiconductor chip or other electronic unit using an escapement mechanism which reciprocates between an aligned position and a non-aligned position. At the aligned position, the solder balls are released onto the substrate through a stencil with apertures matching the layout of contacts on the microelectronic element.

19 The defendants cited works by *Oguro, Matsushita (Kasai), Tondelli and Stumpe* to support their assertion that ASM's claim 1 is not new. ASM retorted that all these works, with the exception of *Oguro*, had been considered during the examination of the corresponding US patent application and they had been found to be irrelevant to the patentability of the claims in its US patent, which mirrors the claims in the Singapore patent. As for *Oguro*, ASM contended that it is not any more relevant than the works already considered by the US examiner before the US patent was approved.

20 ASM relied on A/P Khong's conclusion in his opinion in his AEIC, where he states at [58] as follows:

> In summary, having considered all the above prior art documents which have been cited by the Defendants, I am of the view that these prior art documents do not disclose all the integers of either the unamended claim 1 or the amended claim 1 of the invention. The result is the same whether the prior art documents are considered individually, or in combination as alleged by the Defendants.

21 What matters is not an expert's conclusion but the reasons for the conclusion. In this respect, A/P Khong's evidence at the trial showed that he was not familiar enough with the prior art. On far too many occasions, he had to retract his views during the trial. A/P Khong explained what ASM's invention teaches in the following terms:

The solder ball placement patent teaches one skilled in the art of solder ball placement machine how to position the solder balls contained in the container for filling a positioning member of a ball place apparatus by applying a gravitational force on them in direction of motion of the container as the container moved in the first direction and in the second direction towards and away from the positioning member respectively. The invention helps to avoid the problem of ball damage during ball filling when it was experienced in prior art when the solder balls were being pushed by the wall of the container as the container moved to position to the solder balls.

22 A/P Khong did not explain cogently what was novel about ASM's patent. To begin with, his assertion that ASM's patent is different from what had been disclosed in the prior art because it had a cover or lid on the box could not be taken seriously. When cross-examined, he said as follows:

Q: So you are saying that the diagram teaches you that a concept of a five-sided box, four sides of wall and one on top of the box, yes?

A: Yes.

Q: And notwithstanding that it's clear to even a layman like me that there will be interaction of air inside and outside the box, you say this teaches you as an expert a concept, an inventive concept of reduction of oxidisation. Is that your expert testimony?

A: Yes, because *I also compare with other prior art. They don't have a cover on the box*.

[emphasis added]

23 When cross-examined further, A/P Khong was forced to admit that he was absolutely wrong. The relevant part of the cross-examination is as follows:

Q: [I] was going to suggest to you [that] the concept of providing an enclosed container is not new. Your response to me was that you have looked at the prior arts that have been exhibited in this action, and *you insisted that … the concept of an enclosed container is new?*

A: *Yes …*.

Q: First of all, let me show you the patent by *Stumpe…. Isn't it apparent to you that that container has got a cover?*

A: *Yes.…*

Q: Figure 2 from the patent known as *Fjelstad* in these proceedings. *Do you confirm that there is a lid on the container?*

A: *Yes, I do.…*

Q: *So all these are covered containers, are they not?*

A: *Yes, they are*.

Q: And they are in the prior art?

A: Yes.

Q: *And you will therefore have to retract your earlier assertion that the covered container is not found in the prior art, right?*

A: *Yes*.

[emphasis added]

24 A/P Khong next pointed out that ASM's patent is new because it taught a tilting mechanism. Here again, he was outflanked during cross-examination and he had to concede that this had been previously taught by others. The relevant part of the cross-examination is as follows:

Q: [L]ook at *Kasai* at p 66. This is yet another prior art, correct ---

A: Yes.

Q: Figure 5A shows it at the horizontal position. *Figure 5B shows the tilting mechanism, does it not?*

A: *Yes…*.

