Neutral Citation Number: [2009] EWHC 55 (Pat)

Case No: HC07C02383

IN THE HIGH COURT OF JUSTICE
CHANCERY DIVISION
PATENTS COURT

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 22 January 2009

Before :

THE HON MR JUSTICE ARNOLD

- -

Between :

DYSON TECHNOLOGY LIMITED	**Claimant**
- and -	
SAMSUNG GWANGJU ELECTRONICS CO. LIMITED	**Defendant**

- -
- -

Piers Acland (instructed by **Wragge & Co LLP**) for the **Claimant**
Richard Davis and **Christopher de Mauny** (instructed by **Withers & Rogers LLP**) for the **Defendant**

Hearing dates: 10-12, 15-19 December 2008

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Judgment

MR JUSTICE ARNOLD :

Introduction

1. In this claim the claimant Dyson Technology Ltd ("Dyson") seeks revocation of United Kingdom Patent Nos. 2 424 603 ("'603") and 2 424 606 ("'606"), which I shall refer to collectively as "the Patents". Both Patents have a priority date of 29 March 2005. The Patents describe and claim similar inventions in which the key feature is the use of a series of three cyclones, or sets of cyclones, to separate dust from air in a vacuum cleaner.

2. Dyson alleges that the Patents are invalid on the grounds of lack of novelty or lack of inventive step over the following items of prior art:

   i) United States Patent No. 6,238,451 ("Conrad");

   ii) United States Patent No. 5,129,124 ("Gamou");

   iii) Korean Patent Application No. KR 10-2001-0018947A ("LG");

   iv) Japanese Utility Model No. 52-014775 ("Sanyo"); and

   v) Dyson's DC07 and DC08 vacuum cleaners.

3. The defendant Samsung Gwangju Electronics Co. Ltd ("Samsung") has applied to amend both Patents. The applications are unconditional in the sense that they are not conditional upon the Court concluding that the Patents as granted are invalid. Despite the applications to amend, Samsung maintains that the granted Patents are valid. Dyson opposes both applications on the grounds that the amendments will result in additional matter being disclosed. Dyson also contends that the claims as proposed to be amended are still invalid.

4. Samsung asserted that many of the subsidiary claims in both Patents as proposed to be amended were independently valid over one or more items of prior art. In the run up to trial, Samsung identified two lists of claims, an "A" list consisting of eight claims which it considered to be of particular importance and a "B" list consisting of the remaining 20 claims asserted to be independently valid. In addition, Samsung relied upon five granted claims. At trial attention was focussed on the A list of proposed amended claims. It was agreed that I should first determine the issues arising in relation to those, and that if any separate issues in relation to the B list and granted claims remained after that I should hear further argument in relation to those.

Technical background

5. Cyclones have been used to separate solids and liquids from gases for a very long time. Indeed, the first patent on cyclone separators was granted to O.M. Morse as long ago as 1886. By the mid 20th century cyclonic separation was a well-established technology which was widely used in many sectors of industry. Nevertheless, in recent years there has been an increased interest in cyclones as a result of their widespread use in domestic vacuum cleaners. This use was pioneered by Sir James Dyson (see *Dyson Appliances Ltd v Hoover Ltd* [2001] RPC 26 at [12]-[17] and [44]), although it turns out that one of the items of prior art in the present case (Sanyo,

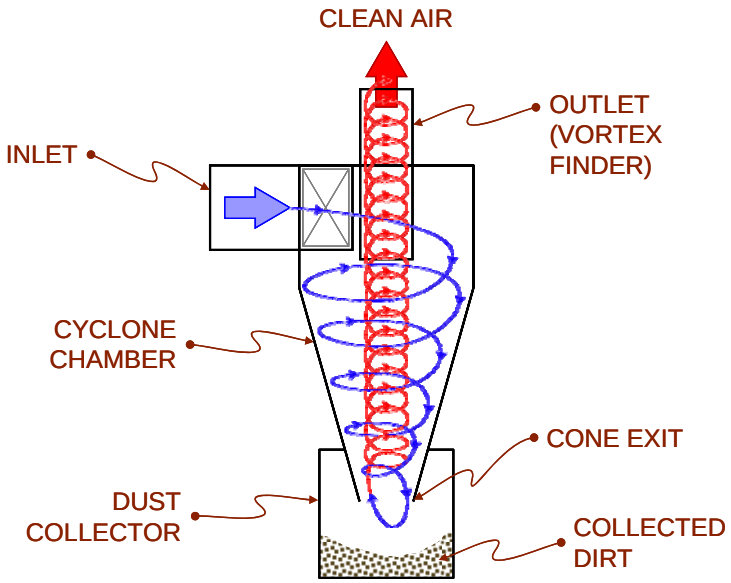
which was not cited in that case) pre-dates his work. Despite the smaller size of cyclones used in domestic vacuum cleaners, the technical principles involved are essentially the same as in industrial cyclones.

6. In a cyclone, a gas such as air is caused to spin in a vortex. Particles such as dust entrained in the air accelerate towards the axis of rotation. This centripetal acceleration is equal to V^2/r (where V = tangential velocity and r = radius of rotation). As a result, the particles experience an apparent force directed away from the axis of rotation which is generally referred to as "centrifugal force". The centrifugal force causes the particles to migrate outwards with respect to the air. Thus particles concentrate in the outer layers of the spinning air and the air in the centre layers is effectively cleaned.

7. The efficiency with which a cyclone separates dust particles depends, amongst other factors, on both the diameter of the cyclone (which determines the centrifugal force applied to the dust) and the inertia (relating to the size and density) of the particle (which determines the dust's response to that centrifugal force). In general, smaller particles are separated less well than larger particles. Thus the aerosol emitted from a cyclone will have a smaller average size than the aerosol entering it. Small diameter cyclones separate smaller particles more effectively than large diameter cyclones. This is because, as a result of the smaller radius of rotation, they apply a higher centrifugal force.

8. In operation, the gas passing through a cyclone is subject to a pressure drop that varies as the square of the flow rate. At constant flow rate the pressure drop increases rapidly as the diameter of the cyclone is reduced. A high pressure drop will affect the suction power of a vacuum cleaner, and thereby reduce the ability of the vacuum cleaner to pick up dust and dirt from the surface to be cleaned.

9. There are two main types of cyclone design. The first is known as a reverse flow cyclone. This normally involves the air spinning down through the cyclone body, then reversing and travelling up through the middle of the exterior vortex and out through an outlet known as a vortex finder. These cyclones are generally either cylindrical or frusto-conical. A frusto-conical cyclone is simply one in which the cyclone is conical, but the tip of the cone is not present. Most high efficiency designs of cyclones are frusto-conical reverse flow cyclones, for example as shown below:



10. The behaviour of the gas and particles in a frusto-conical reverse flow cyclone may be summarised as follows:

i) The gas enters the cyclone chamber, usually via a tangential inlet, and flows in a spiral downwards. This moves down the outer region of the chamber, creating an outer vortex.

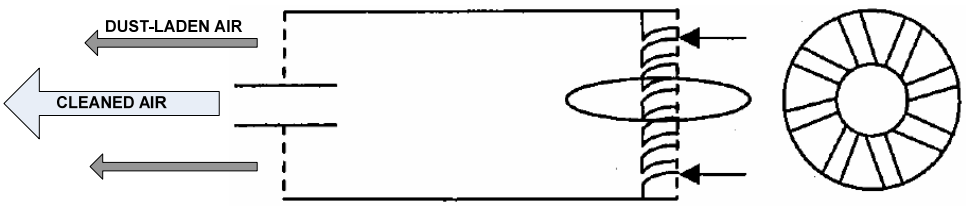
ii) The centrifugal force exerted on the dust causes it to migrate with respect to the gas and so to be concentrated in the slower moving region of flow close to the wall, the boundary layer. The major portion of the particles is concentrated in this region as the gas spirals downwards.

iii) Still spinning, the gas then reverses its direction of axial flow in order to leave the unit via the vortex finder.

iv) This inner vortex has the same tangential direction of rotation, but the reverse axial direction of flow, compared with the outer vortex.

v) The pressure distribution within the cyclone causes the dust in the boundary layer to flow along the internal surface of the cyclone to the cone exit. After exiting the cone, dust is normally collected in a hopper or some other receptacle.

11. The second type of cyclone is an axial or uniflow cyclone. In such a cyclone, air enters one end of the cyclone via either a swirl vane or a tangential inlet, spins through the cyclone (which is normally cylindrical) and leaves the cyclone at the other end. Particles in the airflow are concentrated close to the wall, and the cleaned air is removed from the centre of the unit. A vaned axial flow cyclone looks like this:



12. It is common for multiple cyclones to be arranged in parallel with each other. Arranging cyclones in parallel provides advantages in terms of separation efficiency for a given pressure drop. Dividing the total gas flow into several smaller streams allows the deployment of smaller diameter and hence more efficient cyclones without significantly increasing the overall pressure drop. It is important to ensure that the airflow divides reasonably evenly between the parallel cyclones, since an imbalance in the flow rate can substantially degrade the separation efficiency of the system as a whole.

13. It is also common for two cyclones to be arranged in series with each other (or for sets of parallel cyclones to be arranged in series). When cyclones are operated in series, the first stage cyclone has the opportunity to collect the large, easy to collect particles. Accordingly, it will often be a low efficiency design with a low pressure drop. Nevertheless, it is common for the first stage cyclone to collect the major part (say 80-90%) of the total dust presented to the vacuum cleaner. The second stage cyclone is left with the more difficult fine particles that have escaped the first stage, and so is often designed to be of a higher efficiency i.e. capable of capturing smaller particles. It is not essential, however, for a second stage to be of higher efficiency for it to collect sufficient material to improve the overall collection efficiency of the vacuum cleaner. If two identical cyclones are connected in series, 50% of a particle size collected with 50% efficiency will pass through the first stage to the second stage. Of the material passing through the first stage, 50% will be collected by the second stage, so that the overall collection is 75%.

‘603

14. The specification of ‘603 begins at page 1 lines 3-5 as follows:

> “This invention relates to a multi-cyclone dust separator and to a vacuum cleaner using the same, and in particular to a multi-cyclone dust separator comprising a plurality of cyclones to separate dust particles sequentially according to size, and to a vacuum cleaner using the same.”

15. The specification goes on at page 1 lines 9-10 to say that an “example of a vacuum cleaner incorporating such a cyclone dust separator is disclosed in US Patent No. 3,425,192”. I shall refer to that patent as “Davis”.

16. At page 1 lines 10-20 the specification continues:

> “That vacuum cleaner has a first cyclone separator mounted in a lower part of a housing, and a second cyclone separator mounted above the first cyclone separator. According to this structure, relatively large dust particles included in drawn-in air are separated in the first cyclone separator, and relatively fine dust particles are separated in the second cyclone separator.
>
> However, in such a two-step cyclone separator, suction efficiency is imperfect.

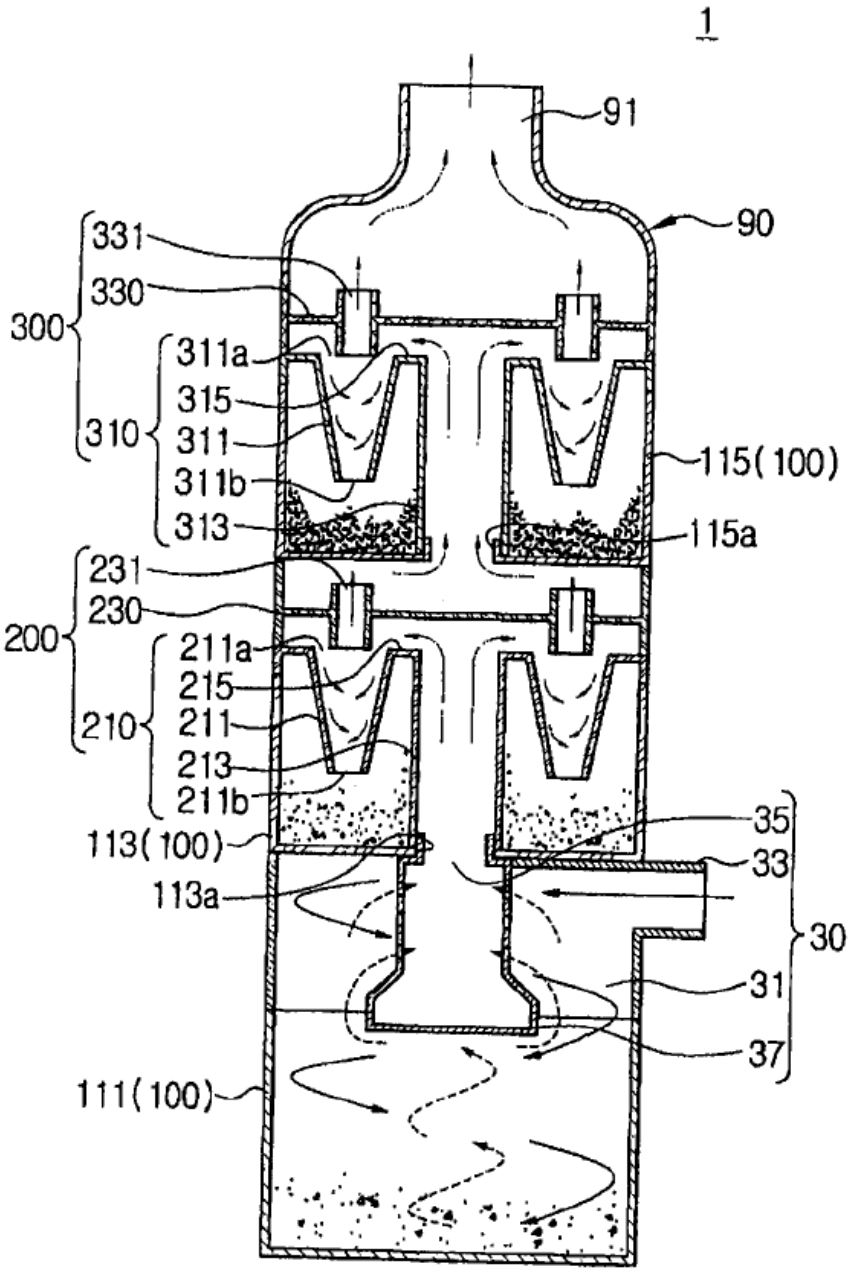
> An aim of the present invention is to provide a multi-cyclone dust separator capable of improving suction efficiency by providing a plurality of cyclone separators for sequentially separating dust according to size, and to [sic] a vacuum cleaner using the same."

17. Both expert witnesses had trouble with '603's use of the expression "suction efficiency". It is common ground that "suction efficiency" is not a term of art in the field of vacuum design. Taken literally, the words clearly convey the idea of the efficiency with which the machine produces suction. Consistently with this, international standard IEC 60312 published by the International Electrotechnical Commission, which sets out the internationally accepted method for determining the suction power of a domestic vacuum cleaner, contains a definition of efficiency as the suction power available at the inlet to the cleaner as a percentage of the total electrical power input. This understanding of suction efficiency does not make sense in the context of '603, however. Samsung's expert Professor Allen interpreted "suction efficiency" to mean "a measure of the given amount of dust that can be collected by the cyclone per unit pressure drop". This is neither a commonly accepted meaning of the term, nor one that receives support from the specification of '603. In my judgment the skilled reader would probably conclude that the references to "suction efficiency" are errors on the part of the draftsman, and that he meant to refer to "dust separation efficiency", which is the expression he uses at page 9 lines 16-17 (quoted in paragraph 23 below).

18. After a consistory clause corresponding to claim 1, the specification states at page 2 lines 12-16:

> "By using the above multi-cyclone dust separator, dust particles can be sequentially separated according to their sizes, thereby enhancing the suction efficiency.
>
> In addition, by incorporating the multi-cyclone dust separator in a vacuum cleaner, cleaning efficiency can be improved."

19. A specific embodiment of the dust separator is described by reference to Figure 1, which I reproduce below:



20. The description states at page 4 lines 12-13 that "[t]he first dust separation unit 30 separates relatively large dust particles included in external air drawn in"; at page 4 lines 20-21 that "[t]he second dust separation unit 200 separates dust particles of a relatively medium size from the air which has been primarily cleaned by the first dust separation unit 30"; and at page 5 lines 16-17 "[t]he third dust separation unit 300 separates relatively fine dust particles still remaining in the air secondarily cleaned by the second dust separation unit 200". As shown in the drawing, the first dust separation unit comprises a single cyclone, whereas the second and third dust separation units comprise a plurality of cyclones.

21. The specification describes the air flow between the first and second dust separation units at page 8 line 16 – page 9 line 2 as follows:

> "The air, from which the relatively large dust particles are separated by the first dust separation unit 30, passes through the first air outlet 35 of the first chamber 31, and ascends along the intermediate path formation member 213. Then, the air is drawn into the second chambers 211 in a tangential direction through the intermediate connection path 215.
>
> Because the air ascending along the intermediate path formation member 213 is radially diverged by the intermediate connection path 215, the volume of the air current is reduced. Accordingly, separation of dust particles in the second dust separation unit 200 can be more easily achieved.
>
> The air entering the chambers 211 is again centrifuged…"

22. The specification describes the air flow between the second and third dust separation units at page 9 lines 8-10 as follows:

> "The discharged air enters the third chambers 311 of the third dust separation unit 300 through the upper path formation member 313, and is then centrifuged in the same manner as in the second dust separation unit 200."

23. At page 9 lines 16-17 the description of the specific embodiment concludes:

> "As described above, by sequentially separating the dust particles included in the external air according to the size thereof, the dust separation efficiency can be enhanced."

24. The A list claims in '603 as proposed to be amended are as follows:

1.[1] A vacuum cleaner comprising:

[2] a cleaner body;

[3] a nozzle unit in fluid communication with the cleaner body to draw in dust-carrying air from a surface to be cleaned; and

[4] a multi-cyclone dust separator mounted in the cleaner body to separate dust from the dust-carrying air drawn in through the nozzle unit,

[5] the multi-cyclone dust separator comprising at least three cyclonic dust separation units, being a first cyclonic dust separation unit, a second cyclonic dust separation unit, and a third cyclonic dust separation unit, for sequentially separating dust particles from the dust-carrying air according to their size;

[6] wherein the third cyclonic dust separation unit comprises a plurality of cyclone chambers,

[7] and wherein the air cleaned by the second cyclonic dust separation unit is discharged from the second cyclonic dust separation unit, and the discharged

cleaned air enters the cyclone chambers of the third cyclonic dust separation unit.

4.[1] A vacuum cleaner according to any of the preceding claims,

[2] wherein the third cyclonic dust separation unit further comprises: an upper path formation member for guiding the air discharged from the second cyclonic dust separation unit such that it ascends towards the cyclone chambers of the third cyclonic dust separation unit;

[3] and an upper connection path connecting the upper path formation member with the cyclone chambers of the third cyclonic dust separation unit and arranged to radially diverge the air ascending along the upper path formation member,

[4] the air being drawn into the cyclone chambers in a tangential direction through the upper connection path so as to be centrifuged therein.

