

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VIKING DRILL & TOOL, INC.
Petitioner

v.

HONGJIA WANG
Patent Owner

Case IPR2023-00473

U.S. Patent No. 11,007,583

**SUPPLEMENTAL DECLARATION OF STEVEN R. SCHMID, PH.D. IN
SUPPORT OF PETITIONER'S REPLY**

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I, Dr. Steven R. Schmid of Charlotte, North Carolina, declare that:

I. Overview

1. I have been retained on behalf of Petitioner Viking Drill & Tool, Inc. (“Petitioner”) as an independent expert consultant. As part of this engagement, I have been asked to provide my opinions regarding the subject matter claimed in U.S. Patent 11,007,583 (“’583 patent”) (Ex-1001),¹ including specifically the scope and content of the prior art relating to the subject matter of the ’583 patent and what the prior art would disclose and/or teach and suggest to a person of ordinary skill in the art (“POSA”) at the time of the purported invention. I previously submitted a declaration in support of the petition for *inter partes* review of the ’583 patent in this proceeding (Paper 2, the “Petition”), Ex-1004, as well as a declaration in support of the petition for *inter partes review* in the IPR2023-00474 proceeding (Ex-1004).

2. I set forth the information below as a supplement to my original declarations, as Patent Owner raised new issues in its response to the petition (Paper 28, “Response”), on which I had not previously been given an opportunity

¹ In this Declaration, I refer to exhibits I understand will be attached to Petitioner’s Reply, in addition to those Petitioner and patent owner Hongjia Wang (“Patent Owner”) have already submitted in this proceeding.

to offer testimony. The legal standards I use here are the same as set forth in my previous declaration, Ex-1004, ¶¶18-34. Having considered Patent Owner's arguments, and the testimony of Patent Owner's declarants, my opinions on the invalidity of the '583 Patent remain the same. My additional opinions are set forth below.

II. Materials That I Reviewed

3. My opinions contained in this Declaration are based on my knowledge and experience gained from my education in the field of mechanical engineering, my experience in the field of machine tool design and engineering in both academia and industry over the last 30 years, and the specific references, documents, and other materials I discuss in this Declaration.

4. In forming my opinions, I reviewed the following (along with any other materials I discuss in my Declaration):

- Any materials I reviewed in connection with my original declaration. Ex-1004, ¶¶9-12.
- Patent Owner's Response (Paper 28) and exhibits submitted by Patent Owner in connection with its response.
- Exhibits 1045-1050 submitted in connection with Petitioner's Reply.

5. All of the papers and publications I reviewed in forming my opinions

for my Declaration are materials that experts in my field would have knowledge of and would reasonably rely on in forming certain opinions set forth in my Declaration. In addition, all of the papers and publications were widely available to a person of ordinary skill in the art (“POSA,” discussed further below) at least as of the time of the filing of the ’583 patent. Based on my experience, people in my field at the time of the alleged invention ordinarily and customarily relied on published papers and textbooks including those listed above, and ordinarily and customarily relied on such publications as having been published as of the publication date listed in the document. I am not aware of any facts or circumstances that call into question the authenticity of any of the above materials or the accuracy of their publication dates.

6. I formed my opinions discussed in this Declaration by placing myself in the position of a POSA back in November 28, 2019 (an easy task, as I have been at or above the level of ordinary skill for at least 30 years). My opinions are the same for a POSA in February 14, 2016.