Q: [I]f you see figure 5B and figure 5C together, you will see the concept where the balls drop downwards due mainly to gravitational force, correct?

A: Yes, your Honour.

Q: That is the concept where because of the tilting, gravitational force automatically pulls the ball downwards, correct?

A: Yes, your Honour….

Q: So essentially *what Kasai already taught us as a prior art was that you can tilt the container* so as to allow the solder balls to fall following the direction of the ball sweeper by their own weight using gravitational force. Correct?

A: *Yes, your Honour*.

[emphasis added]

25 A/P Khong also asserted that ASM's patent shows that solder balls flow downwards at a faster rate due to gravitational pull. What followed during cross-examination shows how unoriginal this idea of gravitational pull was:

> Q: In layman terms, what they are saying is that because of the tilting, the balls are flowing away from the right edge of the container that is following, correct?
>
> A: Yes….
>
> Q: And the balls are following [*sic* flowing] downwards at the rate that is faster than the wall due to gravitational pull, yes?
>
> A: Yes.
>
> Q: *Now, come Professor, that concept exists in every tilting mechanism, does it not?*
>
> A: *Yes*.
>
> [emphasis added]

26 Subsequently, A/P Khong conceded that the use of gravitational force had already been made known in the prior art. The relevant part of the proceedings is as follows:

> Q: Insofar as you have identified the magic of the plaintiff's invention being the use of gravitational force, that would have been covered by *Kasai* … as well as *Ooroku*, correct?
>
> A: Using the gravitational force, yes.

27 A/P Khong next tried to distinguish ASM's patent from the prior art on the ground that it teaches tilting in both directions. However, when cross-examined on the prior art, A/P Khong again had to concede once again that he was wrong. The relevant part of the proceedings is as follows:

> Q: [Y]ou will see that *Kasai* teaches an invention where the tilting is in both directions; Correct?
>
> A: Yes, your Honour.

28 I now turn to Mr Miller's evidence, which showed his mastery of the subject, with the reasons for his conclusions explained very clearly and authoritatively. Mr Miller asserted that claim 1 of ASM's patent is not new because prior art documents, namely *Tondelli, Kasai, Stumpe* and *Oguro* individually disclosed all the elements claimed in claim 1. He explained in his AEIC at [34] as follows:

> *Tondelli* … discloses:
>
> (1) Element 1A as a chilled area in a grid template ….
>
> (2) Element 1B as the container-drawer …; and

(3) Element 1C corresponds to the motion described … as shifting the container-drawer and the mass of balls along over the surface of the grid template to cover the drilled area so that all the holes receive a ball.

Stumpe … discloses:

(1) Element 1A as the stencil which has an array of holes described ….

(2) Element 1B as ball bin which is described as solid … and partially filled with solder balls to fill the holes in the stencil …; and

(3) Element 1C is similar to the mechanism causing the motion described … and illustrated …

Kasai … discloses:

(1) Element 1A as an arranging member ….

(2) Element 1B as a ball supplying box … ; as a container with a slit-like opening in its bottoms and moves on the face of the arranging member; and

(3) Element 1C in the form of a tilting mechanism … which can tilt the arranging member …

Although the direction of movement of the container to remove excess solder balls from the template in *Kasai* is the same when providing solder balls to the template (as opposed to moving in opposite directions to fill and then remove the solder balls), this is not a material difference as both *Kasai* and ASM's invention work on the same principle of using gravitational force to provide solder balls to the template and also to remove excess balls. There is no technical advantage being gained from configuring the container in ASM's invention to operate strictly according to the language in the claim.

Oguro … discloses:

(1) Element 1A in the form of the mask illustrated … and described … as a mask formed with a large number of holes …

(2) Element 1B in the form of an expanding container formed by the squeegees … and ribs ….

The expanding container in *Oguro* functions in the same way as Element 1B in the Plaintiff's patent. The solder balls are moved by gravitational force caused by the tilting of the mask to fill the holes in the mask…. The excess solder balls are then removed by tilting the mask in the opposite direction….