5.[1] A vacuum cleaner comprising:

[2] a cleaner body;

[3] a nozzle unit in fluid communication with the cleaner body to draw in dust-carrying air from a surface to be cleaned;

[4] and a multi-cyclone dust separator mounted in the cleaner body to separate dust from the dust- carrying air drawn in through the nozzle unit,

[5] the multi-cyclone dust separator comprising at least three cyclonic dust separation units, being a first cyclonic dust separation unit, a second cyclonic dust separation unit, and a third cyclonic dust separation unit, for sequentially separating dust particles from the dust-carrying air according to their size;

[6] wherein the third cyclonic dust separation unit comprises a plurality of cyclone chambers

[7] and further comprises: an upper path formation member for guiding the air discharged from the second cyclonic dust separation unit such that it ascends towards the cyclone chambers of the third cyclonic dust separation unit;

[8] and an upper connection path connecting the upper path formation member with the cyclone chambers of the third cyclonic dust separation unit and arranged to radially diverge the air ascending along the upper path formation member,

[9] the air being drawn into the cyclone chambers in a tangential direction through the upper connection path so as to be centrifuged therein.

19.[1] A vacuum cleaner according to any of the preceding claims,

[2] wherein the first cyclonic dust separation unit is for separating large dust particles from the dust-carrying air drawn in,

[3] the second cyclonic dust separation unit is for separating medium dust particles from the air leaving the first cyclonic dust separation unit**,**

[4] and the third cyclonic dust separation unit is for separating fine dust particles from the air leaving the second cyclonic dust separation unit;

[5] and wherein the first cyclonic dust separation unit comprises a first chamber having a first air inlet and a first air outlet, and a grille.

‘606

25. Although it has the same inventors and the same priority date as ‘603, the specification of ‘606 differs from that of ‘603. The specification of ‘606 begins by briefly describing the operation of “cyclonic dust-separating apparatus”. It continues at page 1 lines 12-29:

> “A cyclonic dust-separating apparatus includes a cyclone chamber in which the drawn-in air is rotated. The cyclone chamber is sized to suit the dust to be removed, and generally a cyclonic dust-separating apparatus has a single cyclone chamber. Accordingly, a conventional cyclonic dust-separating device can only separate dust particles that are large enough to be handled by the structure of the cyclone chamber.
>
> Such a limited cleaning operation is disadvantageous, especially for a cyclonic dust-separating apparatus of a vacuum cleaner, which is required to separate almost every dust particle regardless of size. The conventional cyclonic dust-separating apparatus is particularly poor at removing fine dust particles. In order to solve this problem, studies have recently been carried out to develop a cyclonic dust-separating apparatus that has a plurality of cyclone chambers for separating dust in multiple stages. The problem of this approach is that, as the number of cyclone chambers increases to satisfy the desired dust separation efficiency, the overall size of the apparatus increases and its structure is complicated, which is obviously not beneficial for use in a vacuum cleaner.
>
> An aim of the invention is to provide a cyclonic dust-separating apparatus that is compact whilst providing improved dust separation efficiency.”

26. After a consistory clause corresponding to claim 1, the specification states at page 2 lines 13-14:

> “Accordingly, this multi-stage cyclonic dust-separating apparatus can improve cleaning efficiency while remaining compact.”

27. A specific embodiment of the dust separator is described by reference to Figures 1, 3 and 4. Figures 3 and 4 are as follows:

FIG. 3

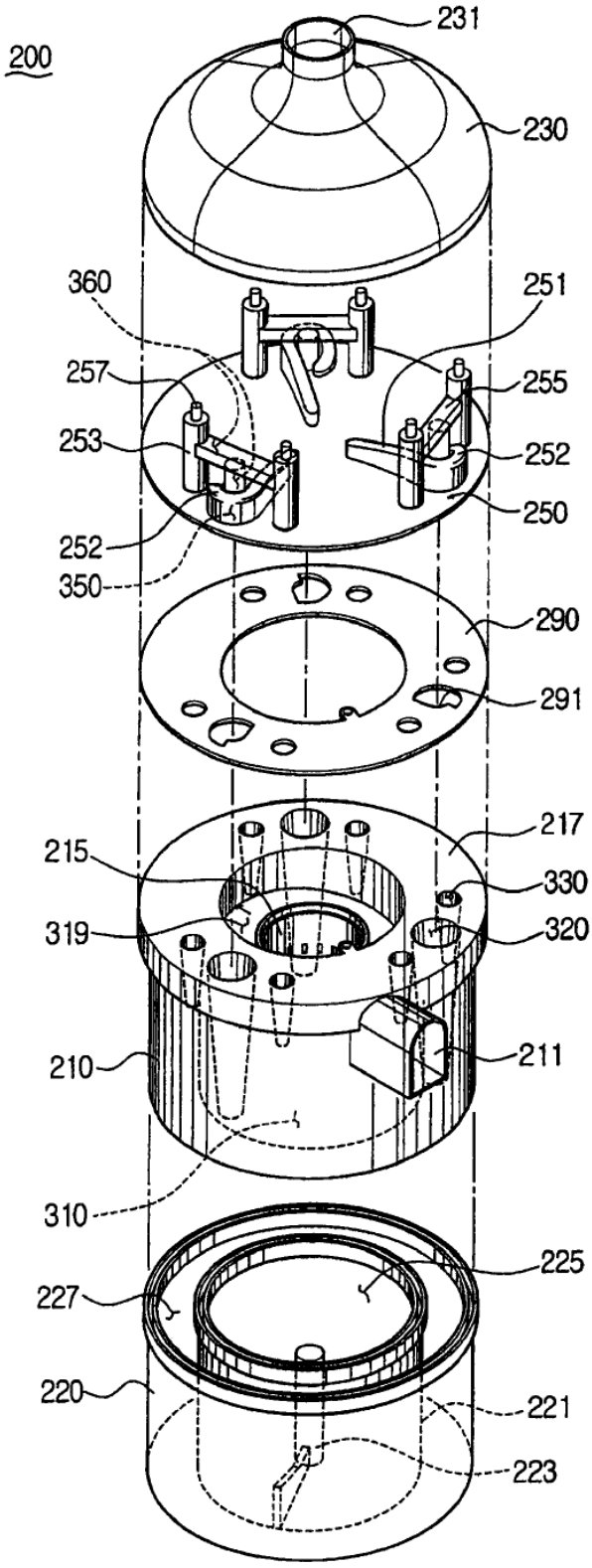
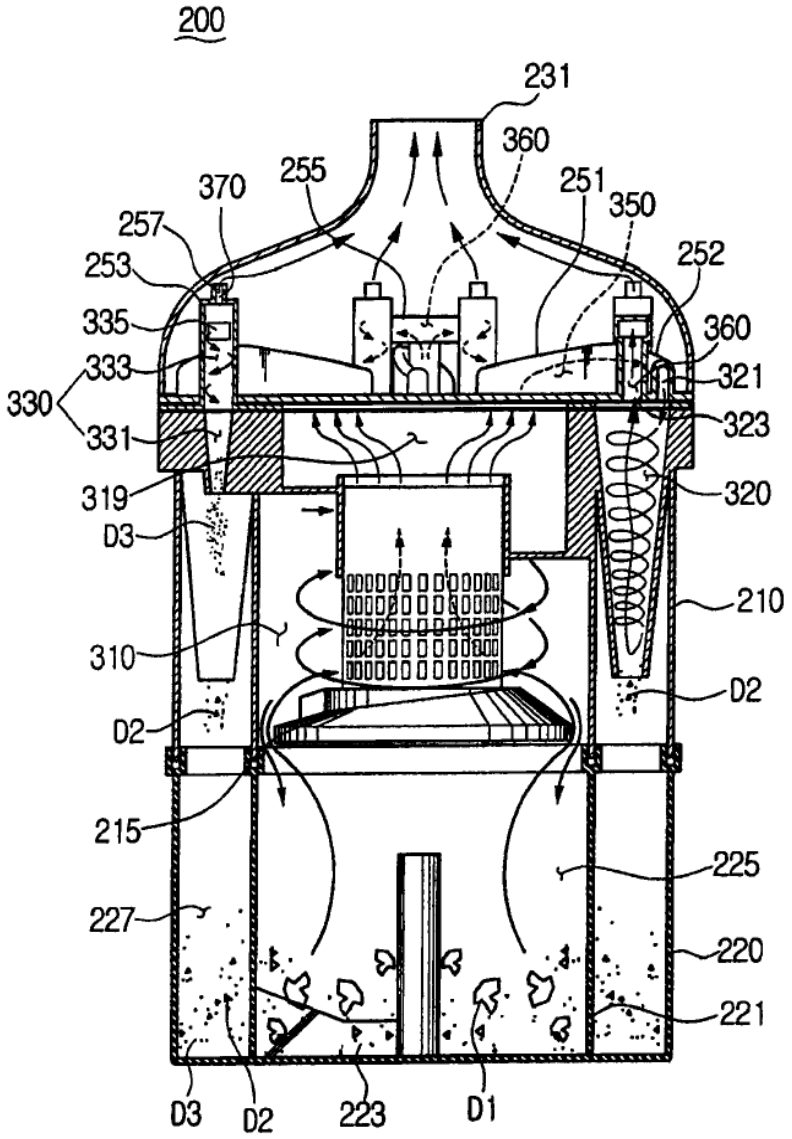


FIG. 4



28. At page 6 lines 2-8 the specification states:

> "Referring to Figures 3 and 4, the cyclonic dust-separating apparatus 200 includes a first cyclone chamber 310, at least one second cyclone chamber 320, and at least one third cyclone chamber 330. Accordingly, dust is separated from the drawn-in air in three stages, thereby leading to an improved dust separation efficiency.
>
> The cyclonic dust-separating apparatus 200 actually includes one first cyclone chamber 310, and a plurality of second and third cyclone chambers 320 and 330."

29. It goes on to say at page 6 lines 10-11 that "the first cyclone chamber 310 separates large dust particles from the air drawn in from a surface to [be] cleaned" and at page 7 lines 10-11 that "[t]he second cyclone chambers 320 provide a second filtration of the air after it has been cleaned by, and flowed from, the first cyclone chamber 310".

30. At page 8 lines 7-13 the specification states:

> "The third cyclone chambers 330 are provided to filter the air flowing in from the second cyclone chambers 320, so as to separate even smaller dust particles D3 from the air. For a higher separation efficiency, the third cyclone chambers 330 have a smaller size than the first and second cyclone chambers 320 and 330. In this particular embodiment, the second cyclone chambers 320 are smaller than the first cyclone chamber 310, and larger than the third cyclone chambers 330."

31. It can be seen from Figures 3 and 4 that the second cyclone chambers 320 and the third cyclone chambers 330 deposit dust into a common collecting space. This is a deliberate design feature, since the text states at page 6 lines 27-30:

> "The dust receptacle 220 is provided with a partition 221 which divides the interior of the receptacle into a space for receiving the dust particles D1 separated in the first cyclone chamber 310 (i.e. in the first collecting space 225), and a space 227 for receiving dust particles D2 and D3 separated in the second and third cyclone chambers 320 and 330."

Furthermore, this feature formed part of granted claim 9 and its corresponding consistory clause. After Dyson had attacked the validity of claim 9 on the ground of insufficiency, Samsung applied to delete that claim.

32. Dyson does not attack the validity of claims 1-8 of '606 as granted, which are not affected by the amendment application. Nor does it attack the validity of claims 17-18 of '606 as proposed to be amended.

33. The A list claims of '606 as proposed to be amended are as follows:

9.[1] A vacuum cleaner comprising:

[2] an air suction port through which dust-carrying air is drawn in from a surface to be cleaned;

[3] a motor for generating a suction force at the air suction port; and

[4] a cyclonic dust-separating apparatus for separating dust from the drawn-in air, the cyclonic dust-separating apparatus comprising:

[5] a first cyclone chamber for separating dust particles from the air by centrifugal force,

[6] at least one second cyclone chamber for separating dust from the air discharged from the first cyclone chamber by centrifugal force; and

[7] a plurality of third cyclone chambers for separating dust from the air discharged from the or each second cyclone chamber by centrifugal force,

[8] wherein the or each second cyclone chamber has an inner diameter smaller than that of the first cyclone chamber and larger than that of each third cyclone chamber.

14.[1] A vacuum cleaner as claimed in any of claims 9 to 13,

[2] wherein the or each respective second cyclone chamber communicates with two or more of the third cyclone chambers such that air discharged from the or each respective second cyclone chamber enters the two or more third cyclone chambers without mixing with other air.

19.[1] A vacuum cleaner as claimed in any of claims 9 to 18,

[2] wherein the first, second and the third cyclone chambers are formed independently from each other, and

[3] the second and the third cyclone chambers are located within the cyclonic dust separating apparatus so as to be disposed in a plane orthogonal to a main axial direction of the cyclonic dust-separating apparatus.

20.[1] A vacuum cleaner comprising:

[2] an air suction port through which dust carrying air is drawn in from a surface to be cleaned;

[3] a motor for generating a suction force at the air suction port;

[4] and a cyclonic dust separating apparatus for separating dust from the drawn-in air, the cyclonic dust-separating apparatus comprising:

[5] a first cyclone chamber for separating dust particles from the air by centrifugal force,

[6] at least one second cyclone chamber for separating dust from the air discharged from the first cyclone chamber by centrifugal force;

[7] and at least one third cyclone chamber for separating dust from the air discharged from the or each second cyclone chamber by centrifugal force,

[8] wherein the or each second cyclone chamber has an inner diameter smaller than that of the first cyclone chamber and larger than that of the or each third cyclone chamber,

[9] and wherein the second and third cyclone chambers are independently formed from each other,

[10] and are located within the cyclonic dust separating apparatus such that respective main axes of the second and third cyclone chambers are parallel,

[11] and the second and third chambers are at least partially overlapping each other in the axial direction of the chambers.

The witnesses

34. Dyson's expert witness was David Harris. Mr Harris obtained a BSc in Physics from the University of Sheffield in 1993. From March 1999 to May 2002 he was employed by Dyson Research Ltd and then Dyson Ltd in the Separations Systems group, whose remit was to research and improve the performance of the cyclones and filters used in Dyson vacuum cleaners. During his first year Mr Harris was involved in work on the cyclone arrangements that eventually led to the DC07 and DC08 machines. During his second year he was involved in work on the filters, but continued to monitor the work on cyclones. During his final year or so Mr Harris took on the management of the group. During this period the group developed and refined the cyclone packs in the DC07 and DC08. Since May 2002 Mr Harris has been employed by Cambridge Consultants Ltd. In 2004 he worked on a project to develop cyclones for use in dry powder inhalers.

35. Counsel for Samsung submitted that Mr Harris lacked real expertise in the design of cyclones for vacuum cleaners. I do not accept this. In my judgment Mr Harris was appropriately qualified to give evidence from the perspective of the addressee of the Patents, although some allowance must be made for the fact that he ceased to be involved in the vacuum cleaner field in May 2002. Moreover, Mr Harris was clearly better qualified to give evidence from the perspective of a vacuum cleaner cyclone designer than Samsung's expert.

36. Samsung's expert witness was Professor Raymond Allen. Professor Allen obtained a BSc in Chemical Engineering from UMIST in 1970, an MSc in Biochemical Engineering from UMIST in 1971 and a PhD from McGill University in 1975. Since then Professor Allen has had a distinguished career in the field of industrial gas cleaning. From 1976 to 1995 he worked in various positions at the Harwell Laboratory of the United Kingdom Atomic Energy Authority, subsequently AEA Technology. In 1995 he became the founding Head of a new Department of Chemical and Process Engineering at the University of Sheffield. He is presently Professor of Chemical Engineering at that university. He has published extensively, and consulted widely, on all aspects of gas cleaning including in particular cyclone design. During the period 1999-2000 he acted as Hoover's expert witness in the *Dyson v Hoover* case even though he had not previously had any involvement in the vacuum cleaner field. As a result of that experience he became knowledgeable about the application of cyclone technology in that field. After the litigation he was asked by Hoover to assess some proposals for a new design of cleaner which would avoid infringement of the Dyson patent. Apart from that, however, he has not been involved in vacuum cleaner design, but he has retained a general interest in the subject.

37. Counsel for Dyson submitted that Professor Allen was highly expert in cyclone technology generally, but not with regard to vacuum cleaner design. Despite this, he sought to rely upon a series of admissions made by Professor Allen during cross-examination regarding the common general knowledge of the person skilled in the art. Counsel for Samsung accepted that Professor Allen could not speak from the perspective of a vacuum cleaner designer, but submitted that the only material gap in his knowledge was as to the vacuum cleaner marketplace. In my judgment Professor Allen was well qualified to give expert evidence on cyclonic separation, but some allowance must be made for his lack of direct involvement in vacuum cleaner design.

38. Counsel for Dyson also submitted that Professor Allen had not been objective in his evidence in the present case. In support of this submission he relied in particular on certain differences between Professor Allen's first report in this case and corresponding passages in his report in the *Dyson v Hoover* case. Having heard Professor Allen's answers when cross-examined on these points, I am satisfied that he did approach his task as an expert witness in this case correctly. As will appear, however, in certain respects I prefer his reasoning in the earlier report.

39. Finally, counsel for Dyson submitted that Professor Allen had applied a double standard in his reports that he had been very critical of the prior art while forgiving of shortcomings in the Patents. I am not persuaded that Professor Allen deliberately applied a different standard to the documents, but as will appear I think he was slightly overcritical of some of the prior art.

40. Samsung also called as a factual witness Min Ha Kim, one of the three inventors of the Patents. He was a straightforward witness whose evidence I accept, but I found most of his evidence of little assistance with regard to most of the issues that I have to decide.

41. In addition, both parties filed written evidence from other witnesses which was not challenged.

The addressee

42. A patent specification is addressed to those likely to have a practical interest in the subject matter of the invention, and such persons are those with practical knowledge and experience of the kind of work in which the invention is intended to be used. The addressee comes to a reading of the specification with the common general knowledge of persons skilled in the relevant art, and he (or, once and for all, she) reads it knowing that its purpose is to describe and demarcate an invention. He is unimaginative and has no inventive capacity.

43. In the present case there is no dispute between the parties as to the identity and attributes of the person skilled in the art to whom the Patents are addressed. The addressee is a person involved in the design and development of cyclonic vacuum cleaners. Such an individual would have a degree (or equivalent) in mechanical engineering, physics or another relevant discipline. He would also have the benefit of a number of years of practical experience working in this field. He would have access to computational fluid dynamics ("CFD") software for the purposes of simulating airflow within any particular design.