III. Ground 1: Obviousness Based on Wang in View of Gentry, Durfee, and/or the Knowledge of a POSA

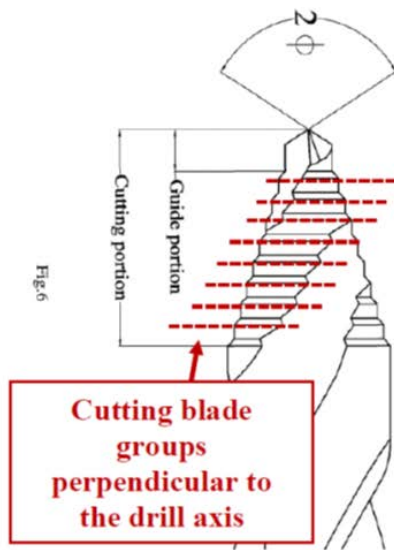
7. I understand Patent Owner disputes that Wang (Ex-1009) is prior art to the ’583 patent. I also understand that Patent Owner does not dispute that if Wang is indeed prior art, then it renders challenged claims 1, 2, 5, 7, 8, 12-15, 18, 19 and 22 of the ’583 patent unpatentable as obvious. As I explained in my

previous declaration, I am informed that because the '583 patent claims priority to Wang as a continuation-in-part, Wang is prior art to the '583 patent if it does not provide written description support for the claims of the '583 patent. Ex-1004, ¶¶102-112; *see also id.* ¶¶31-34.

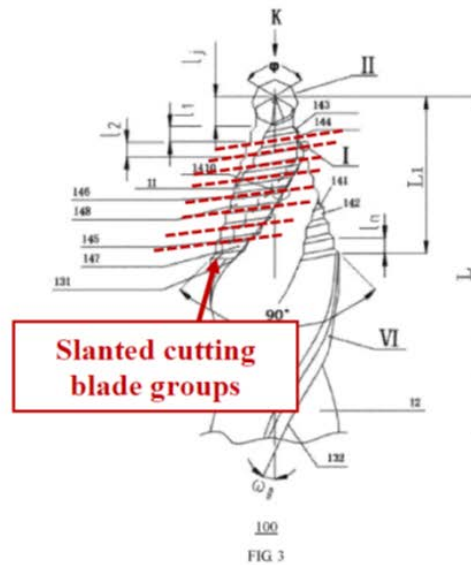
A. Wang is Prior Art

8. Wang does not provide written description support for the limitation “a plurality of composite cutting blade groups formed...spirally” found in independent claims 1 and 8 of the '583 Patent.² When the application that led to the '583 patent was filed, the patent applicant omitted multiple figures from Wang that showed cutting blade groups formed perpendicular to the drill axis, including Figure 6 (shown below). In its place, the patent applicant added a new Figure 3 showing the cutting blade groups formed slanted relative to the drill axis:

² My understanding of priority date and the written description requirement are laid out in my first declaration. Ex-1004, ¶¶31-34.



Wang FIG. 6



'583 patent, FIG. 3

Ex-1001 FIG. 3; Ex-1009, Figs. 5-6, 8. The patent applicant also added new language teaching that the composite cutting blade groups “spirally extend along the rake face.” Ex-1001 6:10-13.

9. I understand Patent Owner argues that a POSA would understand Wang's disclosure to provide written description support for this claim element because "axial relief is so ubiquitous and such a conventional element that a POSA would readily infer it or assume it without an illustration." Response at 9. This is incorrect based on my understanding of the written description requirement that even if a vague description might render a claim element obvious, it is not sufficient to provide written description support for that element. See Ex-1004, ¶34. During the *ex parte* reexamination of the '583 patent that I discussed in my

first declaration, Ex-1004, ¶¶67-76, the “formed . . . spirally” limitation was the key limitation that Patent Owner relied on to distinguish the claims over the prior art. Ex-1003, 481-482, 488-492, 509-511. The Patent Office expressly allowed the claims on this basis. *Id.*, 526. In my opinion, Patent Owner’s argument in its Response that this feature is so old and ubiquitous that it didn’t even need to be disclosed is inconsistent with its reliance on the same element to obtain allowance of its claims over the prior art. As common as axial relief may be on drilling tools, a POSA would not infer it unless it is expressly described. This point is illustrated by the prior art references relied upon in this IPR. When axial relief is present, it is shown and discussed explicitly. *See* Ex-1010, Figure 1, 1:52-60; Ex-1011, Figure 2, 11:27-53; Ex-1006, Figure 1, p.2, 1:75-2:4; Ex-1012, Figure 5, 2:60-3:7.