29 As for the remaining words in ASM's amended claim 1, namely an "apparatus ….thereby tilt it", Mr Miller opined that it lacks novelty in view of *Kasai* and *Oguro*.

30 In relation to ASM's claim 2, Mr Miller stated that it is not novel in view of *Oguro*, which describes a tilting mechanism which is operative to tilt the mask and solder balls multiple times.

31 As for ASM's claim 3, Mr Miller said that it is not novel in view of *Oguro* and *Kasai*. While *Oguro* discloses rotational angles and the controllability of the moving speed of the container, *Kasai* describes a tilting mechanism which can control the rotational angle of the container by "adjusting pivoting directions and angles of the tilting mechanism" and it is clear that the moving speed of the container is controlled by a speed controller, which is described.

32 Turning to ASM's claim 6, Mr Miller rubbished any claim to novelty in view of *Tondelli* and *Kasai*. He said that *Tondelli* discloses that the holes of drilled areas are the same as the apertures in the template and that the diameter of these holes is slightly greater than the diameter of the solder balls. Furthermore, it is evident from *Kasai*'s illustration that the diameter of the apertures is larger than the size of a solder ball.

33 As for ASM's claim 7, which refers to an "additional pick-and-place device" to pick the solder balls in the apertures, while retaining their respective positions to be placed onto corresponding positions of solder pads on a substrate, Mr Miller stated that it lacks novelty in view of *Tondelli* and *Kasai*, who both disclose this device.

34 Mr Miller also had no doubt that ASM's claim 11, which highlights the fact that the "container is closed at the top to reduce oxidation of the solder balls and open at the bottom for direct entry of the balls to the positioning member substantially throughout the bottom of the container" lacks novelty. He explained that *Stumpe* defines the ball bin as being solid and having a closed top and open bottom.

35 In regard to claim 12, which describes the location of the apertures as being near one end of the positioning member, Mr Miller asserted that this is also not novel. After all, *Tondelli* illustrates the location of the apertures according to this definition.

36 I unreservedly accept Mr Miller's explanations as to why ASM's patent lacked novelty.

Inventiveness

37 As for the question of inventiveness, s 15 of the Act provides that 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). In *Windsurfing International Inc v Tabur Marine* [1985] RPC 59 at 73, Oliver J offered the following oft-cited elucidation of inventiveness:

> There are … four steps which require to be taken in answering the jury question. The first is to identify the inventive concept embodied in the patent in suit. Thereafter, the court has to 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 in the art in question. The third step is to identify what, if any differences exist between the matter cited as being "known or used" and the alleged invention. Finally, the court has to ask itself whether, viewed without any knowledge of the alleged invention, those differences constitute steps which would have been obvious to the skilled man or whether they require any degree of invention.

38 Although the *Windsurfing* test has been subject to much scrutiny, it was approved by the Court

of Appeal in *First Currency Choice Pte Ltd v Main-Line Corporate Holdings Ltd* [2008] 1 SLR 335 ("*First Currency*").

39 It is noteworthy that in *Unilever v Chefaro* [1994] RPC 567, Jacob J stated at p 580 as follows:

> It is the "inventive concept" of the claim in question which must be considered, not some generalised concept to be derived from the specification as a whole. Different claims can, and generally will, have different inventive concepts. The first stage of identification of the concept is likely to be a question of construction: what does the claim mean? It might be thought that there is no second stage – the concept is what the claim covers and that is that. But that is too wooden and not what courts applying Windsurfing stage one, have done. It is too wooden because if one merely construes the claim, one does not distinguish between portions which matter and portions which, although limitations on the ambit of the claim, do not. One is trying to identify the essence of the claim in this exercise.