Common general knowledge

44. The law as to what constitutes common general knowledge is set out in the decisions of the Court of Appeal in *General Tire & Rubber Co v Firestone Tyre & Rubber Co Ltd* [1972] RPC 457 at 482-483 and *Beloit Technologies Inc v Valmet Paper Machinery Inc* [1997] RPC 489 at 494-495. As Laddie J explained in *Raychem Corp's Patents* [1998] RPC 31 at 40:

> "The common general knowledge is the technical background of the notional man in the art against which the prior art must be considered. This is not limited to material he has memorised and has at the front of his mind. In 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 if he cannot remember it and which he understands is generally regarded as sufficiently reliable to use as a foundation for further work or to help understand the pleaded prior art. This does not mean that everything on the shelf which is capable of being referred to without difficulty is common general knowledge nor does it mean that every word in a common text book is either. In the case of standard textbooks, it is likely that all or most of the main text will be common general knowledge. In many cases common general knowledge will include or be reflected in readily available trade literature which a man in the art would be expected to have at his elbow and regard as basic reliable information."

45. In the present case there was much common ground between the parties and their respective experts as to the common general knowledge, but there were some differences. I have summarised the core of the relevant common general knowledge under the heading "technical background" above, but it is necessary to elaborate on certain points and add others.

Cyclone technology in general

46. It is common ground that the addressee would have an understanding of cyclone technology in general as well as its application to vacuum cleaners. As Professor Allen put it in his first report at paragraph 2-34:

> "I have emphasised some more general points of cyclone technology but these are easily accessible through the reading of standard textbooks on gas cleaning technology and it would be expected that a competent person skilled in the art would have made some effort to understand cyclones in general as well as their application to vacuum cleaners. Thus some, possibly patchy, knowledge of the industrial cyclone technology would be expected."

47. Professor Allen exhibited to his third report a chapter from *Gas Cyclones and Swirl Tubes* by A.C. Hoffmann and L.E. Stein (Springer, Berlin, 2002) as representing common general knowledge in the art. He explained to me that this was in fact the only book on cyclone technology in print at the priority date, although the subject was

also covered in technical encyclopaedias and the like. Dyson contends that everything in this book was common general knowledge. I do not accept this contention. It is not supported by the evidence of Mr Harris, and Professor Allen was firmly of the opinion that some of the information in the book was not common general knowledge in the industrial cyclone field, let alone in the vacuum cleaner field.

Principles of operation of cyclones

48. It is common ground that the addressee would have a firm command of the principles of operation of cyclones. I have very briefly summarised these in paragraph 6 above.

49. At this point it is necessary to refer to a question of terminology which underpins an issue on construction discussed below. In paragraph 2-1 of his first report Professor Allen stated:

> "[Centrifugal force] causes the particles to migrate outwards with respect to the fluid. The fluid in the outer spinning layers of the vortex acquires a greater concentration of particles so that the particles are no longer in the fluid in the centre layers. If arrangements can then be made to provide for effective disengagement of the concentrated dust stream from the fluid in the centre then the particles have been separated. This is the underlying principle of the separation effect of cyclones."

In paragraph 2-4 Professor Allen described the gas flow in a frusto-conical reverse flow cyclone as

> "creating an outer vortex which continues to concentrate the particles into the outer layers of this vortex".

50. In paragraph 4.2 of his third report Mr Harris said:

> "Separation is the removal of particles from an airflow. Collection is the depositing of particles into a location from which re-entrainment is unlikely (for example a dust hopper). In a reverse flow cyclone, all collected particles have been separated from the airflow and so the terms are often used interchangeably. The skilled person would, however, understand that these terms refer to different stages of the process. In a cyclone using a scavenge flow, dust particles are separated from the main airflow and are concentrated in the scavenge flow before leaving the cyclone. Subsequent arrangements may be made to collect the particles from the scavenge flow."

This evidence was not directly challenged.

51. It was put to Professor Allen in cross-examination that in his report in *Dyson v Hoover* he had used the word "separation" differently to the way in which he used it in his reports in the present case. Thus in paragraph 24 of that report he said:

> "[Centrifugal force] causes the particles to migrate outwards with respect to the fluid. The fluid in the outer spinning layers acquires a greater concentration of particles and the fluid in the

> centre layers is effectively cleaned. This is the underlying principle of the separation effect of cyclones."

In paragraph 35 of that report he described the gas flow in a frusto-conical reverse flow cyclone as

> "creating an outer vortex containing the major portion of the particles separated from the gas by centrifugal action."

52. Professor Allen's explanation for these changes was that his use of the term "separation" in his *Hoover* report was loose, and that as a result of his experience in that case he had tried to be more precise in his reports for this case. He went on to say, however, that in his opinion the term "separation" had to be read in context. When asked how the term would be generally understood by the skilled person he replied:

> "It was capable for a range of meanings. I keep saying the words 'in the context'. If you were talking about how particles achieve the concentration, you could perhaps talk about particles migrating through the gas and you could perhaps call that separation if you were not thinking about it and if there was no need for you to make a distinction in a particular set of circumstances in which you were operating.
>
> …
>
> I have said that people used the word 'separation' in a number of ways. I have said to you that if you start to talk about the force balances on the particles within a vortex and then you talk about the particles migrating outwards with respect to that vortex, it is quite common for people to refer to that as separation.
>
> …
>
> On the other hand, if you start to talk about whether or not a cyclone separates, moving to the bulk thing, the tendency is, and it is by no means absolute because people write in different ways and write with different degrees of rigour, and all the rest of it, to perhaps move more towards the use of separation in the terms which I have used it. Even then it is quite possible to find people using it in a range of ways, as I myself did in the year 2000."

53. That "separation" can be used to refer to concentration without necessarily involving disengagement can be seen from the following passages in Chapter 2 of Hoffmann and Stein:

> "In gas cyclones the particle density is much higher than that of the carrier gas, so the 'boyancy' [*sic*] is low and the particle will move radially outward in the vortex. This, then, becomes and defines the primary mechanism for separation of particles in a cyclone.

> …
>
> This outward movement of the particle is, as mentioned, the principle of separation in all centrifugal separators, both for dedusting and demisting."

54. I conclude that the addressee would know that the term "separation" can be used to describe just concentration of dust particles in a cyclone or to describe concentration and disengagement depending on the context and the rigorousness of the author.

Types of cyclone geometry

55. The addressee would be aware of the types of cyclone geometry commonly encountered. In particular he would be aware of both reverse flow and axial cyclones. He would also be aware of a number of different inlet arrangements, including tangential inlets, wrap around inlets, vaned inlets and multiple inlets.

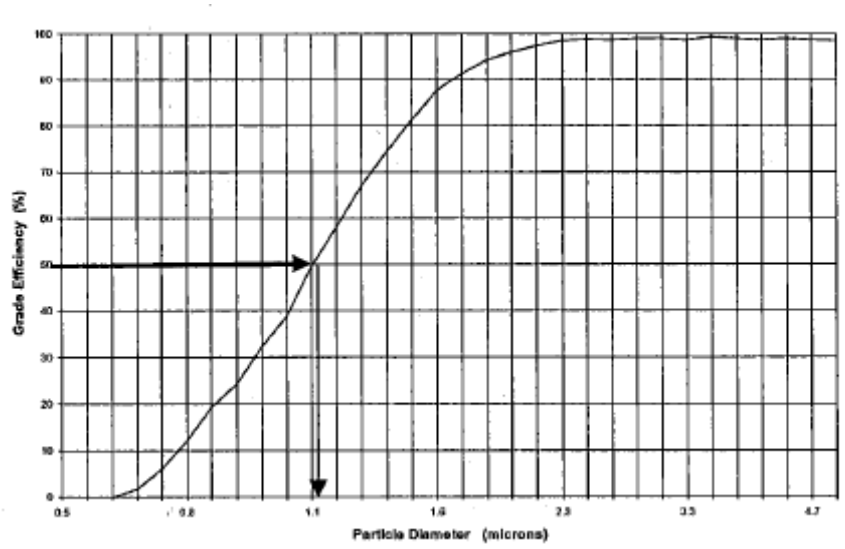
Gas and particle behaviour in reverse flow cyclones

56. The addressee would be aware of how gas and particles behave in reverse flow cyclones. I have briefly summarised this in paragraph 10 above. The skilled person would be aware that a cyclone will operate perfectly well in a variety of orientations since it does not depend on gravity to separate the particles, but gravity has an effect on the particles after they have become disengaged from the airflow.

Collection efficiency of cyclones

57. The addressee would understand the relationship between the collection efficiency of cyclones and the characteristics of the particles. I have briefly summarised this in paragraph 7 above.

58. The collection efficiency of a cyclone is normally defined in terms of its mass or gravimetric efficiency i.e. the fraction consisting of the mass of particles deposited by the cyclone divided by the mass of particles entering the cyclone. As discussed above, collection efficiency depends on the size and density of the particles. Efficiency as a function of particle diameter can be measured for a dust of known density and plotted on a graph known as a grade efficiency curve:

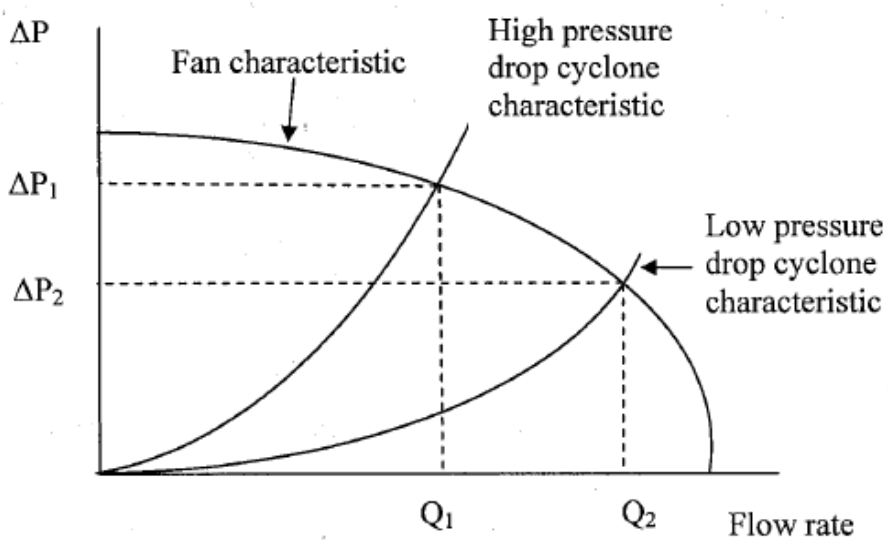


59. An important point on this curve, which is widely used to characterise the efficiency of cyclones, is the d_{50}. This represents the size of particle that has a 50% probability of collection. Thus if two cyclones are being compared, the one with the lower d_{50} has the higher efficiency. Although this particular curve shows a d_{50} of just over 1.1 microns, cyclones are usually unable to collect particles of diameters below about 1 micron.

60. Although the collection efficiency of a cyclone varies with flow rate, the curve passes through a shallow maximum. Most cyclones are operated at or near the maximum and thus, within limits, collection efficiency is approximately independent of the flow rate.

Pressure drop across cyclones

61. The addressee would understand the relationship between pressure drop and flow rate in cyclones. I have briefly summarised this in paragraph 8 above. The effect of a high pressure drop characteristic and a low pressure drop characteristic for a given fan characteristic is illustrated by the following plot of pressure drop against flow rate:



62. It is common ground that it was well known that there are complex trade-offs between collection efficiency, pressure drop and flow rate.

Effect of cyclone geometry on performance

63. A key determinant of the collection efficiency of a cyclone is its geometry. Of particular importance are the barrel diameter, vortex finder diameter, inlet dimensions, cone geometry and cyclone length. The addressee would be well aware of the effect of changing these dimensions. He would also know that the most important factor is the diameter of the cyclone.

Multi-cyclone systems

64. The addressee would be well aware that two or more cyclones may be arranged in parallel or in series as described in paragraphs 12 and 13 above. It was well known at the priority date that, as stated there, connecting two identical cyclones in series would increase the overall separation efficiency. It was also well known that in general the average particle diameter separated by the second cyclone would be smaller than that separated by the first cyclone. Strictly speaking, this is only true if the dust distribution overlaps the sloped portion of the grade efficiency curve; but to a first approximation this can be assumed to be the case.

65. The attitude of the addressee to pressure drop in a multi-stage cyclone system was one of the major points of contention between the parties, and I shall consider this below.

Ducts

66. Where cyclones are arranged in series or in parallel, it is necessary to provide appropriate ducting to carry the air between them. The design of such ducting would be within the expertise of the addressee.

67. Dyson contends that the arrangement illustrated in Figure 16.7 of Hoffmann & Stein, which shows a circular inlet distributor feeding air to four cyclones in parallel, was common general knowledge. In my judgment the evidence does not establish this. It is not supported by the evidence of Mr Harris, and Professor Allen's opinion was that that particular arrangement was not common general knowledge even in the industrial cyclone field.

Domestic vacuum cleaners

68. The addressee would be familiar with the principal designs of cyclone used in domestic vacuum cleaners on the market in March 2005 and during the preceding period. The addressee would certainly be familiar with the designs marketed by Dyson, and in particular the DC07 and DC08, all of which were two-stage designs. The initial Dyson vacuum cleaners, the DC01 and DC02 and their successors the DC04 and DC05, had a low efficiency cylindrical reverse flow cyclone followed by a high efficiency frusto-conical reverse flow cyclone. The DC07 and DC08 had a low efficiency cylindrical reverse flow cyclone followed by a set of parallel high efficiency frusto-conical reverse flow cyclones. The DC07 and DC08 are described in more detail below. The addressee would also be familiar with single-stage cyclone designs used by Dyson's competitors.

69. As the addressee would be well aware, the key selling point of cyclonic domestic vacuum cleaners was that they did not incorporate bags for collecting the dust. This had two advantages: the cleaners did not lose suction as the bag clogged and the bag did not have to be replaced periodically.

70. The addressee would know that both bagged and bagless (i.e. cyclonic) domestic vacuum cleaners were marketed in a considerable range of sizes and specifications in addition to the basic division into upright and cylinder cleaners. Thus bagless cleaners ranged in power from at least 1 kW to 2 kW, in bin size from at least 0.9 litres to 4.5 litres, in weight from at least 3.1 kg to 10 kg and in suction power from at least 175 to 400 air watts.

Grilles

71. Most two-stage cyclonic vacuum cleaners incorporate a sieve with relatively large holes, generally referred to as a "grille" but called a "shroud" by Dyson, after the first stage. The purpose of the grille is to prevent the passage of aerodynamically small but physically large particles, such as animal and human hairs, into the second stage where they can cause blockages.

Barrier filters

72. Most domestic vacuum cleaners, including cyclonic vacuum cleaners, incorporate a high efficiency filter, referred to as a "barrier filter", to remove very fine particles from the air before it is discharged to the room. The barrier filter may be located immediately before or after the fan. Some models have barrier filters in both locations. Barrier filters must be replaced or washed periodically. Thus Dyson recommended that the barrier filters in the DC07 and DC08 be washed every six months.

HEPA filters

73. HEPA (High Efficiency Particulate Air) filters are a type of high efficiency filter which are capable of cleaning fine particles from air to very high standards. HEPA filters can remove 99.97% of particles 0.3 microns in diameter. They are often positioned downstream of the motor in domestic vacuum cleaners so as to capture burnt resins and carbon emissions.

74. The addressee would be well aware that even a high efficiency reverse flow cyclone is not as efficient at separating sub-micron particles as a HEPA. Accordingly, a skilled person would not regard a HEPA filter and a high efficiency cyclone as interchangeable in terms of their performance.

Electronic filters

75. As the name implies, electronic filters separate particles from gas by electrical rather than mechanical means. One type of electronic filter is known as an electrostatic precipitator. Electrostatic precipitators work by attaching electrostatic charges to particles which are then subjected to an electric field. The resulting force on the particles causes them to move (precipitate) down the voltage gradient to a collection plate. Large electrostatic precipitators are used in industry (e.g. in the treatment of

emissions from coal-fired power stations) and smaller units are used for other applications (e.g. air purification). They can collect fine particles ranging between 0.01 and 10 microns. The addressee would be aware of the existence, and basic principles of operation, of electrostatic precipitators; but no more than that.

Construction

76. The task for the court when construing a patent claim is to determine what the person skilled in the art would have understood the patentee to have been using the language of the claim to mean: see *Kirin Amgen Inc v Hoechst Marion Roussel Ltd* [2004] UKHL 46, [2005] RPC 9 at [30]-[35]. In that case the list of principles to be found in the judgment of Jacob LJ in *Technip France SA's Patent* [2004] EWCA Civ 381, [2004] RPC 46 at [41] was approved subject to one point.

77. There are three main issues as to the construction of the claims. The first two main issues arise in relation to both Patents while the third only concerns '606. There are also a couple of other issues of construction which are easier to deal with when discussing novelty and obviousness.

Vacuum cleaner

78. Dyson contends that in both Patents the term "vacuum cleaner" has a broad meaning and covers any apparatus that sucks up dust and dirt from a surface. Samsung contends that the term should be interpreted more narrowly, as being restricted to machines for domestic and light industrial cleaning duties. The dispute is occasioned by Gamou, which Samsung says is not a "vacuum cleaner".

79. Neither party suggested that "vacuum cleaner" was a technical term of art. To my surprise, neither referred me to any dictionary definition of the term. The definition in the *Oxford English Dictionary* is as follows:

> "an electrical appliance for removing dust (from carpets and other floorings, soft furnishings, etc.) by suction."

80. Turning to '603, although the specific embodiments illustrated in Figures 2 and 3 appear to be domestic vacuum cleaners, the specification contains three pointers towards a broad understanding of the term. First, the vacuum cleaner is described and claimed as comprising "a cleaner body; a nozzle unit in fluid communication with a cleaner body to draw in dust-carrying air from a surface to be cleaned; and a multi-cyclone dust separator". This indicates that the vacuum cleaner cleans a surface by drawing in dust-carrying air. There is no limitation on the size or purpose of the cleaner. Secondly, at page 1 line 8 the specification defines "dust" as meaning "dust and dirt". There is no limitation on the nature or size of the dirt other than the implicit limitation that it should be capable of being cleaned from a surface by suction. Thirdly, at page 1 line 9 the specification states that Davis discloses "[a]n example of a vacuum cleaner". As Professor Allen accepted, what Davis discloses is a heavy duty industrial unit for cleaning storage tanks. Thus the inventor's technical purpose in using the term "vacuum cleaner" appears to have been a fairly broad one, and certainly not one limited to domestic or quasi-domestic machines. Moreover, I cannot see any reason why the inventor would have wished to restrict the scope of his claims to such machines. Accordingly, I accept Dyson's construction.