10. I agree with the Board’s preliminary analysis in its Decision Granting Institution that because Wang’s flutes³ are parallel with each other, they “do not intersect,” and “cannot have connecting lines on account of an intersection.” Paper 13 at 18. I further agree with the Board’s analysis that “only thing about the flutes that could seemingly be said to connect are the part of the flute that are interrupted by the cutting blades.” *Id.* Patent Owner’s argument that “connecting lines” are

³ Wang uses “flute” to refer to the groove formed between what the ‘583 patent calls “composite cutting blade groups.”

found at the boundary between two adjacent flutes does not have any support from Wang's specification. A POSA would not unambiguously understand what is meant by the term "the connecting lines of the flutes." Wang fails to describe what is meant by a "connecting line."

11. Patent Owner's contention that a "connecting line" can only be where two surfaces intersect, Response at 15, cannot be reconciled with Wang's use of "connecting line" to describe lines that connect points on a drill. Specifically, Wang states:

Since flutes need to be dug in the flank surface to form the ladder-like main cutting blades, the area of the flank surface 3 will be set to be slightly larger, and an angle b formed by the connecting lines of the top endpoints of the first cutting blades 5...is 20-60 degrees, as shown in FIG. 8.

Ex-1009, ¶[0032]. The "connecting lines" forming angle b referred to in the above quote are shown in Figure 8.

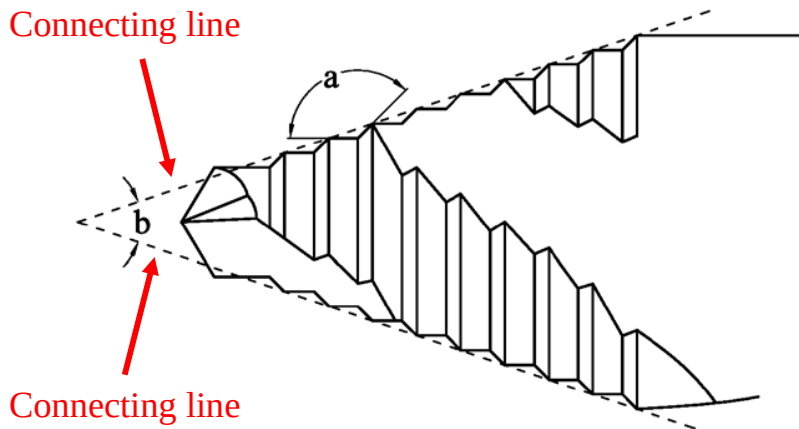


Fig.8

Exhibit 1009, FIG. 8 (red annotations added). A POSA would understand that the “connecting lines” shown in FIG. 8 above connect points on adjacent steps of the step-like structure on the cone portion of the drill. A POSA would thus understand that Wang’s disclosure does not limit “connecting line” to being only where one surface intersects another.

12. A POSA would understand that the prosecution history of the ’900 application, of which Wang is the publication, does not support an interpretation of “connecting lines” that describes axial relief, even if it refers to the lines between adjacent flutes. During prosecution, the Examiner rejected dependent claim 5, which recited “[t]he drill bit of claim 1, wherein the connecting lines of the flutes form a spiral structure.” This rejection was based on FIG. 3 of Shibata (Ex-1015).

Ex-1018 at 145. FIGs. 1 and 3 from Shibata are shown below. FIG. 3 is cross section taken at section line 3-3 in FIG. 1.