40 As for expert evidence on the question of inventiveness, in *SmithKline Beecham plc v Apotex Europe* [2005] FSR 23, Jacob LJ said at pp 52-53 as follows:

> [I]n weighing the views of rival experts as to what is taught or what is obvious from what is taught, a judge should be careful to distinguish his views on the experts as to whether they are good witnesses or good teachers – good at answering questions asked and not others, not argumentative and so on, from the more fundamental reasons for their opinions. Ultimate it is the latter which matter – are they reasons which would be perceived by the skilled man?

41 When dealing with obviousness, one is entitled to make a "mosaic" out of relevant documents if it can be put together by an unimaginative man with no inventive capability (see *Technograph v Mills & Rockely* [1972] RPC 346). In the present case, ASM's invention "relates to an apparatus and method for automatically placing an array of solder balls onto a substrate, such a ball-grid array (BGA) substrate" and ASM's patent describes some shortcomings in the prior art, including the following:

(i) the "high risk that solder balls that are partially engaged in empty apertures are sheared by the edges of the container as the container is moved over the apertures";

(ii) The "solder balls can still be damaged by the distribution means, which in itself, has edges and produces undesired forces on the solder balls that can cause damage";

(iii) "by brushing the solder balls or by the use of a U-shaped blade, the balls are made to fall into the apertures, the problem is that since the solder balls are exposed to the atmosphere, they can be oxidized more easily and contamination may occur from the surroundings and/or the blade"; and

(iv) "Solder balls may be damaged by the edges of the side walls of the solder bin and also by the edges of the many apertures".

42 It is thus not surprising that the summary of ASM's invention states that "it is an objective of the present invention to provide an improved apparatus for automated placement of solder balls onto a substrate so that damages and/or oxidation of solder balls are reduced as compared to the prior art".

43 ASM's expert witness, A/P Khong thought that there were three aspects of inventiveness of ASM's patent. When cross-examined, he stated as follows:

> The first thing in the invention, he [*sic* it] provide[s] the multiple opportunity to back fill the solder ball. That's the first advantage.
>
> The second one…. The plaintiff's invention minimise[s] the damages of the solder ball…..
>
> [T]he third advantage is .. the invention … can reduce … oxidisation in the process.

44 In regard to inventiveness, A/P Khong tied himself up in knots. As for the first inventive feature claimed by A/P Khong, namely multiple opportunities to fill solder balls, Aurigin's counsel, Mr Low rightly pointed out that this is not a real advantage when others, including the holders of patents constituting the prior art, teach the finishing of the job with only one stroke. A/P Khong agreed as he stated as follows during cross-examination:

> Q: So [ASM's machine gives] three possible opportunities for the solder balls to completely fill all the thousands and thousands of aperture. Yes?
>
> A: Yes.
>
> Q: And the plaintiff is saying "This is their inventive step" which is better than what is out there in the prior arts. You understand that?
>
> A: Yes ….
>
> Q: If the inventive concept is to achieve a more efficient filling of all the apertures, would you not agree that that objective ideally should be accomplished by a total filling of apertures in one stroke.
>
> A: Ideally, yes.
>
> Q: That must be right?
>
> A: Yah, The best design, yah.

45 Apart from A/P Khong, ASM's own inventor, Mr Cheng Chi Wai, said during cross-examination that the most efficient method to fill solder balls is to utilize the tile mechanism once. His exact words are "For the best efficiency, rotate one time is the best, just one time tilting".

46 No one from ASM could articulate the inventiveness of a double tilting mechanism other than to say that it increases the opportunity for filling solder balls, a feature which is irrelevant if a machine is better because it does not require a second or third tilt. When Aurigin's counsel, Mr Low Chai Chong asked A/P Khong about Aurigin's claim that its AU800 does its job of filling solder balls in just *one* stroke, the latter conceded that if it does, it would be a superior machine. The relevant part of the cross-examination is as follows:

> Q: If [the defendants] are right and they could possibly fill it up in one stroke, they have a more efficient way of doing it. Correct?

A: Yes.