81. I am fortified in this conclusion by two considerations. First, in paragraph 76 of his report in *Dyson v Hoover* Professor Allen interpreted the expression "vacuum cleaning appliance" in the claims of the Dyson patent as not placing any direct limitation upon the size, nature or intended purpose of the appliance, other than that it be suitable for separating and depositing fine dust from a gas, and as extending to an appliance for domestic or industrial use "e.g. as a street sweeper etc". A key part of his reasoning for reaching this conclusion was that the Dyson patent cited Davis as disclosing a vacuum cleaning appliance. By contrast, in his reports in the present case Professor Allen ignored the fact that '603 stated that Davis was an example of a vacuum cleaner and opined in paragraph 2-28 of his first report that vacuum cleaners "are not used for large scale cleaning activities such as street sweeping, leaf collection and so on".

82. Secondly, in his judgment in *Dyson v Hoover* at [55]-[56], Michael Fysh QC sitting as a Deputy High Court Judge construed "vacuum cleaning appliance" as a device which was "intended to clean a variety of surfaces which have become dirty or covered with unwanted particles" and as covering an appliance "for use in industrial and commercial establishments". This construction was upheld by the Court of Appeal: [2001] EWCA Civ 1440, [2002] RPC 22 at [14]-[19].

83. Unlike '603, '606 does not refer to Davis as an example of a vacuum cleaner. Nevertheless, similar pointers to the first two discussed above again point to a broad understanding of the term even though Figure 2 shows a domestic vacuum cleaner. First, the vacuum cleaner is described and claimed in a similar way. Secondly, at page 1 lines 6-7 the specification defines "dust" as meaning "dust and contaminants". Again, therefore, the inventor's technical purpose appears to have been a fairly broad one and I accept Dyson's construction.

Dust separation unit/for … separating dust particles from the dust-carrying air/for separating dust from the air

84. Samsung contends that the term "dust separation unit" and the words "for separating … dust particles from the dust-carrying air" in claim 1 of '603 both require disengagement of the dust from the air stream and not merely concentration of the dust in a scavenge airflow. It advances the same contention in relation to the words "for separating dust from the air" in claim 9 of '606. Dyson contends that these expressions are not so limited, but cover devices which concentrate the dust in a scavenge airflow and thereby separate it from the cleaned air. Again, this dispute is occasioned by Gamou.

85. I have dealt with the addressee's general understanding of the term "separation" above and concluded that he would appreciate that it can be used to refer to just concentration or to concentration and disengagement.

86. In '603 the term "separation", and cognate expressions, are used in the specification to refer to both concentration and disengagement. This can be seen most clearly from the description of the specific embodiment at page 8 lines 5-14:

> "The principle of separating the dust will briefly be explained. The external air is tangentially drawn in along an inner wall of the first chamber 31. As it rotates along the inner wall of the first chamber 31, the

> drawn-in air generates a centrifugal force. Since the air, which is relatively light, is less influenced by the centrifugal force, the air gathers at the centre of the first chamber 31, thereby generating a whirling current, and is discharged towards the first air outlet 35.
>
> On the other hand, the dust (being heavier than the air) is influenced to a greater extent by the centrifugal force. Therefore, the dust flows along the inner wall of the first chamber 31, and is collected in the first dust receptacle 111."

87. There is nothing in the specification of '603, however, to indicate that concentration and disengagement, as opposed to merely concentration, is a requirement of the invention. Since the cyclones used in the specific embodiment are reverse flow cyclones, it is not surprising that the draftsman uses "separation" to refer to both concentration and disengagement; but there is there is nothing to indicate that he intended the term to be so limited. On the contrary, given that axial flow cyclones are frequently described as "separating" dust, it seems unlikely that such a limitation was intended. Accordingly, I prefer Dyson's construction.

88. This analysis is equally applicable to '606.

For sequentially separating dust particles … according to their size

89. Dyson contends that this merely requires that the average particle size separated in the third dust separation unit is smaller than the average particle size separated in the second unit, which in turn is smaller than the average particle size separated in the first unit. Samsung contends that these words require that the successive dust separation units should be designed to separate large, medium and small particles and hence should be of low, medium and high efficiency respectively.

90. Although counsel for Samsung advanced no less than nine arguments in support of Samsung's interpretation, I agree with counsel for Dyson that there are two simple answers to it.

91. The first is that the word "for" in a patent claim means "suitable for": see *Coflexip SA v Stolt Comex Seaway MS Ltd* [2000] EWCA Civ 242, [2000] IP&T 1332 at [23]-[27]. Accordingly '603 claims a vacuum cleaner in which the three dust separation units are suitable for sequentially separating particles according to their size, and not merely one in which the three units are specifically designed to separate different sizes of particle. As discussed above, if two identical cyclones are placed in series, the second cyclone will separate a smaller mass of material with a smaller average diameter. The same principle applies if a third identical cyclone is added to the series, although the proportion of particles collected by the third cyclone may be quite small if no other changes are made. The ordinary meaning of the claim covers such an arrangement.

92. The second is that Figure 1 shows the second and third dust separation units of the specific embodiment, and in particular their cyclones, as being identical to each other. The description at page 4 line 12 to page 5 line 18 is consistent with this. Nowhere does the specification state or even imply that the second and third cyclones have different efficiencies to each other. (Although it does not expressly state that the first

cyclone in the specific embodiment has a different efficiency to the second and third cyclones either, the skilled reader would probably infer from Figure 1 that the first cyclone is intended to be of lower efficiency than the second and third cyclones since it is shown as being cylindrical.) It follows that on Samsung's interpretation of claim 1 the specific embodiment does not fall within it. This is most unlikely to be correct.

93. Counsel for Samsung argued that, even if claim 1 of '603 did not require the three dust separation units to be of increasing efficiency, claim 19 of '603 did. I do not agree. Again, the language of this claim is "for separating", which means suitable for.

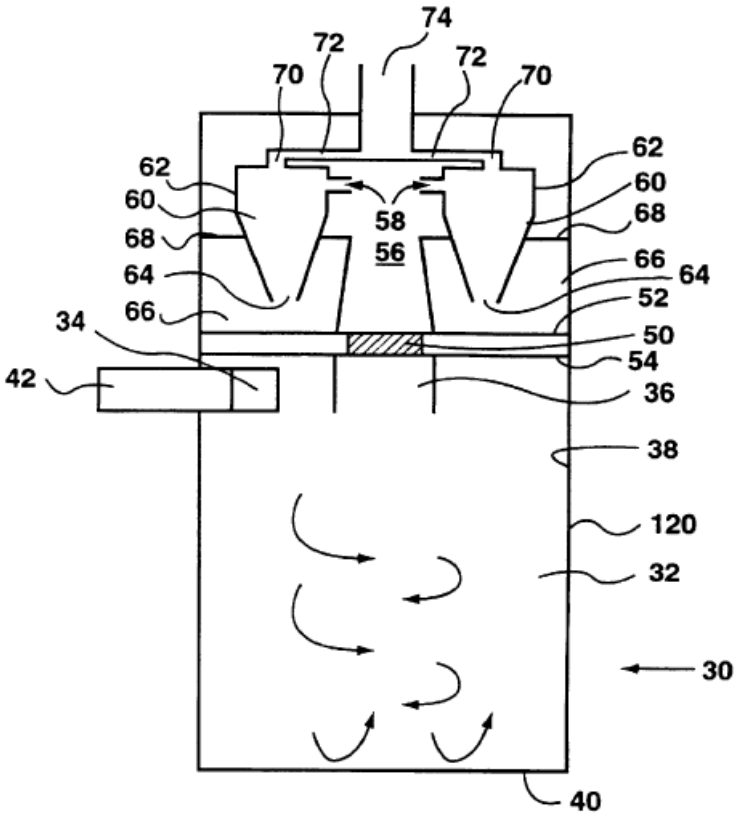
The prior art

Conrad

94. Conrad was published on 29 May 2001. Under the heading "Background of the Invention", Conrad outlines the operating principles of cyclone separators in general terms. At column 2 lines 26-45, the specification refers to a number of prior art patents as disclosing an approach to vacuum cleaner design in which sequential cyclones are utilized as the filtration medium for a vacuum cleaner: the first sequential cyclone is designed to be of lower efficiency to remove larger particles entrained in the air stream and the second sequential cyclone is a frusto-conical cyclone designed to remove smaller particles.

95. Under the heading "Summary of the Invention", Conrad describes various configurations of vacuum cleaner in which the filtration assembly comprises: (i) at least one first cyclone, (ii) at least one second cyclone and (iii) at least one electrostatic filter upstream from the first cyclone and downstream of the clean air outlet. The electrostatic filter may be located either downstream of the second cyclonic separation stage or between the two cyclonic separation stages.

96. Conrad goes on to describe two preferred embodiments by reference to Figures 2 and 3. These depict vacuum cleaners in which the electrostatic filter is situated between the first and second cyclonic separation stages or after the second stage respectively. I reproduce Figure 2 below:



97. At column 4 lines 9-16 Conrad states:

> "Referring to FIG. 2, the vacuum cleaner has a filter assembly 30 comprising a first stage cyclone 32. First stage cyclone 32 may, if desired, comprise a plurality of individual cyclones through which the air passes either in sequence or in parallel. Preferably, filter assembly 30 uses only one first cyclone 32. Such a single cyclone may be designed to remove approximately 90% of the particle matter in the air stream entrained by the vacuum cleaner."

98. At column 4 lines 50-62 Conrad describes the characteristics of the electronic filter in the following terms:

> "Electronic filter 50 may be removable so that it may be cleaned, such as by rinsing with water to remove the particulate matter which is collected thereon. Electronic filter 50 may be of any particular construction known in the art. Various constructions for electrostatic devices which use charged regions to remove particulate matter from an air stream are known. In a particular preferred embodiment, electronic filter 50 comprises an electrostatic precipitator. The electrostatic filter is preferably designed to remove the smallest portion of the particulate matter from the air stream (e.g. up to 30 microns). However, the actual level of filtration which may be achieved by the electrostatic filter will vary depending on the design of filter."

99. As Conrad explains at column 4 line 62 to column 5 line 5, in this embodiment the cleaned air which exits the electronic filter passes through a plurality of second stage cyclones 60. As Conrad explains at column 5 lines 29-39, in the embodiment of Figure 3, the electronic filter is positioned downstream from the second stage cyclones (rather than between the first and second stages).

100. At column 5 lines 26-28 Conrad states in relation to the Figure 2 embodiment:

> "Clean air [from outlet] 74 may be fed, if desired, to further filtration means, such as additional cyclones (i.e. third stage cyclones) or a HEPA™ filter."

101. At column 5 lines 56-67 Conrad states:

> "The instant invention provides an alternate approach to the use of such HEPA™ filters. Electrostatic filters generally provide minimal resistance to the flow of air and accordingly do not provide much of the pressure drop as an air stream passes therethrough. Electrostatic filter 50 may be designed to remove the same size particles as are removed by the HEPA™ filter which is currently in use. Alternately, electrostatic filter 50 may be designed to remove even larger particles. Accordingly, by using an electrostatic filter, the pressure drops for a vacuum cleaner may be substantially reduced (compared to a vacuum cleaner using a HEPA™ filter)."

102. Professor Allen expressed the view in his first report that Conrad contained "numerous technically inaccurate statements about cyclones" and gave four instances:

i) The first was the statement at column 1 line 26 that "the drag of the spinning air as well as the force of gravity causes [the particles] to fall down the walls into an outlet or collector". In my judgment, a less critical reader would regard this sentence as badly drafted rather than seriously technically inaccurate: gravity does not cause the particles to move down the cyclone, but it does have a role to play once the particles drop into the collector.

ii) The second was the statement in the following sentence that "[t]he lighter or less dense particles, as well as the air medium itself, reverses course at approximately collector G". In his report Professor Allen said that this was "overly simplistic", while during cross-examination he said it was actually wrong. In my judgment he was nearer the mark the first time: the sentence is not well written, but if correct emphasis is given to the word "approximately" it is not really inaccurate.

iii) The third was the statement at column 2 lines 43-46 that "[i]f larger particles are carried over into the second cyclone separator, then they will typically not be removed by the cyclone separator but exit the frusto-conical cyclone with the air-stream". Mr Harris read this as a reference to the phenomenon of particles bouncing off the surface of the cyclone. In my view that reading is difficult to square with the words "will typically". Thus I accept that this sentence is erroneous. But in my judgment the skilled reader would again

regard this as infelicitous drafting rather than indicative of a serious lack of technical understanding on Conrad's part: there would be nothing wrong with the sentence if it said "may sometimes" rather than "will typically".

iv) The last was what Professor Allen called the "inference" from column 5 line 27 that a cyclone could be used instead of a HEPA filter. As I shall discuss below, I consider that this is a misreading of Conrad.

103. In addition to these instances, counsel for Samsung suggested to Mr Harris in cross-examination that there were certain other errors about cyclones in Conrad. Since none of these had been mentioned by Professor Allen in his reports, however, I do not consider that these are matters that would have influenced the addressee. Moreover, in my judgment they were at worst further examples of infelicitous drafting.

104. Professor Allen also pointed out that Conrad's suggestion at column 4 lines 7-8 that his invention may be used in a wet/dry vacuum cleaner was a bad idea since the electronic filter would short circuit. Mr Harris accepted this. Even assuming that the skilled reader (who, it is common ground, it is not an expert on electronic filters) spotted this, however, I do not consider that it would influence his reading of the remainder of the document.

Gamou

105. Gamou was published on 14 July 1992. Under the heading "Background to the Invention" and the sub-heading "Field of the Invention", Gamou states:

> "This invention relates to a cleaning machine, in particular a cleaning machine which comprises a suction blower driven by an engine and mounted on a frame, a dirt intake communicating with an inlet of the suction blower by means of a duct, and a dirt collecting receptacle disposed under the separator, in which the cleaning machine sucks dirt such as fallen leaves and dust together with air by the sucking force generated by rotation of the engine of the suction blower and collects it into the receptacle by separating it from the air by the separator."

106. The statement that the machine sucks up and separates fallen leaves and dust is repeated several times in the specification. Reference is also made to separating pieces of waste paper. These references, the repeated references to the "engine", the fact that dust may be deposited back on the ground and the general appearance of the machine illustrated in the figures indicate that the cleaning machine disclosed is intended for use as a street sweeper or the like.

107. Under the sub-heading "Description of the Prior Art", Gamou states that it is desired that as much dust as possible should be removed. For this purpose various filters have been used. A filter is likely to become clogged with dust, however, which causes the "sucking power" to decrease. Furthermore, the filtering capability is likely to be decreased, especially when the air or dirt contains moisture. For these reasons it is necessary frequently to clean and replace the filter.

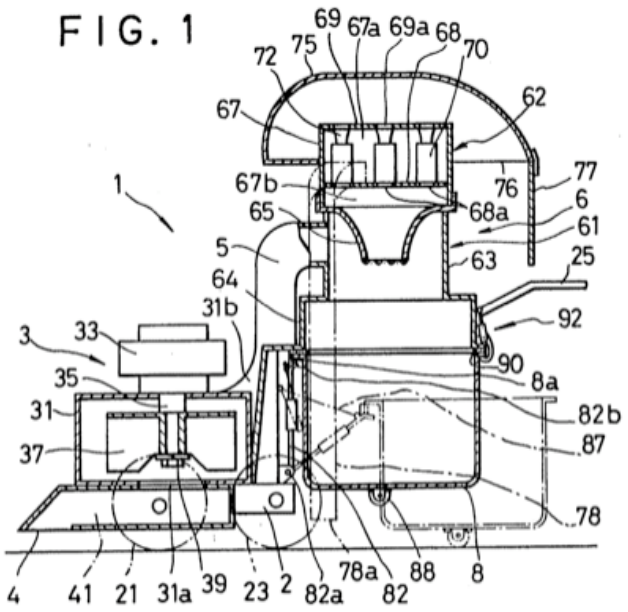
108. Under the heading "Summary of the Invention", Gamou says that the main object of the invention is to provide a cleaning machine "having a dirt separator which is not prone to being clogged with dust contained in the dirt and which can deal with air containing water or moisture as well as wet dirt". To achieve this object:

> "The separator comprises a main separator for separating relatively large dirt such as fallen leaves and a subseparator for separating relatively small dirt such as dust contained in the air which has passed through the main separator. The subseparator comprises a plurality of centrifugal dust separators."

109. Gamou goes on to describe four preferred embodiments by reference to 28 figures. Of these embodiments, only the first two are relevant for present purposes.

110. The first embodiment is depicted in Figures 1-11 and described at column 3 line 35 – column 6 line 38. Figure 1 is reproduced below:

FIG. 1



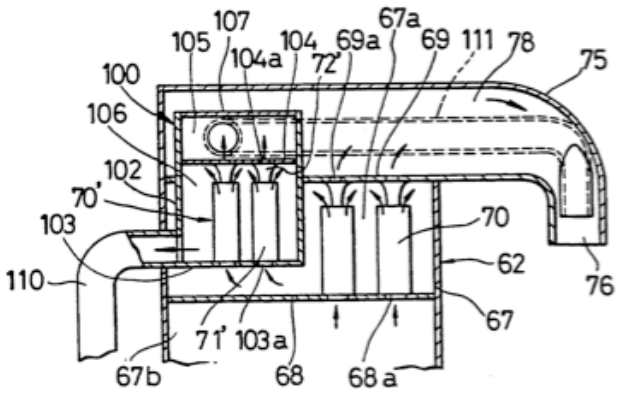
111. In this embodiment a mixture of dirt and air is sucked into the machine via intake 4 and discharged into the main separator 61 through duct 5. The main separator is a cylindrical reverse flow cyclone. The air whirls around and down, depositing leaves, paper and other large items in the dirt collecting receptacle 8. Dust-laden air then passes upwards through the middle of the funnel-shaped exhaust guide 65 and through a subseparator 62 comprising seven centrifugal dust separators 70 arranged in parallel. These are axial flow cyclones with vaned inlets. Most of the dust is concentrated in the air flow around the periphery of each cylinder and escapes via the upper chamber 67a and then the dust discharging duct 78. The dust is deposited back onto the ground or collected in an auxiliary bag. The cleaner air escapes through the funnel-shaped exhaust guide 72 of each subseparator and out under the hood 75. A filtering net may be attached at the outlet 76 or any other place in the dust discharge path. At column 6 lines 46-53 Gamou states that the air flow through the centrifugal dust separators 70 divides approximately 80:20 between the "first main stream" (the cleaner air) and the "first side stream" (the dust-laden air).

112. The second embodiment is depicted in Figures 14-17 and described at column 7 line 14 – column 8 line 68. The object of the second embodiment is described at column 6 line 54 – column 7 line 3:

> "In this case, it is preferable that the amount of the air flow of the first side stream is reduced as small as possible, because when the dust in the first side is caught in an auxiliary dust bag, the small amount of the air is easy to pass the bag, or when the dust is discharged outside without the auxiliary dust bag, the small amount of the air flow will not spread the dust so much. It is therefore preferable that the amount of the air flow of the first side stream is to be smaller as far as the air flow is sufficient to carry the dust. Therefore, in view of this the second embodiment is so constructed as to further divide the first side stream into the second main and side streams, in which the second main stream flows out separately or together with the first main stream, and the second side stream whose amount is reduced to 20 percent of that of the first side stream, that is 4 percent of the amount of the air from the main separator carries the dust."