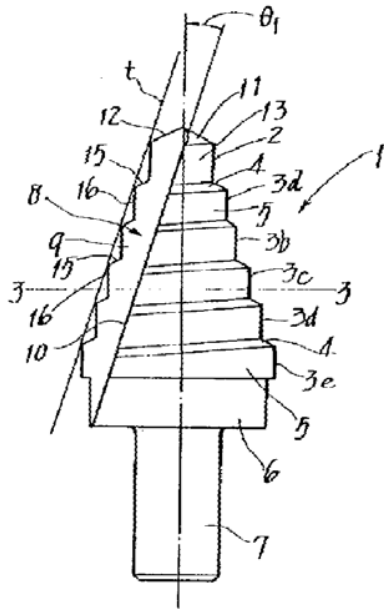


FIG. 1

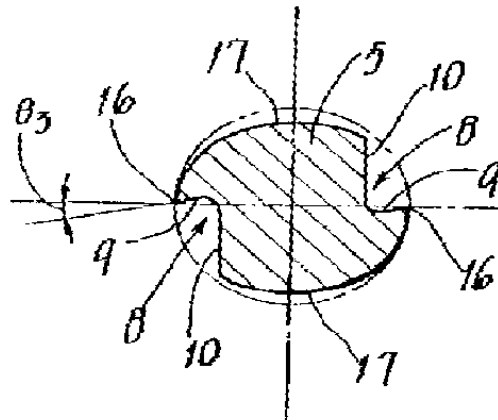


FIG. 3

Ex-1015. FIG. 1 shows axial relief and FIG. 3 shows radial relief. The Examiner's reliance on FIG. 3, rather than FIG. 1, is notable. A POSA would infer that the Examiner understood "connecting lines of the flutes form a spiral structure" to refer to radial relief and not axial relief.

13. Although not critical to my analysis, I will address a few points about Shibata made by Patent Owner in its Response. First, Patent Owner give undue importance to of the fact that the section view shown in FIG. 3 cuts through a cylindrical step surface at about the midpoint of its step height rather than at a line

formed by the intersection of a cylindrical step surface and an adjacent conical step surface. Response at 19-20. Specifically, Patent Owner asserts that “the surface shown in Fig. 3 is not a line . . . it connects two chip-evacuating flutes, not the flutes (or grooves) recited in claim 5 of the ’900 Application.” Response at 20. A POSA would understand that FIG. 3 shows radial relief even though it is a cross section in the middle of a flank surface (i.e., a cylindrical step surface).

Furthermore, a POSA would understand that the cross-sectional shape at Shibata FIG. 3, showing radial relief, would be generally the same as the cross-sectional shape shown if the section line 3-3 were moved up or down axially to a position where a cylindrical step surface intersects a conical step surface.

14. Patent Owner also contends that “the surface shown in Fig. 3 ... shows a cross-section that is oval, not spiral.” I disagree with this characterization. Shibata FIG. 3 shows a cross section of the drill inside a circular projection (i.e., the dashed line representing the cross section of a hole the drill would cut). To the extent the cross section appears oval-like, it is because the figure is not drawn to scale and is somewhat compressed in the vertical direction. A POSA would understand the dashed line to represent a circular projection meant to show the radial relief of Shibata. In the context of a drill cross section, the widest portion of which will sweep along a circular path while in use, it would not make sense for the dashed projection line to be an oval, or anything other than a circle. The

examiner's interpretation of Shibata FIG. 3 as showing "connecting lines of the flutes form a spiral structure" is thus reasonable from the standpoint of a POSA.

15. I disagree with Patent Owner's contention that "[r]adial relief just as readily gives rise to a spiral formation as axial relief." Response at 20. I understand the proper construction of the "formed . . . spirally" limitation refers to cutting blades that are arranged non-perpendicular to the drill axis, as is the case with axial relief. Ex-1004, ¶¶88-99. This does not include radial relief. *Id.* Axial relief and radial relief are different, and one may be present on a drill without the other. A description of radial relief in Wang's disclosure would not provide a description of axial relief under the proper construction of the "formed . . . spirally" term.

16. Patent Owner's Response and the evidence it submitted in connection with it have not altered my conclusion that Wang does not provide written description support for the term "formed . . . spirally" in claims 1 and 8 of the '583 patent. Thus, it is still my opinion that Wang is prior art to the '583 patent.