Q: Much better than the plaintiffs?

A: Yes, agree.

47 A/P Khong said that he had not seen the AU800 and had not carried out any tests on this machine. The efficiency of Aurigin's AU800 was tested and confirmed by A/P Tay, who stated as follows in his AEIC at [32]:

> From my experiment, I am convinced that the AU800 machine performs the complete filling of solder balls onto the BGA template during the forward filling stroke with high efficiency. *In all the 21 filing cycles tested, 100% of the holes were filled in the forward stroke*.
>
> [emphasis added]

48 In short, ASM's patent may be viewed as a disadvantageous modification of the closest prior art in that it requires more than one opportunity to fill solder balls. In this regard, it ought to be borne in mind that in EPO Case Number T119/82, the EPO held that an invention which is the result of a foreseeable disadvantageous modification of the close prior art, which the skilled person can clearly predict and correctly assess, and this predictable disadvantage is not accompanied by an unexpected technical advantage, the claimed invention would not involve an inventive step.

49 Turning to the second of the alleged inventive steps, namely minimization of damage to solder balls, Aurigin's expert witness, Mr Miller could not see how this involved an inventive step. During re-examination, he opined as follows:

Q: And therefore viewing this filling operation as one complete cycle… what are your comments with regard to the claim by the plaintiffs that their invention solves the shearing problem or reduces the shearing problem?

A: I see no evidence of that. It reduces damages, possibly because of … gravity but not the shearing problem.

50 As for the third of the alleged inventive steps, namely reduction of oxidation, A/P Khong was not very coherent. The relevant part of the cross-examination is as follows:

Q: [I]f [ASM's container] is not sealed, it must follow that there is constant interaction of air outside the container and air inside the container, yes?

A: Yes.

Q: [It's] clear to even a layman like me that there will be interaction of air inside and outside the box, you say this teaches you as an expert a concept, an inventive concept of reduction of oxidation. Is that your expert testimony?

A: Yes, because I also compare that with prior art. *They don't have a cover on the box*.

[emphasis added]

51 What was troubling was the following exchange between Aurigin's counsel and A/P Khong, during which it was clear that there was very little difference between the rate of oxidation in the systems disclosed in the prior art and that disclosed in ASM's patent. A/P Khong repeated his discredited assertion that the cover of the container in ASM's patent made the difference. When cross-examined, he stated as follows:

Q: So what is important to you is that there's this solid box that exclude[s] air on top but it doesn't matter that by its own configuration, air is leaking thought the bottom of the container?

A: Er, there's no teaching in the plaintiff's patent that he can control the environment….

Q: *And if there is constant interaction of air inside and outside, there can be very little difference if at all to the rate of oxidation, you agree?*

A: *Yes, agree*.

Q: And if you agree, how could you possibly as an expert, reading this patent come forward and say "Well, there is an inventive concept of a reduction of oxidation found in this patent"?

A: *The inventive is … from the cover of this box…*.

[emphasis added]

52 What was also rather startling was A/P Khong's response to Mr Low's carefully crafted question on the practical value of the alleged 3 inventive steps in ASM's patent. The relevant part of the proceedings is as follows:

Q: And I have gone through an exercise where I have put to you our case that there [is] no inventiveness, no novelty and no practical value in the plaintiff's invention so far as each of these elements [is] concerned, okay?

A: Yes.

Q: I'm also suggesting to you that … even if you take all these as a package, there is still no practical value in the plaintiff's invention because all these have been done and done much better by the prior arts. Do you agree?

A: *I have no comments … on the practical value*.

[emphasis added]

53 The defendants' expert witness, A/P Tay, who was of the view that ASM's patent showed no inventiveness, concluded in his AEIC (at [50] - [52]) as follows:

[50] Based on the above analysis, it is conceivable that a person skilled in the art of BGA or similar technology at 8 January 2002 is able to configure the ASM Singapore Patent. He merely has to replace the squeegee in *Oguro* with a bottomless container found in *Tondelli* to arrive at the invention claimed in the ASM Singapore Patent.