113. In this embodiment, one of the cylindrical dust separators 70 is replaced by a second subseparator 100 comprising three centrifugal dust separators 70':

FIG. 16



114. The air flow through the dust separators 70' divides in the same 80:20 split as before, this time between the cleaner "second main stream", which escapes into the atmosphere via exhaust duct 111, and the dust-laden "second side stream" which flows out through dust discharging duct 110. It is important to appreciate that the function of the second subseparator 100 is to reduce the volume of dust-laden air, thereby making it easier to collect the dust in an auxiliary dust bag or reducing the spreading of the dust back into the environs. As Mr Harris accepted in cross-examination, the addition of the second subseparator makes the overall separation efficiency of the machine worse, because more dust will be expelled via outlet 76, compared to the first embodiment.

115. Gamou states at column 7 lines 37-39:

> "The construction of each of the centrifugal dust separators 70' is the same as that of the centrifugal dust separators 70 of the first embodiment."

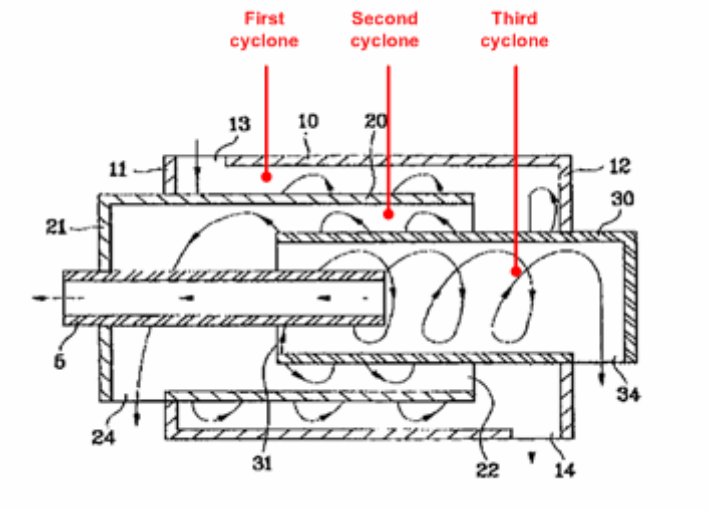
LG

116. LG was published on 19 October 2002. According to the abstract (in the agreed translation):

> "The present invention relates to a cyclone dust-collecting device employed, for example, in a vacuum cleaner; and the aim of the present invention is to provide a multi-cyclone dust collecting device which is able to collect even fine detritus by carrying out the operation of collecting detritus a plurality of times."

117. In order to achieve this aim, LG employs a "first cyclone body", a "second cyclone body" and a "third cyclone body" of different sizes nested inside each other. These form three axial flow cyclones.

118. LG describes three examples by references to Figures 2-5. The first example is depicted in Figures 2 and 3 and described at page 8 line 1 – page 12 line 11. I reproduce Figure 3 annotated to show the position of the first, second and third cyclones:



119. Detritus-containing air flows in through the air-suction port 13 and around the inner barrel of the first cyclone 20 (which is also the outer barrel of the second cyclone). As the airflow swirls along the first cyclone, relatively large particles are separated by centrifugal forces and pass through the discharge port 14 into a first dust-collecting unit 41 (not shown in Figure 3). The airflow then reverses axial direction, and swirls with increased tangential velocity into the second cyclone with the effect that medium sized particles remaining in the airflow are subjected to higher centrifugal forces. These are separated and pass through the discharge port 24 into a second dust-collecting unit 42 (again not shown in Figure 3). The airflow again reverses axial direction and swirls with further increased tangential velocity into the third cyclone. Fine dust particles that have not yet been separated by either of the first two cyclones

pass through the discharge port 34 into a third dust-collecting unit 43 (again not shown in Figure 3). The cleaned airflow reverses axial direction once more, and exits the third cyclone chamber through the air-discharge tube 5.

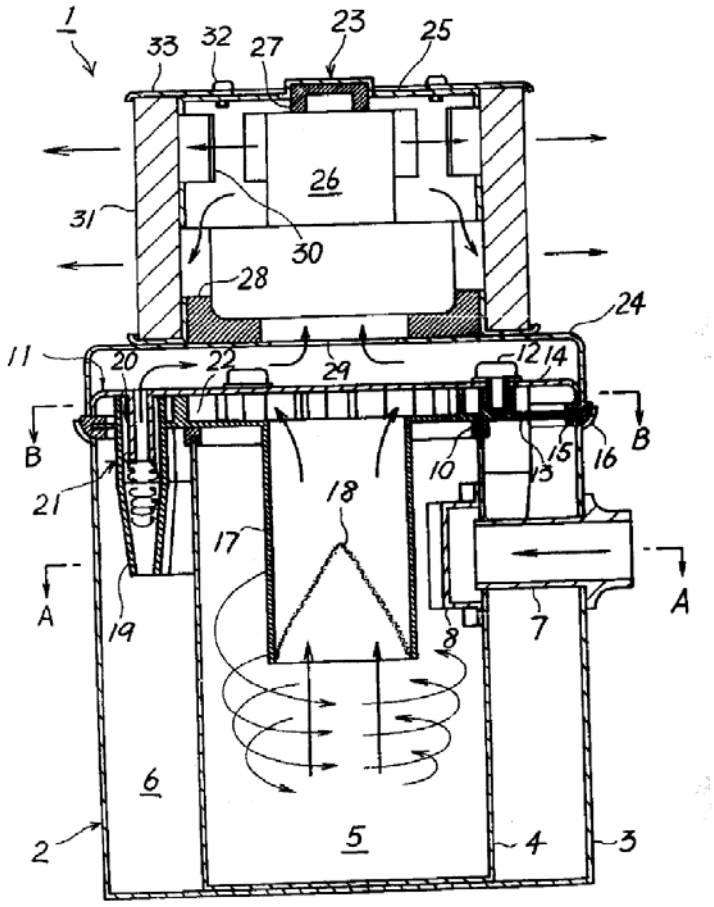
120. The second and third examples are similar to the first, except that greater centrifugal forces are created by making the cyclone chambers "conical" (i.e. frusto-conical). In the second example shown in Figure 4, the second cylindrical cyclone is replaced by a frusto-conical cyclone. In the third example shown in Figure 5, the first and the second cyclones are frusto-conical. In both figures, the third cyclone is cylindrical; but LG states at page 14 lines 21-22 that this too can have a "conical form".

Sanyo

121. Sanyo was published on 2 February 1977. The invention is summarised in the first paragraph as follows (in the agreed translation):

> "The present invention relates to an electric cleaner which is capable of sucking dust by using a double cyclone device as a dust capturing means. More particularly, the present invention relates to an electric cleaner which is provided with a substantially compact double cyclone device, thereby preventing the size thereof from being unnecessary bulk[y]."

122. Sanyo describes a single preferred embodiment by reference by Figures 1-3. I reproduce Figure 1 below:



123. A mixture of dust and air is sucked into the machine through the air suction pipe 7. Can 4 and turn guide pipe 17 form a single large cyclone. A proportion of the dust accumulates in the collecting chamber 5. The air passes through a conical fine filter 18 within the turn guide pipe and is then distributed to a plurality of small cyclones 21 via guide passages 22. The small cyclones collect dust in a collecting chamber 6. The air escapes through exhaust pipes 20, flows through the air blower and is expelled to the surrounding atmosphere via exhaust hole 30 and exhaust filter 31. It can be seen from Figure 1 that the single large cyclone is cylindrical, whereas the small cyclones are frusto-conical.

124. Sanyo describes the function of the filter 18 in the following passage at page 6 lines 3-6:

> "Even if the air flows within the intermediate cover 11 through the turn guide pipe 17, a predetermined amount of dust still remaining in the air is caught by means of the fine filter 18."

Sanyo goes on shortly afterwards to say that the small cyclones can separate "even a relatively fine dust".

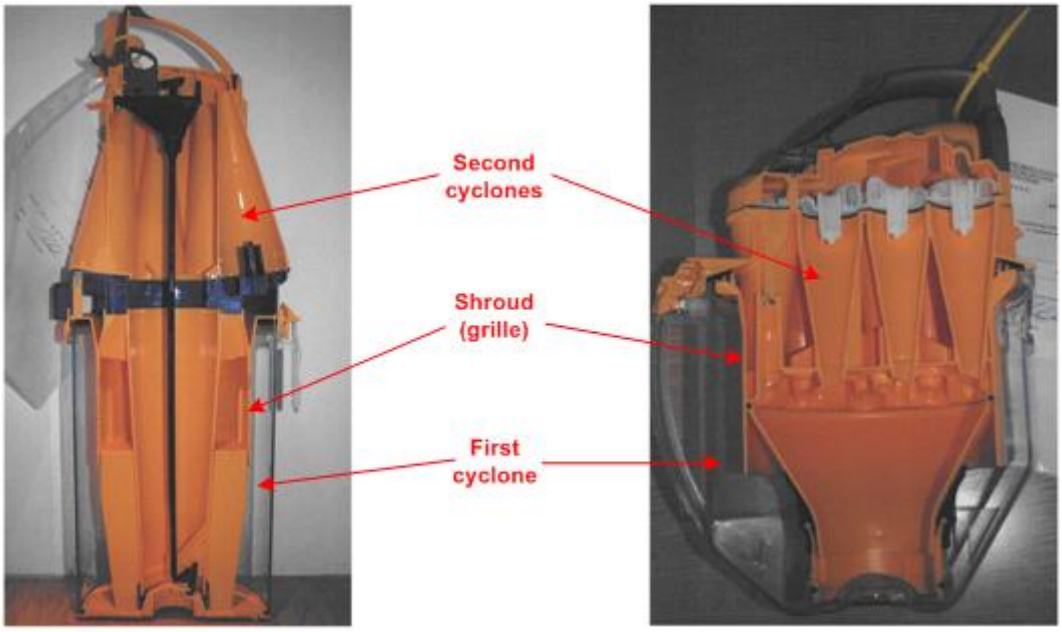
DC07 and DC08

125. The DC07 is an upright vacuum cleaner and the DC08 is a cylinder or canister vacuum cleaner. They were first sold in the United Kingdom in June 2001 and April 2002 respectively. They were also sold in a number of other countries. Both were successful: by the end of 2004 Dyson had sold some 2,846,500 DC07s and 785,400 DC08s. The DC07 and DC08 have very similar dust collection systems, which Dyson referred to as its "Root Cyclone Technology". It is agreed that both were common general knowledge at the priority date.

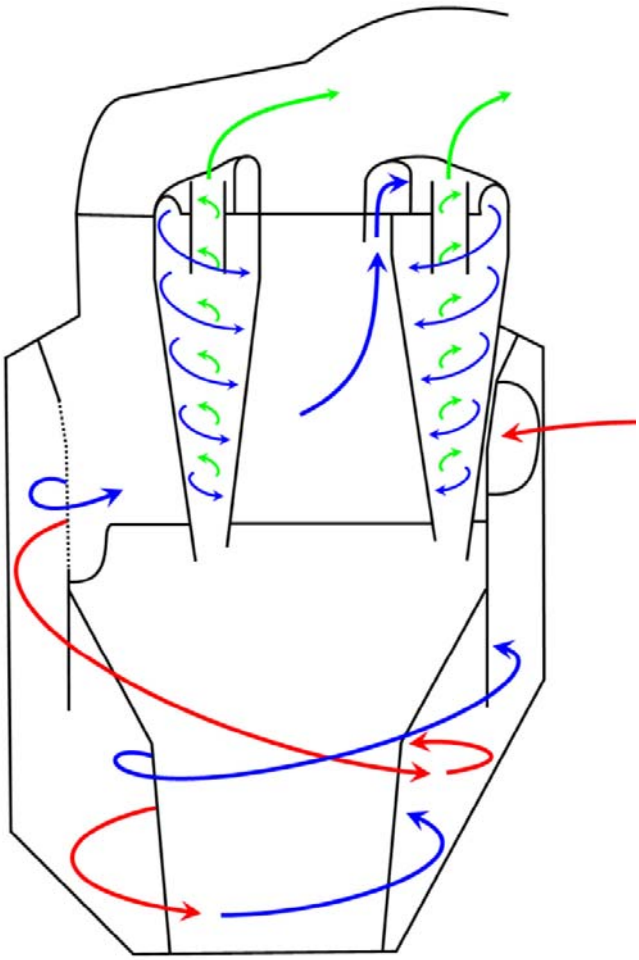
126. Each has a large, reverse flow cylindrical cyclone, followed by a grille, followed by a plurality of frusto-conical reverse flow cyclones connected in parallel. Dust-laden air enters the cylindrical cyclone tangentially, and large debris is separated from the airflow and deposited at the base of the cyclone. The airflow reverses axially, and travels upwards and through the grille. The airflow then divides evenly between the array of parallel cyclones, and fine dust particles are subjected to high centrifugal forces that separate them from the airflow. All of the parallel cyclones deposit dust into a common collection chamber, arranged coaxially within the large, cylindrical cyclone. Clean air exits the parallel cyclones into a common outlet region.

127. These photographs show sections through the DC07 and DC08 dust collection systems:

DC07 **DC08**



128. This diagram shows the airflow through the DC08:



Novelty

129. As was explained in *Synthon BV v SmithKline Beecham plc* [2005] UKHL 59, [2006] RPC 10, in order for an item of prior art to deprive a patent claim of novelty, two requirements must be satisfied. First, the prior art must disclose subject matter which, if performed, would necessarily infringe that claim. As it was put by the Court of Appeal in *General Tire and Rubber Co v Firestone Tyre and Rubber Co Ltd* [1972] RPC 457 at 486, "[t]he prior inventor must be shown to have planted his flag at the precise destination before the patentee". Secondly, the prior art must disclose that subject matter sufficiently to enable the skilled addressee to perform it. In the present case the dispute is over the first requirement rather than the second.

130. In *Ranbaxy UK Ltd v Warner-Lambert Co* [2005] EWHC 2142 (Pat), [2006] FSR 14 Pumfrey J said at [52]:

> "It is occasionally said that there cannot be clear and unmistakable directions to do something which is described as optional. I do not agree: to describe the thing as optional is to describe the thing. It is rather like the disclosure of something as adjustable: it necessarily also discloses something that is not adjustable—see *Gillette Safety Razor Co v Anglo-American Trading Co Ltd* (1913) 30 RPC 465."

131. That approach was upheld by the Court of Appeal in its decision that case [2006] EWCA Civ 876, [2007] RPC 4, where Jacob LJ said at [40]:

> "If the claim were valid it would cover one of the alternatives explicitly taught by the citation."

Novelty of '603 over Conrad

132. Dyson alleges that claims 1, 4 and 5 of '603 are all anticipated by Conrad. Samsung disputes this on a number of grounds.

133. The first issue is whether Conrad discloses a "third cyclonic dust separation unit" as required by integer [5] of claim 1. Dyson contends that Conrad expressly discloses the option of a third stage cyclone in two places. First, in the statement at column 4 lines 10-13 (quoted in paragraph 97 above) that the first stage cyclone "may, if desired, comprise a plurality of individual cyclones … in sequence". As is common ground, if the first stage comprises two cyclones in sequence, there will be three stages of cyclones in total. Secondly, in the statement at column 5 lines 26-28 (quoted in paragraph 100 above) that air from the second stage cyclones "may be fed, if desired, to … third stage cyclones".

134. In relation to the first passage, Samsung relies on the fact that the following sentence states that only one first stage cyclone is preferred. Samsung reinforces this by pointing out that the whole thrust of Conrad is that the inventors claim to have found a way of avoiding excessive pressure drop by using an electronic filter instead of a HEPA filter. Accordingly, Samsung contends, the skilled reader would not want to include a third stage cyclone when implementing Conrad. Furthermore, Samsung contends that, if the skilled reader searched Conrad for a reason for adding another

first stage cyclone, the skilled reader would conclude from the passage at column 2 lines 43-46 (discussed in paragraph 102(iiii) above) that Conrad wrongly thought that high efficiency cyclones were not capable of separating large particles and would discount this.

135. In my judgment none of Samsung's points is an answer to Dyson's novelty attack. Conrad expressly discloses the option of having a first stage comprising at least two cyclones in series, and thus a total of three cyclonic separators in series, albeit that it is not a preferred option. Samsung's arguments go to the obviousness or otherwise of adopting the less preferred option, but do not alter the fact that it is disclosed. I would add that I am not persuaded that the skilled reader would think that the passage at column 2 lines 43-46 was relevant to this disclosure anyway.

136. In relation to the second passage relied on by Dyson, Samsung contends that the skilled person would disregard it as being technically flawed on the basis that he would know that cyclones cannot separate particles as small as those separated by HEPA filters.

137. In my judgment this argument involves a misreading of this passage. Conrad gives two options, one of which is to use third stage cyclones and the other of which is to use a HEPA filter. Conrad does not say that third stage cyclones may be used instead of a HEPA filter to do the same job, and the skilled reader would be well aware that that was not possible. Accordingly, the skilled reader would understand that the two options were independent options. Again, therefore, Conrad expressly discloses the option of three stages of cyclones.

138. The second issue is whether Conrad discloses that the three cyclonic dust separation units are "for sequentially separating dust particles … according to their size" as required by integer [5] of claim 1. On the construction of these words which I have adopted above, this requirement would be satisfied by the three stages of cyclones disclosed by Conrad.

139. The third issue is whether Conrad discloses that the third cyclonic dust separation unit comprises a plurality of cyclone chambers as required by integer [6] of claim 1. If the first stage comprises two cyclones in series in accordance with the first passage relied on by Dyson, the second stage cyclones 60 will in fact be third stage cyclones. The second passage expressly discloses "additional cyclone*s* (i.e. third stage cyclone*s*) [emphasis added]". In both cases, therefore, this feature is disclosed.

140. The fourth issue is whether Conrad discloses the ducting arrangements which are the subject of integers [2]-[4] of claim 4 and [7]-[9] of claim 5. Although Dyson asserts that these claims are anticipated, it has not identified any specific passages as disclosing these features. In fact, as Mr Harris accepted in cross-examination, what Conrad appears to disclose is the use of a plenum chamber-type arrangement.

141. Accordingly, I conclude that Conrad anticipates claim 1 of '603, but not claims 4 or 5.

Novelty of '606 over Gamou

142. Dyson alleges that claim 9 of '606 is anticipated by the second embodiment of Gamou. Samsung disputes this on a number of grounds.

143. The first issue is whether the second embodiment of Gamou is a "vacuum cleaner" as required by integer [1] of claim 1. On the interpretation of that term I have adopted above, it is, at least when the dust is collected in an auxiliary bag.

144. The second issue is whether the second embodiment of Gamou has second and third cyclones "for separating dust from the air" as required by integers [6] and [7] of claim 9. On the construction of those words I have adopted above, it does. The separated dust is contained in a scavenge airflow, but nevertheless it is separated from the cleaned airflow.