B. The Challenged Claims Would Have Been Obvious Under Wang in View of Gentry, Durfee, and/or the Knowledge of a POSA

17. Patent Owner's response and evidence cited in connection with it have not altered my conclusion that Wang in view of Gentry (Ex-1010), Durfee (Ex-1011), and/or the knowledge of a POSA renders obvious each of the challenged claims.

IV. Ground 2: Obviousness Based on Bannister in View of Zhou, Welty, and/or the Knowledge of a POSA

18. Claims 1, 2, 5, 7, 8, 12, 14, 15, and 19 of the '583 patent would have been obvious over Bannister (Ex-1006) in view of Zhou (Ex-1007), Welty (Ex-1008) and/or the knowledge of a POSA. As I set forth in my first declaration, Bannister has substantially all of the elements of these claims except for a first step surface that is conical in shape. Ex-1004, ¶¶189-244. The secondary references show this feature, and it would have been obvious to modify Bannister to have a conical first step surface. *Id.*

A. Perpendicular versus conical steps on the conical portion

19. I understand Patent Owner argues that it would not be obvious to modify Bannister by making the intermediate cutting edges 22, 23 of the drill as conical instead of being perpendicular to the drill axis. Patent owner specifically contends that Bannister teaches that the outer, beveled cutting edges 24 are used to generate long chips that carry out any fine chips created by the straight intermediate blades, so it would not be obvious to modifies those cutting edges to be angled. Response at 22-23. However, Bannister states the intermediate cutting edges are “preferably substantially normal to the axis of the drill” but does not require them to be perpendicular. Ex-1006 at p. 2, col. 1:7-9. Thus, modifying Bannister in this way is not inconsistent with its disclosure. Furthermore, it would have been obvious to a POSA to modify the shape of the cutting edges to find an

optimal configuration. I am informed that a solution is obvious if a POSA can choose from a finite number of identified, predictable solutions with a reasonable expectation of success. Only two different configurations for the major cutting edges are possible: perpendicular to the axis and non-perpendicular to the axis, i.e. conical. A POSA would understand from either Zhou or Welty, or from background knowledge, that it would be reasonable to expect success from the introduction of conical cutting blades. Modifying Bannister according to the teachings of Zhou or Welty would result in the drill of claims 1 or 8. Ex-1004, ¶¶189-244.

20. Furthermore, A POSA would understand that Bannister likely does not represent the chip formation mechanics of its drill accurately. Bannister was published in 1940, which is before the research of Eugene Merchant that transformed the understanding of cutting mechanics and chip formation. Ex-1050, 24. Bannister's description reflects an outdated and oversimplified understanding of chip formation. Bannister speaks in generalities about how it forms chips that are unlikely to be true in all circumstances in which Bannister's drill might be used (e.g., different cutting tool materials, workpiece materials, geometries such as rake angle and relief angles, feed rates, etc.). *See, e.g.*, Ex-1050, 14. Thus, a POSA would understand that cutting blades that are angled relative to a drill's axis and those that are normal to it can each create continuous or discontinuous chips based

on these factors. Whether a cutting edge is angled or normal relative to the drill axis does not alone determine whether cutting chips will be continuous or discontinuous. A POSA, equipped with a modern understanding of cutting mechanics and chip formation at the priority date of the '583 Patent, would not be dissuaded by Bannister's disclosure from modifying the intermediate steps to be conical. Bannister's disclosure of continuous and discontinuous chips being formed by different blades could be achieved with conical major cutting edges.

21. A POSA would also understand that Bannister's description of creating long, continuous chips that carry out short, discontinuous chips, Ex-1006 at 2, col 1:10-19, is likely not an accurate description of what would actually occur with Bannister's drill. It is unlikely that continuous chips would be able to impart a significant amount of force on and "engage" with smaller chips in such a way that they would be more easily evacuated from the flutes. A POSA would understand that the mechanical Archimedean screw action of the flutes would provide the majority of the force to remove chips. A POSA would also recognize that drilling in such a way that avoids continuous chips is often preferred because discontinuous chips interfere less with drilling and pose a smaller safety hazard to a user than continuous chips. Bannister's drill could thus be configured for efficient chip removal, which is more generally one of Bannister's objectives, even if it had conical major cutting edges and was optimized to make all discontinuous

chips.