[51] Similarly, a person skilled in the art at 8 January 2002 could refer to *Tondelli* and *Cobbley* which did not have a tilting mechanism to move the balls over the holes on the template and realized that by using a tilting mechanism disclosed in *Kasai, Oguru* and *Ooroku*, the risk of shearing of the solder balls by the trailing wall of a container could be reduced, hence arriving at an apparatus similar to the invention in the ASM Singapore Patent.

[52] For the reasons given above, I am of the opinion that none of the Asserted Claims in the ASM Singapore Patent are inventive.

54 A more detailed explanation as to why ASM's patent disclosed no inventive steps was furnished by Mr Miller. He was, unlike A/P Khong, clearly non-partisan for when cross-examined, he made it absolutely clear that there was nothing inventive about both ASM's patent and Aurigin's patent. The relevant part of the cross-examination is as follows:

Q: We are going to obviousness, inventive step.…

A: It was obvious to me. I – I knew everything about that and --- and that's what I --- told counsel … that to me both patents were obvious.

Q: Which of both patents?

A: *The Singapore* patent that Aurigin had, as well as the ASM patent. As far as I'm concerned, they were obvious. …

[emphasis added]

55 As the invalidity and revocation of Aurigin's patent were not pleaded and are not issues before the court, only the validity of ASM's patent needs to be considered in this judgment. In regard to ASM's patent, Mr Miller backed his assertion that it was not inventive with forceful submissions. With respect to claim 1 of the said patent, he explained that it is obvious because of *Ooroku*. Although ASM's counsel submitted that Mr Miller did not appreciate that a very small step or a very slight advance could be an inventive step, the fact remains that Mr Miller minced no words when he declared that the ASM invention "is nothing but a workshop variation of *Ooroku* because the trailing edge of the container during the removal stroke in the ASM invention is still designed to move over the positioning member, thus causing damage to partially engaged solder balls". Innumerable cases illustrate that such workshop improvements are insufficient to establish inventiveness. For instance, in *Shaw v Burnet & Co* [1924] 41 RPC 432, it was held that the addition of a piece of plastic to an ordinary bag veil to prevent it from slipping off a hat was a mere workshop improvement that did not involve any invention. Another instructive case is *Curtis & Son v Heward & Co* (1923) 40 RPC 53, where it was held that an alleged invention that made improvements to abdominal supports for medical purposes was not patentable as it was an ordinary workshop improvement of a well-known type of apparatus. I had no doubt whatsoever that with his wealth of experience in BGA technology, Mr Miller is in a position to explain what is a workshop variation of existing prior art in BGA technology.

56 In regard to claim 2, which includes an additional operability of the apparatus to rotate the container and template multiple times when the container is directly over the apertures of the template to fill the apertures with solder balls, Mr Miller said "it would have been obvious to combine the operability disclosed in *Inoue* with any apparatus to achieve the objective of repeatedly spreading over the positioning member". He added as follows:

> Inoue discloses a mode of operation …. The operation is tilting the tool …, which is similar to the container in the claim 1 to fill the solder balls into the through holes … similar to the template in the claim 1.

57 As for claim 3 of ASM's patent, which concerns the further inclusion of "an additional controllability of the rotational angles of the container and/or the moving speed of the container to optimize the efficiency of the apparatus", Mr Miller had no doubt that it is obvious to combine the operability disclosed in *Oguru* and/or *Kasai* with any apparatus to achieve the objective of repeatedly spreading over the positioning member.

58 With respect to claim 4 of ASM's patent, which claims an additional element of a positioning rail and motor whereby the container is positioned and driven, Mr Miller said that it is obvious in view of *Lim Ee Teoh*, which teaches the element of a positioning rail in the form of tracks. Furthermore, the additional element being the external mechanical means for driving the container is standard engineering practice as a mechanical means is always required for any motion.