145. The third issue is whether the second embodiment of Gamou has third cyclones for separating dust "from the air discharged from the or each second cyclone" as required by integer [7] of claim 9. Samsung contends that this means that the partially cleaned air from the second stage enters the third stage for further cleaning, and that the second embodiment of Gamou does not achieve this. Dyson argues that this is reading a requirement into the claim that is not actually there.

146. In my judgment Samsung is correct. In context and having regard to the inventors' purpose, "the air discharged from the or each second cyclone" must refer to the partially cleaned air from which the dust has been separated. In the second embodiment of Gamou, the partially cleaned air discharged from the second cyclones (the separators 70) is exhausted to the atmosphere and does not pass through the third cyclones (the separators 70'). It is only the dust-laden scavenge airflow that passes through the third cyclones. Another way of putting this is that, although I have accepted that "separating dust from the air" extends to concentrating dust in a scavenge airflow and thereby separating it from the cleaned airflow, if the claim is read in that way, it follows that the scavenge airflow is the "dust" and the cleaned airflow is the "air". Accordingly, integer [7] is not present in the second embodiment of Gamou because the third cyclones do not separate dust from the "air" from the second cyclones, but instead separate air from the "dust".

147. The fourth issue is whether in the second embodiment of Gamou the first, second and third cyclones have increasingly smaller diameters as required by integer [8] of claim 9. There is no dispute that the second and third cyclones are of smaller diameter than the first, but Samsung contends that Gamou discloses that the second and third cyclones are of the same size or at the very least is unclear. In support of this contention Samsung relies upon the passage at column 7 lines 37-39 (quoted in paragraph 115 above).

148. In my judgment the passage relied upon by Samsung means that the separators 70' are of the same design as the separators 70, but not necessarily of the same size. In Figure 16 they appear to be slightly smaller, whereas in Figure 14 they appear to be about the same size. In my view no conclusion can be drawn either way from the Figures given that they appear to be different in this respect and are schematic anyway. More importantly, as Professor Allen accepted in cross-examination, given the stated 80:20 split in airflow and the fact that the second embodiment has six separators 70 and three separators 70' as shown in Figure 17, one can calculate that the flow rate through each of the separators 70' is 40% of the flow rate through the separators 70. Since (as Samsung accepts) the separation efficiencies of separators 70' must be at least as good as the separation efficiencies of separators 70, it follows that the

diameters of separators 70' must be smaller than those of separators 70. Accordingly this requirement of the claim is satisfied.

149. Thus I conclude that claim 9 is not anticipated by Gamou, but only for one of the four reasons advanced by Samsung.

Obviousness

150. A patent will be invalid for lack of inventive step if the invention claimed in it was obvious to a person skilled in the art having regard to the state of the art at the priority date. The familiar structured approach to the assessment of allegations of obviousness first articulated by the Court of Appeal in *Windsurfing International Inc v Tabur Marine (Great Britain) Ltd* [1985] RPC 59 has recently been re-stated by Jacob LJ in *Pozzoli v BDMO SA* [2007] EWCA Civ 588, [2007] FSR 37 at [23] as follows:

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

151. In both *H. Lundbeck A/S v Generics (UK) Ltd* [2008] EWCA Civ 311, [2008] RPC 19 at [24] and *Conor Medsystems Inc v Angiotech Pharmaceuticals Inc* [2008] UKHL 49, [2008] RPC 28 at [42] Lord Hoffmann approved without qualification the following statement of principle by Kitchin J at first instance in the former case:

> "The question of obviousness must be considered on the facts of each case. The court must consider the weight to be attached to any particular factor in the light of all the relevant circumstances. These may include such matters as the motive to find a solution to the problem the patent addresses, the number and extent of the possible avenues of research, the effort involved in pursuing them and the expectation of success."

152. What matters is whether or not the invention was technically obvious, not whether it was commercially obvious: see *Hallen Co v Brabantia (UK) Ltd* [1991] RPC 195 at 213. This does not necessarily mean that commercial considerations are irrelevant. The mindset of the skilled person may be conditioned by commercial considerations only to consider certain types of technical solutions, as in *Dyson v Hoover*.

153. In considering whether an invention is technically obvious, it may sometimes be important to consider whether the addressee would have a prejudice against taking a particular step. As Pumfrey J explained in *Glaxo Group Ltd's Patent* [2004] EWHC 477 (Pat), [2004] RPC 43 at [30]:

> "Such a prejudice may be a merely commercial one ('this device won't sell') or it may be a technical one ('this won't work and it is not worth bothering with'). A 20-year monopoly is conferred for overcoming a prejudice of the second kind, but not for overcoming a commercial prejudice (see *Hallen Co v Brabantia (UK) Ltd* [1999] RPC 307 (Aldous J)). A technical prejudice must be general: it is not enough that some persons actually engaged in the art at the material time labour under a particular prejudice if a substantial number of others do not. A prejudice which is insufficiently widespread for it properly to be regarded as commonly shared will not, in my view, be attributed to the notional skilled person. As Jacob J put it in *Union Carbide v BP* (above at p. 16):
>
> > 'It is not good enough to show that a matter was known to some but not to others and in particular it is not good enough to show that knowledge (or a prejudice) was confined to one or a limited class of suggested exemplars of the skilled man.'"

154. More recently, in *Pozzoli* Jacob LJ said:

> "25. … There is an intellectual oddity about anti-obviousness or anti-anticipation arguments based on 'technical prejudice.' It is this: a prejudice can only come into play once you have had the idea. You cannot reject an idea as technically unfeasible or impractical unless you have had it first. And if you have had it first, how can the idea be anything other than old or obvious? Yet when a patent demonstrates that an established prejudice is unfounded – that what was considered unfeasible does in fact work, it would be contrary to the point of the patent system to hold the disclosure unpatentable.
>
> 26. I put it this way in *Union Carbide v BP* [1998] RPC 1, 13:
>
> > 'Invention can lie in finding out that that which those in the art thought ought not be done, ought to be done. From the point of view of the purpose of patent law it would be odd if there were no patent incentive for those who investigate the prejudices of the prior art.'
>
> 27. Patentability is justified because the prior idea which was thought not to work must, as a piece of prior art, be taken as it would be understood by the person skilled in the art. He will read it with the prejudice of such a person. So that which forms part of the state of the art really consists of two things in combination, the idea and the prejudice that it would not work or be impractical. A patentee who contributes something new by showing that, contrary to the mistaken prejudice, the idea will work or is practical has shown something new.

> He has shown that an apparent 'lion in the path' is merely a paper tiger. Then his contribution is novel and non-obvious and he deserves his patent.
>
> 28. Where, however, the patentee merely patents an old idea thought not to work or to be practical and does not explain how or why, contrary to the prejudice, that it does work or is practical, things are different. Then his patent contributes nothing to human knowledge. The lion remains at least apparent (it may even be real) and the patent cannot be justified.
>
> 29. This analysis does not require a different way of looking at the inventive concept depending on whether or not the patentee has shown the prejudice is unjustified as the Judge thought at [67]. It is simply that in the former case the patentee has disclosed something novel and non-obvious, and in the latter not. The inventive concept, as I have said, is the essence of what is in the claim and not dependent on any question about a prejudice being overcome."

155. Counsel for Samsung submitted that the first sentence of paragraph [28] is no longer good law in the light of the subsequent decision of the House of Lords in *Conor v Angiotech*, where Lord Hoffmann said at [19]:

> "There is no requirement in the EPC or the statute that the specification must demonstrate by experiment that the invention will work or explain why it will work."

156. Counsel for Dyson accepted that Jacob LJ's wording required some adjustment. He submitted that, although it was not necessary for the patent to explain "how or why, contrary to the prejudice, that it does work or is practical", it was necessary for the disclosure in the patent to make it plausible that the invention would work or be practical contrary to the prejudice. In support of this submission he relied on what Lord Hoffmann said at [37]:

> "… there is in my opinion no reason as a matter of principle why, if a specification passes the threshold test of disclosing enough to make the invention plausible, the question of obviousness should be subject to a different test according to the amount of evidence which the patentee presents to justify a conclusion that his patent will work."

157. I accept the submission of counsel for Dyson subject to the rider that I do not believe that the patent must expressly address the prejudice, although a failure to mention any prejudice in the specification may be of evidential significance.

158. The primary evidence as to obviousness is that of properly qualified experts and secondary evidence needs to be kept in its place: see *Mölnlycke AB v Procter & Gamble Ltd* [1994] RPC 49 at pages 112-114. It is permissible for the experts to opine on the ultimate question i.e. whether or not the invention is obvious, but such conclusions in themselves are of little value. What matters are the experts' reasons for their opinion: see *Technip's Patent* at [12]-[16].

The inventive concepts

159. The inventive concept is defined by the claim and not by some vague paraphrase based on the extent of the disclosure in the description: see *Conor* at [19]. Nevertheless, it is often useful when considering obviousness to try and summarise the claim in a way which eliminates excess verbiage. In the present case I would summarise the inventive concepts of the A list claims as I have construed them as follows.

160. *'603 claim 1*. A vacuum cleaner with at least three cyclonic dust separation units in series which are suitable for sequentially separating dust from the air according to size and in which the third unit comprises a plurality of cyclones.

161. *'603 claims 4 and 5*. The inventive concept of these claims is essentially the same. It is a vacuum cleaner according to claim 1 with a particular ducting arrangement between the second and third stages, referred to at trial as the "mushroom".

162. *'603 claim 19*. The inventive concept of this claim is essentially the same as that of claim 1 except that the first unit includes a grille.

163. *'606 claim 9*. The inventive concept of this claim is essentially the same as that of '603 claim 1 with the addition that the diameters of the cyclones are progressively smaller.

164. *'606 claim 14*. This adds the requirement that air from the second stage enters the third stage without mixing with other air

165. *'606 claims 19 and 20*. The inventive concepts of these claims are largely the same. They add requirements that the cyclone chambers be independently formed from each other and that they have a particular spatial relationship with each other.

Was there a technical prejudice against increasing the pressure drop?

166. Before proceeding further, it is convenient next to consider two related issues which are central to the dispute on obviousness. The first is that Samsung contends a skilled person who had the idea of putting three cyclones in series in March 2005 would have considered that the idea was not worth pursuing because of a technical prejudice against increasing the pressure drop over that encountered with two cyclones in series. Professor Allen expressed this point in his first report at paragraph 3-4 as follows:

> "The obvious response of individuals skilled in the art to a proposal to incorporate three series cyclones into a vacuum cleaner would be - **why would I want to do that? - The pressure drop would be too high.** In saying this I mean that the idea of having three stages in series might occur or be suggested in a casual way but that it would be dismissed by the person skilled in the art as not a sensible way forward on the grounds that it would mean too high a pressure drop across the vacuum cleaner."

167. In my judgment the evidence does not establish that a skilled person would be deterred from pursuing the idea of three cyclones in series by a prejudice against increasing the pressure drop. Apart from Professor Allen's opinion, there is no evidence supporting the existence of such a prejudice and a considerable amount of evidence pointing the other way. I will come to Professor Allen's reasons for espousing this opinion below, but even on its face his first report is unconvincing in its suggestion that there was such a prejudice amongst skilled persons. Thus at paragraph 3-10 he said (emphases added):

> "… in the twenty six years between the publication of the original Dyson Patent and the filing of the Samsung Patent the concept of three stage cyclone collection in vacuum cleaners has not been *widely* discussed, not *explicitly* patented and no *significant* commercial position was established by any vacuum cleaner manufacturer using three stage technology *of the type under consideration*."

168. Beginning with the common general knowledge, Chapter 16 of Hoffmann & Stein is entitled "Multicyclone Arrangements". In the first page of this chapter the authors say:

> "In this chapter we wish to briefly discuss two types of multi-unit arrangements used in cyclone and swirl tube installations in industry. We also give some guidelines for the choice of arrangement in a given arrangement including a worked example given in Appendix 16A. In addition, we briefly describe how to apply the modelling equations outlined in previous chapters to multicyclone arrangements.
>
> There are many situations where one cyclone or swirl tube is inadequate for the separation task in hand. In such situations, it is often feasible to use multiple units either in series or in parallel or both.
>
> 16.1 Cyclones in Series
>
> When the solids concentration is high, and the emission from just one separator would be too high, second – or even a third – separator can be added in series with the first stage separator to collect additional solids. Such an arrangement is sketched in Fig. 16.1 [which shows three cyclones in series]. It is customary to refer to the individual stages as the 'primary', 'secondary' and 'tertiary' stages or as the 'first', 'second' and 'third' stage."

169. Later in the same chapter the authors state:

> "A simplified vessel plan of two parallel sets of three-stage cyclones is presented in Fig. 16.8. Such parallel and series arrangements are very commonly found in fluid catalytic cracking units (FCCU) and similar fluid bed processing units."

170. When he was cross-examined on these passages, Professor Allen accepted that the skilled person would know as a matter of common general knowledge that three stage cyclones were used in industry, although he did not agree that the specific arrangements shown in Figs 16.1 and 16.8 were common general knowledge even to industrial cyclone designers. There is no suggestion anywhere in Chapter 16 of Hoffmann & Stein of any prejudice against increasing the pressure drop by placing three cyclones in series.

171. Turning to the patent literature on cyclonic vacuum cleaners, the patents in evidence provide no support for the existence of a prejudice against increasing the pressure drop by adding a third stage of cyclones either. Neither of the Patents mentions any such prejudice. Nor does LG, which discloses three cyclones in series. Conrad is concerned to avoid excessive pressure drop, but nevertheless suggests that third stage cyclones may be added.

172. As for the "commercial position" referred to by Professor Allen, he accepted in cross-examination that the skilled person would be aware that Hoover had launched a vacuum cleaner called the Triple Vortex which was the subject of the well-publicised *Dyson v Hoover* litigation and which, as the name implies, had three cyclones in series. (As Professor Allen pointed out, there was considerable dispute in the *Dyson v Hoover* case as to the precise function of the second stage cyclone, and the machine was found to infringe a Dyson patent for a dual cyclone appliance; but in my view that is immaterial for present purposes.)

173. Turning to Professor Allen's reasons, the principal technical reason he gives in his first report for the existence of the prejudice is that an increased pressure drop would either lead to a reduced gas flow, and hence reduced suction, or require a more powerful and expensive fan. Again, even taking his report at face value, I do not find this persuasive. Thus in paragraph 3-9 he said in relation to the Dyson two stage designs:

> "Opinions of such designs would vary depending upon the experience of the person skilled in the art. At one extreme, many would also regard these as requiring a great deal of extra engineering and so see them as over-complex and expensive. On the other hand, others would recognise that there is a trade-off between the extra dust collection achieved by the second stage and the price played in terms of increased pressure drop and the more expensive fan set. In this latter case, the two stage cyclone would be seen as superior technology but, given the common general knowledge of the person skilled in the art, I do not believe that the idea of simply adding yet another stage would naturally or obviously follow to an uninventive individual."

174. Given that the skilled person would recognise that there is a trade-off between collection efficiency and pressure drop (and hence suction) in the case of two stages of cyclones, it is difficult to see why he should regard adding a third stage any differently. This is particularly so when it is appreciated that, as the skilled person was aware, vacuum cleaners on the market in 2005 varied considerably in suction power. It follows that, as Professor Allen accepted, the skilled person would know that he had a substantial pressure drop "budget" to use as he saw fit:

"Q. So the amount of headroom or the pressure budget, I think you refer to, is very, very substantial, is it not?
A. Yes.
Q. As far as I can see, if you happen to be running a product which had a suction of 400 air watts, you could come down to a matter of 150-200 and still have a commercial product?
A. Or you could clean someone's room and use less energy. It is a budget for you to spend as you will.
Q. I am sorry?
A. It is a budget of pressure for you spend as you will."

175. Mr Harris disagreed with Professor Allen's opinion, as he explained in his third report:

"5.1 In paragraphs 3-4 to 3-6 of his first report, Professor Allen comments on the skilled person's response to the idea of using three stages of cyclonic separation in a vacuum cleaner. The primary basis for these comments is a suggestion that the skilled person would consider the pressure drop across three stages of cyclone to be too high. I disagree with this suggestion. The skilled person would be well aware that a third stage of cyclones has the potential to improve the separation efficiency of the whole system.

5.2 As I have mentioned in paragraph 3.9 of my first expert report, and explained in a little more detail in paragraph 3.10, pressure drop across a cyclone system can be traded against separation efficiency by increasing the inlet and outlet areas in the first and second stages. The skilled person would know this because the same issue had been resolved during the development of two stage cyclones. Taking the cyclonic system as a whole, the skilled person would know how to make adjustments so that the total pressure drop would be acceptable. The skilled person would know that there would be no need to use a more powerful fan."

176. This evidence was not seriously challenged. It was not even put to Mr Harris in cross-examination that there was a prejudice against increasing the pressure drop which would deter the skilled person from adding a third stage cyclone. Instead, the cross-examination proceeded as follows:

"Q. Adding an additional stage of cyclone separation -- I think we have done this -- without more, must increase the pressure drop.
A. Yes. If you simply add it, yes, it will.
Q. The skilled person would not, therefore, add an additional stage of cyclone separation unless he believed he would gain an appreciable benefit to make up for the additional pressure drop?
A. Yes, it is a trade-off between pressure, the separation efficiency and how much suction power and cleaning ability you get at the hose in the vacuum cleaner.
Q. I think we have already covered this. At page 8 of your

report, the short paragraph 3.9.

A. Yes.

Q. You have already said, have you not, that you can compensate using, changing the inlet and outlet areas but there comes a limit on how much you can do that?

A. Yes.

Q. If you do compensate using the inlet and outlet areas you will of course change the collection efficiency?

A. Yes.

Q. However much you tune that new additional cyclone, you cannot eliminate its pressure drop entirely?

A. No, you cannot.

Q. If you are trying to get comparable pressure drop, what you would need to do is tune the other cyclones that were already there, altering their efficiency, so that overall you can reduce the pressure drop?

A. It depends. If you had a very highly powerful vacuum cleaner in the first place that had a lot of suction power and you were prepared to make it have a lower suction power, then you could not necessarily tune the other cyclones, you could add one."

177. Even if the skilled person thought that moving to three stages of cyclones would require a more powerful, and hence more expensive, fan, that is a commercial and not a technical consideration. The same is true of other factors mentioned by Professor Allen in his report, such as that three stages of cyclones would require more complex, and hence more expensive, mouldings.

178. Samsung also relied upon the evidence of Mr Kim, who said that he and his co-inventors "were fearful at first to have three cyclone stages because we expected this to increase the pressure drop". Despite this expectation, however, they proceeded to make sketches of three cyclone designs and then to model them using CFD software. They did not say to themselves, in Pumfrey J's words, "[t]his won't work and it is not worth bothering with". There is nothing to suggest that their approach was different to that which any other skilled person would have adopted.

Obviousness of three stages of cyclones generally

179. Samsung also contends that, even if there was no technical prejudice against increasing the pressure drop by adding a third stage of cyclones, it was not an obvious step for a skilled person to take in the light of his common general knowledge. Consistently with the cross-examination of Mr Harris quoted above, counsel for Samsung submitted that the skilled person would not have taken the step of adding a third stage unless he perceived an appreciable benefit from doing so, and that he would not have perceived any such benefit. I accept the first part of this submission, but not the second. As explained in paragraphs 13 and 64 above, it was well known that adding a second stage would generally improve the overall separation efficiency. As suggested by the passage from Hoffmann & Stein set out in paragraph 168 above, and as Professor Allen accepted subject to the qualification that the grade efficiency curve and particle size distribution were reasonably coincident, the skilled person

would appreciate that adding a third stage would further improve the overall separation efficiency.

180. Having reached this conclusion, it is not necessary for me to deal with two other reasons identified by Mr Harris as to why a skilled person would regard adding a third stage as potentially beneficial or Samsung's criticisms of those reasons. I will, however, record that the first, referred to as the "solids loading effect", resulted in a complicated, and to my mind inconclusive, dispute between the experts.

181. Apart from these technical points, the principal argument deployed by Samsung in support of the contention that adopting three stages of cyclones was not obvious was the question "why wasn't it done before?". This is always a pertinent question, but in the present case I do not find it persuasive for the following reasons.

182. First, as I have related, three stage cyclones had in fact been both suggested and actually used before not only in industry but also specifically in vacuum cleaners.

183. Secondly, as Professor Allen said, a three stage design is likely to be more complicated and expensive than a two stage design. It is therefore not surprising that vacuum cleaner manufacturers should have concentrated on improving their one and two stage designs before moving onto three stage ones. This is what Dyson itself did: as Mr Harris explained, during the time he worked there, Dyson's focus was on reducing the pressure drop in its machines. This was because, while Dyson was the market leader in terms of separation efficiency and in terms of not losing suction, its machines had lower suction power than many of its competitors. This was one of the key reasons for the use of parallel second stage cyclones in the DC07 and DC08.

184. Thirdly, I believe that many manufacturers will have wanted to play safe, particularly after Hoover's experience with the Triple Vortex, by concentrating on single stage designs which did not risk infringing Dyson's dual cyclone patent.

185. More specifically, Samsung relies upon the fact that, shortly after the priority date of the Patents, Dyson itself filed patent applications (UK Patent Applications Nos. 2 426 473A and 2 426 726A and, subsequently, International Applications Nos. WO2006/125946 and WO2006/125945) for vacuum cleaners with three stage cyclones. Samsung says that this shows that the leading manufacturer of cyclonic cleaners thought that there could be invention in using three stage cyclones and therefore it cannot have been obvious. I am not persuaded by this secondary evidence in view of all the other evidence pointing the other way. I would add that I was informed by counsel for Dyson that it accepted that the UK applications were not valid and was withdrawing them.

Obviousness over Conrad

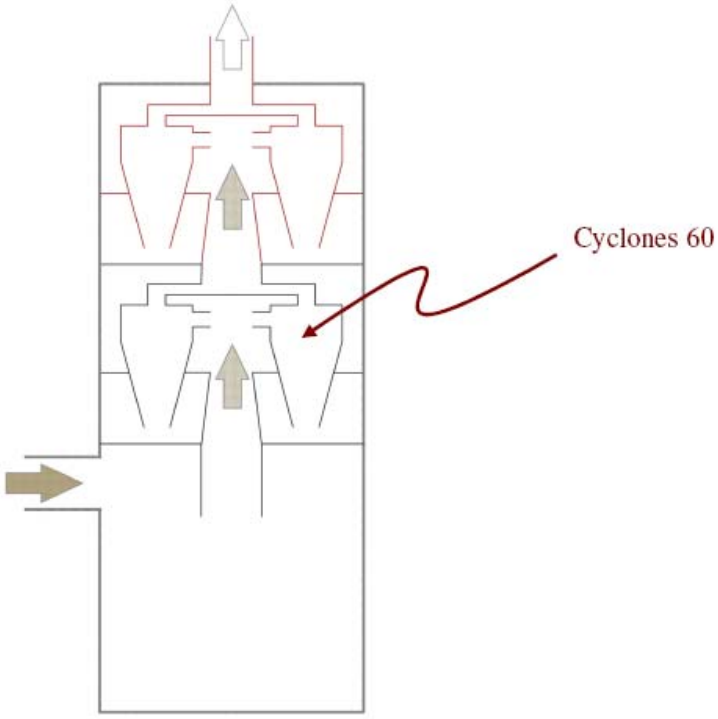
186. Dyson contends that claims 1, 4, 5 and 19 of '603 and claims 9 and 14 of '606 are obvious over Conrad. Since I have held that claim 1 is anticipated, it is only necessary to consider claims 4, 5 and 19 of '603 and claims 9 and 14 of '606.

187. Before addressing these, it is convenient to deal with a general point about Conrad. This is that Dyson contends that it would be obvious to discard the electronic filter since it was common ground between the experts that the skilled person would not

think that the electronic filter would be likely to offer any real advantage. (Indeed, Professor Allen, who has considerable experience of electrostatic precipitators, gave evidence that it would be difficult if not impossible to make Conrad's device work as described. This is because, in order to collect significant quantities of fine particles, large collection plates would be required and it would not be practicable to make them sufficiently compact. Although Mr Harris did not dispute this, given that it is common ground that the addressee of the Patents would not be an expert on electrostatic precipitators, I do not think that this is something that would be apparent to the skilled reader.)

188. In my judgment, it would not be obvious to the skilled reader to discard the electronic filter. The addition of the electronic filter is the core of the invention in Conrad. As Professor Allen said, if the skilled person were to discard that, he would be likely to discard the entire document. Certainly, I cannot see that it would be obvious to discard the central teaching but retain the remainder. On the other hand, the skilled reader would appreciate that Conrad is using the electronic filter in substitution for (or in addition to) a HEPA filter.

189. The starting point for Dyson's attack on the subsidiary claims of '603 is to consider how the skilled reader who chose to implement the disclosure of third stage cyclones at column 5 lines 26-28 would do so. Mr Harris gave unchallenged evidence that an obvious way to implement this would be to replicate the second stage. The result of this is shown schematically in the following diagram:

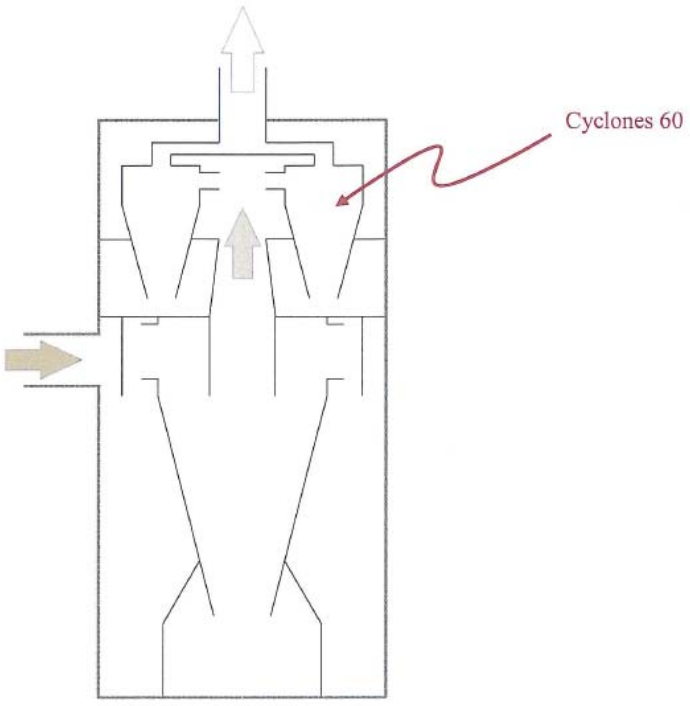


190. This diagram omits the electronic filter. If Conrad's disclosure is followed, the electronic filter would be between the second and third stages. In my judgment, however, it would also be obvious to place the electronic filter after the third stage cyclones, since this would simply represent an extension of Conrad's teaching in relation to the Figure 3 embodiment.

191. *Claims 4 and 5 of '603*. The difference between the inventive concept of these claims and the arrangement shown above is the mushroom ducting. In my judgment it would be entirely obvious to the skilled person to put a T-shaped (in cross-section) pipe into the third stage of the arrangement so as to distribute the airflow evenly between the cyclones. This would simply require application of his common general knowledge about parallel cyclones and routine plumbing. Professor Allen expressed the opinion that this would be quite a clever thought, but he gave no real reason for this view. Although I have not accepted that the arrangement shown in Figure 16.7 of Hoffmann & Stein was common general knowledge, there is no suggestion in the book that there was anything remotely inventive about it.

192. *Claim 19 of '603*. The difference between the inventive concept of this claim and the arrangement shown above is the addition of a grille to the first stage. Samsung does not dispute that that would be an obvious step. Samsung contends that that would not bring one within claim 19, however, for a different reason. This is that Samsung contends that claim 19 excludes an electronic filter because the air leaving the second dust separation unit must enter the third dust separation unit. I do not accept this: the claim does not require that there be nothing between the second and third units. Moreover, as noted above, it was Professor Allen's evidence that the electronic filter would not work. In any event, even if this is the correct construction of claim 19, it would not exclude the obvious modification of Conrad in which the electronic filter is placed after the third stage cyclones.

193. The starting point for Dyson's attack on the subsidiary claims of '606 is to consider how the skilled reader who chose to implement the disclosure of two first stage cyclones at column 4 lines 10-12 would do so. Mr Harris gave unchallenged evidence that an obvious way to implement this would be to locate the second cyclone within the first in the same way as was done, for example, in the Dyson DC04 and DC05 machines. The result of this is shown schematically in the following diagram (which again omits the electronic filter):



194. *Claim 9 of '606.* In the arrangement shown above the three stages of cyclones are of progressively smaller diameter as required by this claim. Accordingly this claim is obvious.

195. *Claim 14 of '606.* In the arrangement shown above the air discharged from the second stage cyclone chamber enters the third stage cyclone chambers without mixing with other air. Accordingly this claim is obvious.

Obviousness over Gamou

196. Dyson contends that claims 9, 19 and 20 of '606 are obvious over the second embodiment of Gamou. Although Dyson opened a case of obviousness of '603 in the light of Gamou, it did not pursue that case in its closing submissions. This is significant, since the basis of that case was that it would be obvious to replace the axial flow second and third stage cyclones of the second embodiment with frusto-conical reverse flow cyclones as employed in Gamou's third embodiment.

197. *Claim 9 of '606*. The difference between the second embodiment of Gamou and this claim is that, as explained above, Gamou does not fulfil the requirement of integer [7] for a plurality of third cyclones for separating dust from the air discharged from the second cyclones. In my judgment it would not be obvious to modify Gamou in a way which would satisfy this requirement. To do so, it would be necessary to change the third stage cyclones in precisely the way that Dyson no longer contends would be obvious.

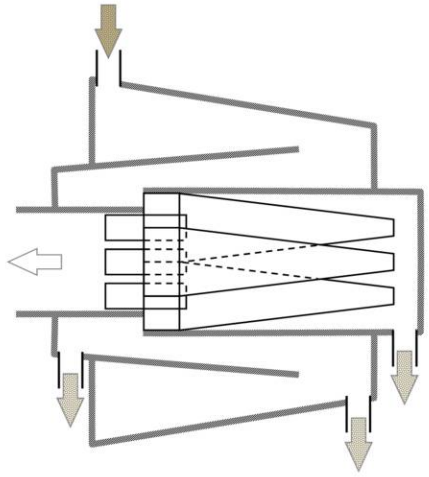
198. *Claims 19 and 20 of '606*. Since these claims are either dependent on claim 9 or include the same features they are not obvious either.

Obviousness over LG

199. Dyson contends that claim 1 of '603 and claims 9 and 14 of '606 are obvious in the light of LG.

200. Before addressing the question of obviousness, it is necessary to consider a preliminary point about LG. Samsung contends that, although LG says in terms that the three cyclones separate large, medium and fine dust respectively, it would not actually work. This contention was supported by Professor Allen, who opined that the vortex velocity would degenerate exponentially as it passed through the unit and that the reduction in cyclone diameter was not sufficient to compensate for this, with the result that the centrifugal force would reduce rather than increase. This evidence, however, was based on treating Figure 3 as a blueprint, taking measurements from it and using them as the basis for calculations, rather than treating it as the schematic diagram which it plainly is. Moreover, it was adopting a critical approach to LG rather than an approach of considering whether it could be made to work. In any event, Professor Allen accepted in cross-examination that LG could probably be made to work to the extent that the average particle size separated by the three cyclones would be progressively smaller even if the separation efficiency of those cyclones did not increase. This accords with the evidence of Mr Harris, which was that the vortex degeneration would be tolerable provided that the design was not too long compared to its diameter, and thus in his opinion the device could be made to work.

201. It is common ground that LG discloses three cyclones in series. Dyson contends that it would be obvious to modify LG by substituting a set of parallel cyclones for the third cyclone as shown schematically in the following diagram based on Figure 5 of LG:



202. As Professor Allen accepted, in 2005 it was common general knowledge that there was a benefit in substituting parallel cyclones for a single cyclone in terms of the trade off between collection efficiency and pressure drop. At first blush, this appears to support the suggestion it would be obvious to modify LG in this way. Against this, however, Samsung advances two main arguments as to why it would not be obvious.

203. First, Samsung contends that the pressure drop would not be reduced but increased if the space occupied by the system is the same and there is no change to the inlet design. Mr Harris accepted that this was correct if those constraints applied. Dyson points out that the skilled person who was modifying LG would not be so constrained, which is true. Nevertheless, what this shows that the reason for substituting parallel cyclones will not apply unless other changes are made. This in itself shows that the modification is not as straightforward as Dyson suggests.

204. Secondly and perhaps more importantly, Samsung relies on Professor Allen's evidence that the effect of making the suggested modification would be that the second cyclone would more or less cease to function. As he pointed out, the LG device involves the air reversing its direction of flow between each stage and relies upon the cyclones having open faces. If a set of parallel cyclones with tangential inlets are substituted for the third cyclone as postulated, the impact will be to damp the airflow in the second cyclone. As Professor Allen put it, "That second chamber is going to much more resemble a pipe than it is a cyclone." Professor Allen did not accept that this could easily be addressed by making other changes.

205. Accordingly, I conclude that modifying LG so as to substitute parallel cyclones for the single third cyclone and yet retain the functionality of the second cyclone would in fact be a far from straightforward exercise. It follows that claim 1 of '603 and claims 9 and 14 of '606 are not obvious in the light of LG.

Obviousness over Sanyo

206. Dyson contends that all of the A list claims of both Patents are obvious over Sanyo. The basis for this contention is that it would be obvious to replace the "fine filter 18"

with a cyclone. Whether this is so or not depends crucially on what the skilled reader's understanding of the function of the "fine filter 18" would be. This was the subject of a substantial dispute at trial. Dyson's case is that the skilled reader would realise that, although described as a "fine filter", it must actually be a coarse filter. Samsung says that the skilled reader would regard it as an early form of grille.

207. Having considered all the evidence from the experts on this issue, I have come to the clear conclusion that Sanyo is completely unclear as to what the function of the "fine filter" is. My reasons are as follows. First, there is a contradiction between the statement that dust is caught by the fine filter, which implies that fine dust is caught, and the subsequent statement that fine dust can be separated by the second stage cyclones. Secondly, the use of the word "predetermined" is simply baffling. Thirdly, it is difficult to see why a fine filter would not clog up, but it is neither described as, nor in the correct position for, a grille. Fourthly, if it is supposed to be a coarse filter, why on earth would Sanyo describe it as "fine"? Fifthly, it is relevant to bear in mind that Sanyo is an extremely early patent in the field of cyclonic vacuum cleaners. I think that the skilled reader might well conclude that Sanyo had not fully understood the technology.

208. I therefore consider that this is a case in which the words of Pumfrey J in *Hewlett Packard GmbH v Waters Corp* [2002] IP&T 5 at [32] are apposite (emphasis added):

> "Mr Wyand submitted that it is the task of the court to determine what Saito clearly and distinctly taught the skilled person at the priority date, not what can be read out of Saito by the application of hermeneutical stress. This admirable phrase concisely describes the process of squeezing a document to extract every last drop of meaning. The submission is correct: to anticipate, a document must contain a clear description of, or clear and unmistakable directions to do or make, something within the claim: see *General Tire v Firestone* [1972] RPC 457. When considering obviousness, on the other hand, ambiguities in the disclosure of the document may be obviously capable of resolution in a particular way without the exercise of ingenuity: *but it is not legitimate to try to resolve obscurity by an exercise in imaginative reconstruction to ascertain what it was that the patentee must have been trying to describe*."

209. It follows that Dyson's case of obviousness over Sanyo does not get off the ground.

Obviousness over DC07 and DC08

210. In one respect, Dyson's case underwent a curious metamorphosis during the course of trial. In his opening skeleton argument counsel for Dyson submitted that all of the A list claims of both Patents were obvious over the DC07 and DC08. He also pointed out that it was common ground that the relevant aspects of the DC07 and DC08 formed part of the common general knowledge of the addressee. Save to that extent, he did not open any case as to obviousness over common general knowledge alone. In his written closing submissions, however, he contended that both Patents were obvious over common general knowledge alone without reference to the DC07 and DC08. The basis for this contention was a passage of cross-examination during which

Professor Allen substantially accepted that, upon certain assumptions as to (i) the correct construction as to the claims, (ii) the common general knowledge and (iii) the absence of a technical prejudice against putting three cyclones in series, there was nothing inventive in the claims of the Patents. When I wondered if it was open to him to advance such a contention, he pointed out that it was within the scope of the pleaded grounds of invalidity, that no objection had been taken to the cross-examination in question and that no application had been made by counsel for Samsung to recall Mr Harris. For his part counsel for Samsung objected to this late change of tack, but nevertheless accepted that the evidence of Professor Allen was now before the Court.

211. Having reflected on the matter, I consider that it is open to Dyson to contend that Patents are obvious over common general knowledge alone. In addition to the reasons given by counsel for Dyson, I would add two more. First, given that Dyson did open a case of obviousness over the DC07 and DC08 and that it is common ground that they are common general knowledge, at least to that extent Dyson did open a case of obviousness over common general knowledge alone. Secondly, it was part of Samsung's case as articulated in both its opening skeleton argument and written closing submissions that the claimed inventions were not obvious over common general knowledge and that the cited prior art took Dyson no further forward. Thus I cannot see that Samsung will have been prejudiced by Dyson's change of tack.