59 Turning to an analysis of claim 6 of ASM's patent, which defines the apertures in the template as each being larger than the size of a solder ball, Mr Miller opined that *Inoue* defines the diameter of the apertures as being larger than the diameter of the solder ball and it would have been obvious to define the diameter of the apertures as being larger than the diameter of the solder balls since the objective of the apparatus is to position the solder balls into the apertures.

60 Claim 7 of ASM's patent, which refers to an "apparatus according to claim 6, wherein solder balls captured in the plurality of apertures are removable by a pick-and-place device while retaining their respective positions and placed onto corresponding positions of solder pads on the substrate", was also regarded as an obvious claim by Mr Miller. He said that it would have been obvious to combine the device described in *Tondelli* or *Kasai* with any other document because removing the solder balls while retaining their respective positions to be placed on a target substrate is the next step of the process and this pick-and-place device had already been disclosed in *Tondelli* and *Kasai*.

61 Mr Miller also did not find claim 11 an inventive step. Claim 11 relates to an "apparatus according to any one of preceding claims, wherein the container is closed at the top to reduce oxidation of the solder balls and open at the bottom for direct entry of the balls to the positioning member substantially throughout the bottom of the container". According to Mr Miller, *Kasai* defines a container, having a slit at the bottom while *Ooroku* illustrated a container with an open bottom. According to him, it would have been obvious to isolate the solder balls from direct contact with the surrounding atmosphere to reduce the problem of oxidation and contamination of the solder balls.

62 In relation to claim 12, which concerns an "apparatus according to any one of the claims 6 to 11, wherein the plurality of apertures are located substantially toward one end of the positioning member whereby the container is in communication with the apertures on the positioning member only while the container is in the vicinity of the second end position", Mr Miller was emphatic that there is nothing inventive about locating the plurality of apertures substantially towards one end of the positioning member whereby the container is in communication with apertures on the positioning member while the container is in the vicinity of the second end position. He added that if the

apertures are located at one end of the positioning member, for example the second end position, it is obvious that the container must be in communication with the apertures while being in the vicinity of the second end position for the solder balls to be placed into the apertures.

63 I agree with Aurigin's submission that the evidence at the trial showed that ASM's patent involves nothing more than an aggregation of the known features of a closed top container (as taught by *Stumpe*), a positioning member located at the end of a template (as taught by *Tondelli*), a tilting mechanism (as taught by *Oguro*, *Ooroku* and *Kasai*) and a bi-directional tilting mechanism (as taught by *Oguro* and *Kasai*). It follows that there was nothing inventive in ASM's patent.

64 As I accept the evidence of Aurigin's expert witnesses, Mr Miller and A/P Tay, that there was nothing novel or inventive in ASM's patent, I order that this patent be revoked. That being the case, I need not consider whether or not Aurigin's AU800 infringed ASM's patent.

Groundless Threats

65 As for Aurigin's counterclaim with respect to groundless threats, reference should first be made to s 77 of the Act, which provides as follows:

Remedy for groundless threats of infringement proceedings

77. —(1) Where a person (whether or not the proprietor of, or entitled to any right in, a patent) by circulars, advertisements or otherwise threatens another person with proceedings for any infringement of a patent, a person aggrieved by the threats (whether or not he is the person to whom the threats are made) may, subject to subsection (4), bring proceedings in the court against the person making the threats, claiming any relief mentioned in subsection (3).

(2) In any such proceedings, the plaintiff shall, if he proves that the threats were so made and satisfies the court that he is a person aggrieved by them, be entitled to the relief claimed unless —

(a) the defendant proves that the acts in respect of which proceedings were threatened constitute or, if done, would constitute an infringement of a patent; and

(b) the patent alleged to be infringed is not shown by the plaintiff to be invalid in a relevant respect.