212. That said, I propose to concentrate on Dyson's original case since Samsung did have a full opportunity to address that. Moreover, I shall concentrate on the DC08 since, as counsel for Dyson accepted in opening, the DC07 adds nothing to it.

213. *'603 claim 1*. The principal difference between the DC08 and this claim is the absence of a third cyclonic dust separation unit. If a third unit is added, the units must sequentially separate according to size as I have construed that requirement and the last unit must comprise a plurality of chambers.

214. In my judgment it would have been obvious for the addressee to take the cyclonic separation method embodied in the DC08, namely the use of a single reverse flow cyclone followed by a set of parallel reverse cyclones, one step further by adding a third stage. This could be either a new single second cyclone between the existing stages or a new third stage with parallel cyclones – in my view both were obvious. For the reasons I have given above, I consider that adding a third stage was generally obvious and that there was no technical prejudice against it. Moreover, by contrast with LG, there is nothing peculiar about the DC08 which makes taking such a step difficult in practice. Indeed, Mr Harris gave evidence that the first way could be achieved by a fairly simple modification of the DC08 cyclone train itself. In cross-examination he accepted that he was in error in having said that this could be done without increasing the overall size of the cyclone train, but otherwise adhered to his opinion. The second way would require more design effort, and would no doubt result in a still larger machine, but would present no difficulty in principle. Either approach would result in a vacuum cleaner falling within claim 1 as I have construed it.

215. Counsel for Samsung relied on the fact Dyson had not itself come up with a three stage design until shortly after the priority date (assuming that the Dyson applications were filed promptly). I am not persuaded by this for the general reasons given above. More specifically, the DC07 was launched less than 4 years before the priority date

and the DC08 less than 3 years. At least until Mr Harris left shortly after the launch of the DC08, and probably for some time afterwards, Dyson had other priorities.

216. *'603 claims 4 and 5*. In my judgment it would be obvious to provide mushroom ducting for the same reasons as I have given in relation to Conrad.

217. *'603 claim 19*. The first stage of the DC08 has a grille.

218. *'606 claim 9*. This claim is obvious for essentially the same reasons as claim 1 of '603. If a new second cyclone was added, it would be obvious to make it intermediate in diameter between the first and third stages. If new third stage cyclones were added, it would be obvious to make them smaller in diameter, and hence more efficient, than the second stage.

219. '*606 claim 14*. It would be obvious to ensure that air from the second stage entered the third stage without mixing with other air.

220. *'606 claims 19 and 20*. It would be obvious to form the cyclones independently and in this spatial relationship. There is nothing special about either step.

221. Accordingly, I conclude that all the A list claims are obvious over the DC08.

Amendment

222. Samsung's application to amend '603 involves almost complete re-writing of the claims. Claim 1 is to be heavily amended and a considerable number of new claims are to be introduced. The application to amend '606 is less comprehensive, but also involves introducing a considerable number of new claims.

223. As noted above, Dyson opposes both applications. Dyson contends that the proposed amendments do not comply with one of the statutory conditions for amendment. This is that no amendment of a patent shall be allowed if it results in the specification disclosing additional matter, that is, matter extending beyond that disclosed in the application for the patent as filed: section 76(3)(a) of the Patents Act 1977. The UK Intellectual Property Office also considers that some of the proposed amendments are objectionable on this ground.

The law

224. The test for added matter was stated by Aldous J in *Bonzel v Intervention Ltd (No 3)* [1991] RPC 553 at 574 as follows:

> "The decision as to whether there was an extension of disclosure must be made on a comparison of the two documents read through the eyes of a skilled addressee. The task of the Court is threefold:
>
> (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 patent [as proposed to be amended].

> (3) To compare the two disclosures and decide whether any subject matter relevant to the invention has been added whether by deletion or addition. The comparison is strict in the sense that subject matter will be added unless such matter is clearly and unambiguously disclosed in the application either explicitly or implicitly."

225. More recently, Jacob LJ stated the law in *Vector Corp v Glatt Air Techniques Ltd* [2007] EWCA Civ 805, [2008] RPC 10 as follows:

> "4. In *Richardson-Vicks' Patent* [1995] RPC 568 at 576 I summarised the rule in a single sentence:
>
> > 'I think the test of added matter is whether a skilled man would, upon looking at the amended specification, learn anything about the invention which he could not learn from the unamended specification.'
>
> I went on to quote Aldous J in *Bonzel.* His formulation is helpful and has stood the test of time.
>
> 5. The reason for the rule was explained by the Enlarged Board of Appeal of the EPO in G1/93 *ADVANCED SEMICONDUCTOR PRODUCTS/Limiting feature* [1995] EPOR 97 at [Reasons 9]:
>
> > 'With regard to Article 123(2) EPC, the underlying idea is clearly that an applicant shall not be allowed to improve his position by adding subject-matter not disclosed in the application as filed, which would give him an unwarranted advantage and could be damaging to the legal security of third parties relying upon the content of the original application.'
>
> 6. Mr Richard Arnold QC provided a clear articulation as to how the legal security of third parties would be affected if this were not the rule:
>
> > 'The applicant or patentee could gain an unwarranted advantage in two ways if subject-matter could be added: first, he could circumvent the "first-to-file" rule, namely that the first person to apply to patent an invention is entitled to the resulting patent; and secondly, he could gain a different monopoly to that which the originally filed subject-matter justified.'
>
> 7. Kitchin J has recently helpfully elaborated upon the *Bonzel* formulation in *European Central Bank v Document Security Systems* [2007] EWHC 600 (Pat), 26th March 2007:
>
> > '[97] A number of points emerge from this formulation which have a particular bearing on the present case and merit a little elaboration. First, it requires the court to construe both the

original application and specification to determine what they disclose. For this purpose the claims form part of the disclosure (s.130(3) of the Act), though clearly not everything which falls within the scope of the claims is necessarily disclosed.

[98] Second, it is the court which must carry out the exercise and it must do so through the eyes of the skilled addressee. Such a person will approach the documents with the benefit of the common general knowledge.

[99] Third, the two disclosures must be compared to see whether any subject matter relevant to the invention has been added. This comparison is a strict one. Subject matter will be added unless it is clearly and unambiguously disclosed in the application as filed.

[100] Fourth, it is appropriate to consider what has been disclosed both expressly and implicitly. Thus the addition of a reference to that which the skilled person would take for granted does not matter: *DSM NV's Patent* [2001] RPC 25 at [195]-[202]. On the other hand, it is to be emphasised that this is not an obviousness test. A patentee is not permitted to add matter by amendment which would have been obvious to the skilled person from the application.

[101] Fifth, the issue is whether subject matter relevant to the invention has been added. In case G1/93, *Advanced Semiconductor Products*, the Enlarged Board of Appeal of the EPO stated (at paragraph [9] of its reasons) that the idea underlying Art. 123(2) is that that an applicant should not be allowed to improve his position by adding subject matter not disclosed in the application as filed, which would give him an unwarranted advantage and could be damaging to the legal security of third parties relying on the content of the original application. At paragraph [16] it explained that whether an added feature which limits the scope of protection is contrary to Art. 123(2) must be determined from all the circumstances. If it provides a technical contribution to the subject matter of the claimed invention then it would give an unwarranted advantage to the patentee. If, on the other hand, the feature merely excludes protection for part of the subject matter of the claimed invention as covered by the application as filed, the adding of such a feature cannot reasonably be considered to give any unwarranted advantage to the applicant. Nor does it adversely affect the interests of third parties.

[102] Sixth, it is important to avoid hindsight. Care must be taken to consider the disclosure of the application through the eyes of a skilled person who has not seen the amended specification and consequently does not know what he is looking for. This is

> particularly important where the subject matter is said to be implicitly disclosed in the original specification.'

8. When amendment of a granted patent is being considered, the comparison to be made is between the *application* for the patent, as opposed to the granted patent, and the proposed amendment (see the definition of 'additional matter' in s.76(1)(b)). It follows that by and large the form of the granted patent itself does not come into the comparison. This case was to some extent overcomplicated by looking at the granted patent, particularly the granted claim 1.

9. A particular, and sometimes subtle, form of extended subject matter (what our Act calls 'additional matter') is what goes by the jargon term 'intermediate generalisation'. Pumfrey J described this in *Palmaz's European Patents* [1999] RPC 47, 71 as follows:

> 'If the specification discloses distinct sub-classes of the overall inventive concept, then it should be possible to amend down to one or other of those sub-classes, whether or not they are presented as inventively distinct in the specification before amendment. The difficulty comes when it is sought to take features which are only disclosed in a particular context and which are not disclosed as having any inventive significance and introduce them into the claim deprived of that context. This is a process sometimes called "intermediate generalisation".'"

Amendments to '603

226. *Claim 1*. Claim 1 as proposed to be amended claims a multi-cyclone dust separator "comprising at least three cyclonic dust separation units, being a first cyclonic dust separation unit, a second cyclonic dust separation unit, and a third cyclonic dust separation unit … wherein the third cyclonic dust separation unit comprises a plurality of cyclone chambers". Dyson contends that this discloses a single first cyclone in conjunction with a single second cyclone and multiple third cyclones i.e. *single: single: multiple*, whereas the application for '603 ("'603A") only discloses a single first cyclone in conjunction with multiple second cyclones and multiple third cyclones i.e. *single: multiple: multiple*.

227. The arrangement shown in Figure 1 of '603A and described in the accompanying text is *single: multiple: multiple*. The same arrangement is disclosed by claim 11 of '603A and its corresponding consistory clause. Although it was Professor Allen's evidence that '603A also disclosed three other arrangements, namely *single: single: multiple*, *single: multiple: single* and *single: single: single*, counsel for Samsung rightly did not rely on that evidence and accepted that '603A did not disclose a *single: single: multiple* arrangement.

228. I turn to the question of whether '603 as proposed to be amended discloses a *single: single: multiple* arrangement. Samsung contends that it does not, and that amended claim 1 merely covers such an arrangement without disclosing it: cf. *A.C. Edwards Ltd v Acme Signs & Displays Ltd* [1992] RPC 131. In my judgment, however,

amended claim 1 does disclose a *single: single: multiple* arrangement. My reason for reaching this conclusion is that the amended wording distinguishes between the "first cyclonic dust separation unit" and the "second cyclonic dust separation unit" on the one hand and the "third cyclonic dust separation unit" on the other hand. The latter is specified as having "a plurality of cyclone chambers", thereby impliedly disclosing that the former two may have single cyclone chambers.

229. *Claim 4*. Proposed amended claim 4 requires an "upper path formation member for guiding the air … and an upper connection path … arranged to radially diverge the air ascending … the air being drawn into the cyclone chambers in a tangential direction through the upper connection path…". Dyson contends that this is an intermediate generalisation since, although such ducting is disclosed in '603A, it is only disclosed in the context of the specific embodiment and is not said to have inventive significance. Samsung disputes this. In my judgment Dyson is correct for the following reasons.

230. In '603A Figure 1 shows, and the accompanying text describes, an embodiment in which the second dust separation unit has an intermediate path formation member and intermediate connection path and the third dust separation unit has an upper path formation member and upper connection path. The passage corresponding to the passage in '603 at page 8 lines 21-25 quoted in paragraph 21 above draws attention to the advantage of the intermediate path formation member and intermediate connection path. Consistently with this, claim 10 of '603A claims a dust separator "wherein the second dust separation unit further comprises an intermediate path formation member … and an intermediate connection path". By contrast, no such statement is made in relation to the upper path formation member and upper connection path. Nor is any claim directed to that feature.

231. Counsel for Samsung argued that the skilled reader would nevertheless appreciate that the statement is equally applicable to the upper path formation member and upper connection path. I am prepared to accept that the skilled reader would understand that what is said in relation to the intermediate path formation member and intermediate connection path is likely also to apply to the upper path formation member and upper connection path; but this is because the context is a specific embodiment in which the second and third dust separation units are shown and described in the same way.

232. Turning to '603 as proposed to be amended, claim 4 discloses an arrangement having an upper path formation member and upper connection path shorn of that context. In particular, it divorces the upper path formation member and upper connection path from the intermediate path formation member and intermediate connection path. It thereby presents the upper path formation member and upper connection path for the first time as having inventive significance in the absence of the intermediate path formation member and intermediate connection path.

233. Counsel for Samsung argued that there is no difference in the disclosures because '603A teaches the skilled reader that it is advantageous to have one formation member and connection path without necessarily having the other and the reader would appreciate that this teaching is equally applicable to both. I do not accept this. The message of '603A is that the intermediate path formation member and intermediate connection path are advantageous whether or not the upper path

formation member and upper connection path are present, whereas the message of claim 4 as proposed to be amended is the opposite.

234. *Claims 1 and 13*. Proposed amended claim 13 requires that "all of the air discharged from the second cyclonic dust separation unit enters the third cyclonic dust separation unit". Dyson contends that, when read in the light of claim 13, claim 1 discloses an arrangement in which some of the air discharged from the second unit does not enter the third unit, whereas no such arrangement is disclosed by '603A.

235. Samsung does not dispute that '603A does not disclose that arrangement, but contends that '603 as proposed to be amended does not disclose it either. Again, it says that such an arrangement is covered by claim 1, but not disclosed by it. This time I agree with Samsung. Dyson's argument reads too much into the relationship between the claims. The skilled reader would appreciate that this is a legal rather than a technical question.

236. *Conclusion*. Accordingly, I conclude that the amendments to claim 1 and to introduce new claim 4 are not allowable, but the introduction of new claim 13 would otherwise be permissible.

Amendments to '606

237. *Claim 9*. Proposed amended claim 9 claims "a first cyclone chamber … at least one second cyclone chamber … and a plurality of third cyclone chambers". Dyson contends that this discloses arrangements with *single: ≥1: multiple* cyclones, whereas the application for '606 ("'606A") only discloses *single: ≥1: ≥1* cyclones.

238. The arrangement shown in Figures 3 and 4 of '603A and described in the accompanying text is *single: multiple: multiple*. Claim 10 of '603A and its corresponding consistory clause, however, claim an arrangement with "a first cyclone chamber … at least one second cyclone chamber … and at least one third cyclone chamber". In my judgment this discloses *inter alia* arrangements with *single: ≥1: multiple* cyclones. Accordingly, proposed amended claim 9 discloses nothing additional.

239. *Claim 14*. Dyson contends that proposed amended claim 14 discloses an arrangement in which "air discharged from the or each respective second cyclone chambers enters the two or more third cyclone chambers without mixing with other air", whereas no such arrangement is disclosed in '606A.

240. Indeed, Dyson goes further and contends that '606A discloses the exact opposite. The apparatus depicted and described in '606A includes a common collecting space for all the second cyclone chambers. Dyson says that some or all of the air entering each second cyclone chamber will exit into this collecting space and will mix with air from other second cyclone chambers before entering the third cyclone chambers.

241. Samsung contends that this part of claim 14 is supported by Figures 3 and 4 and by the following passage at page 10 lines 5-8 of '606A:

> "The second passages 360 are formed such that the air exiting from each second cyclone chamber 320 is directed towards the associated pair of third chambers 330."

242. In my judgment the passage relied on by Samsung does not disclose that air discharged from each second cyclone chamber enters the third cyclone chambers without mixing with other air. Nor is this clearly and unambiguously disclosed by the Figures. On the other hand, I would not go so far as to say that '606A clearly and unambiguously discloses that the air will mix in the way that Dyson suggests. In my view '606A is unclear on this point. Accordingly claim 14 discloses additional matter.

243. *Claim 19*. Proposed amended claim 19 requires the second and third cyclone chambers to be disposed in a plane orthogonal to a main axial direction of the cyclonic dust-separating apparatus. Dyson contends that this is an intermediate generalisation since, although such an arrangement is disclosed in '606A, it is only disclosed in the context of the specific embodiment and is not disclosed as having inventive significance.

244. The only basis for this feature in '606A is Figures 3, 4 and 5. There is no textual support for it at all. In my judgment this amendment is precisely covered by the words of Neuberger LJ in *LG Philips LCD Co Ltd v Tatung (UK) Ltd* [2006] EWCA Civ 1774, [2007] RPC 21 at [41]:

> "The appellant seeks to extract an otherwise unidentified feature (nowhere suggested to have inventive significance) which appears from a drawing of one of the preferred embodiments of the invention, and to insert it into the claim, without taking any other features of that embodiment. What the appellant is thereby doing is what Pumfrey J said was not permitted in the *Palmaz* case, namely to effect a so-called intermediate generalisation, that is, to extract a feature (which was neither remarked on in the specification nor of significance to the person skilled in the art) of one of the preferred embodiments of the invention and insert it into a claim, while ignoring the other features of that embodiment."

245. *Claim 20*. Proposed amended claim 20 requires that "respective main axes of the second and third cyclone chambers are parallel, and the second and third chambers are at least partially overlapping each other in the axial direction of the chambers". Dyson contends that this is an intermediate generalisation since, although such an arrangement is disclosed in '606A, it is only disclosed in the context of the specific embodiment and is not disclosed as having inventive significance.

246. Again, the only basis for this feature in '606A is Figures 3, 4 and 5. Again, there is no textual support for it at all. Again, I consider that it is precisely covered by Neuberger LJ's words in *LG Philips*.

247. *Claims 20 and 21*. Proposed amended claim 21 requires that "all of the drawn-in air passes through: the first cyclone chamber; the at least one second chamber; and the at least one third cyclone chamber". Dyson contends that this discloses additional matter

since, when read in combination with claim 20, this discloses an arrangement in which all of the drawn-in air does not pass through, whereas no such arrangement is disclosed in '606A.

248. Samsung accepts that no such arrangement is disclosed in '606A, but argues that it is not disclosed by claims 20 and 21. Again, it says that such an arrangement is covered by claim 20, but not disclosed by it. Again, I agree with Samsung. Again Dyson's argument reads too much into the relationship between the claims.

249. *Conclusion*. Accordingly, I conclude that the amendment to claim 9 is allowable, the amendments to introduce new claims 14, 19 and 20 are not permissible and the amendment to introduce new claim 21 is otherwise allowable.

Summary of conclusions

250. For the reasons given above my conclusions are as follows:

i) Claim 1 of '603 lacks novelty over Conrad, but not claims 4 or 5 of '603.

ii) Claim 9 of '606 is novel over Gamou.

iii) Claims 4, 5 and 19 of '603 and claims 9 and 14 of '606 are all obvious in the light of Conrad.

iv) Claims 9, 19 and 20 of '606 are not obvious in light of Gamou.

v) Claim 1 of '603 and claims 9 and 14 of '606 are not obvious in the light of LG.

vi) None of the A list claims are obvious in the light of Sanyo.

vii) All of the A list claims are obvious in the light of the DC08.

viii) In the case of '603, the amendments to claim 1 and to introduce new claim 4 are not allowable, but the introduction of new claim 13 would otherwise be permissible.

ix) In the case of '606, the amendment to claim 9 is allowable, the amendments to introduce new claims 14, 19 and 20 are not permissible and the amendment to introduce new claim 21 is otherwise allowable.