(3) The said relief is —

(a) a declaration to the effect that the threats are unjustifiable;

(b) an injunction against the continuance of the threats; and

(c) damages in respect of any loss which the plaintiff has sustained by the threats.

(4) Proceedings may not be brought under this section for a threat to bring proceedings for an infringement alleged to consist of making or importing a product for disposal or of using a process.

(5) It is hereby declared that a mere notification of the existence of a patent does not constitute a threat of proceedings within the meaning of this section.

(6) Nothing in this section shall render an advocate and solicitor or any other person liable to an action under this section in respect of an act done by the advocate and solicitor or the other person in his professional capacity on behalf of a client.

66 ASM had demanded through its solicitors on 6 December 2006 that Aurigin cease and desist from "making, disposing of, offering to dispose of, importing, or keeping whether for disposal or otherwise, as well as withdraw from circulation and sale of the infringing product" in order to avoid legal proceedings. This constitutes a threat of legal proceedings within the meaning of s 77(1) of the Act and Aurigin, being the aggrieved party, is entitled to relief unless ASM is able to justify the threat. Such a threat may be justified under s 77(2) if ASM is able to satisfy two conditions. First, it must be shown that the acts in respect of which ASM had threatened proceedings constitute or would constitute an infringement of its patent. Secondly, the patent must not be shown to be invalid in a relevant respect. The use of the word "and" in s 77(2) shows that *both* conditions must be satisfied.

67 As regards the second condition, where the patent of the party making the threats is found to

be invalid, its threats are unjustified and the aggrieved party is entitled to relief. In *Siegfried Demel (Trading As Demotec Siegfried Demel) v. C & H Jefferson (A Firm) and Another* [1999] FSR 204 ("*Demel v Jefferson*"), a case concerning s 70 of the United Kingdom ("UK") Patents Act 1977 (c 37), on which s 77 of the Act is based, the defendant had alleged that the plaintiff had violated two of the defendant's patents (for inventions concerning prostheses for cows) and threatened legal proceedings. The plaintiff brought a claim for groundless threats of legal proceedings and, in that process, challenged the validity of the defendant's patents and sought an order for revocation of the patents. The defendant resisted the revocation of one of its patents but not the other. The court held that the consequence of this was that the threats made in respect of the patent which revocation had not been challenged were not justified. The plaintiff was thus entitled to relief in respect of the threats pertaining to the invalid patent.

68 It may be noted that the UK position has changed after 2005 because of the inclusion of s 70(2A) of the UK Patents Act, which provides as follows:

> (2A) If the defendant or defender proves that the acts in respect of which proceedings were threatened constitute or, if done, would constitute an infringement of a patent—
>
> (a) the claimant or pursuer shall be entitled to the relief claimed only if he shows that the patent alleged to be infringed is invalid in a relevant respect;
>
> *(b) even if the claimant or pursuer does show that the patent is invalid in a relevant respect, he shall not be entitled to the relief claimed if the defendant or defender proves that at the time of making the threats he did not know, and had no reason to suspect, that the patent was invalid in that respect*.
>
> [emphasis added]

69 As a result of the inclusion of s 70(2A), the present position in the UK is that even if the patent of the party making the threats is shown to be invalid, that party may avoid liability for making the threats by showing that when the threats were made, he did not know, and had no reason to suspect, that the patent was invalid. There has, however, been no such modification to s 77 of the Act. As a result, the Singapore position is that explained above (at [66]) and illustrated in *Demel v Jefferson*, which precedes the 2005 amendments to the UK Patents Act.

70 As I have found that ASM's patent is invalid and ordered that it be revoked (see [64] above), ASM's threats of infringement proceedings are clearly unjustified. As such, Aurigin is entitled to relief and an injunction is granted to restrain ASM from continuing to threaten Aurigin, its customers, directors, officers, employees and agents with any legal proceedings for infringement of ASM's patent. There will also be an inquiry as to damages.

Costs

71 Aurigin is entitled to costs.

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