B. “Composite cutting blade groups are configured to crush cutting chips into finer chips”

22. I understand that Patent Owner asserts that in Bannister’s drill, “each composite cutting blade group is not configured to crush cutting chips into finer chips” because the beveled cutting edge is used “to produce long spiral chips that carry the short chips.” Response at 24-25. As I described above, this does not reflect an accurate understanding of cutting mechanics and chip formation, and a POSA would understand that Bannister’s drill would not necessarily cut in this manner in all use cases. Furthermore, whether some chips are discontinuous is not relevant to determining whether Bannister’s drill teaches this claim element under its proper construction. The construction of the “crushing” term I laid out in my initial declaration, which was also advanced by Petitioner, is the same as that proposed by Patent Owner in the litigation: creating cutting chips that are smaller than they would be if the drill did not have composite cutting blade groups. Ex-1004, ¶100; Petition, 23-24; Ex-1021, 4 (proposing the construction “each composite cutting blade group is small, relative to the single major cutting edge that the cone portion would have if there were no composite cutting blade groups on the cone portion of the twist drill.”); *see also* Ex-1022; Ex-1004, ¶100. Bannister has a series of stepped cutting blade groups that produce chips narrower than those produced by a conventional drill of similar outer diameter. Bannister’s

drill, therefore, produces smaller chips than a conventional drill and meets the “crushing” limitation under the proper construction even if it produced discontinuous chips.

23. Patent Owner also contends that Bannister is intended to reduce crushing and therefore it does not meet this limitation. Response at 25. The term “crush,” however, is used in Bannister differently than how it is used in the ’583 patent. One of Bannister’s stated goals is to “reduce to a minimum the metal to be crushed during the drilling operation.” Ex-1006 at 1, col 1:16-17. Bannister uses the term “crush” to describe the removal of material by the central point of the drill, not by a cutting blade group. *Id.* at 1:45-50; *see also* Ex-1017, 8. Bannister’s goal of reduced “crushing” thus means that the diameter of the central core of the drill is reduced. It has nothing to do with how the cutting blade groups interact with the workpiece. *Id.* at 2, col. 1:20-27.

24. Patent Owner contends that “Bannister seeks to provide a drill that evacuates the chips “as they are formed,” and does not crush chips into finer chips.” Response at 25. This is incorrect under the correct construction of the “crushing” term. Bannister’s drill produces smaller chips than a conventional drill and meets the “crushing” limitation under the proper construction regardless of whether the chips are evacuated immediately after they are formed.

25. To the extent that Patent Owner is now proposing a different

construction of this term in contradiction to the construction it proposed in the litigation, I do not agree with it. No other construction is described in the '583 Patent. Furthermore, based on my understanding of cutting mechanics and chip formation, I do not believe a construction where chips cannot be "crushed" if they are evacuated immediately as they are formed, rather than retained in the workpiece for an appreciable amount of time to be "crushed," would be practiced by any of the products that Patent Owner contends are embodiments of the challenged claims, whether its own licensed drills, *see* Ex-2074 - Ex-2089, or the Viking Vortex-Point drills it accuses of infringement in the Litigation. *See* Ex-1022. A POSA would recognize that as a general matter, chips are formed through shearing. *See, e.g.,* Ex-1017, 8; Ex-1050, 20-32. In the context of the intrinsic record of the '583 patent, a POSA would understand the term does not require actual "crushing," which would result from compressive stress. Rather, a POSA would understand that chips are formed through shearing in the drills of the challenged claims, and that chips would flow directly into the chip evacuation flutes of a drill as they are formed, where no appreciable compression occurs. A POSA would thus understand that in the context of the '583 Patent, the term means that, as opposed to the major cutting edge of a standard prior art twist drill, the claimed drill is broken up into a plurality of smaller major cutting edges along the exterior of the cone portion, which leads to narrower chips than in the standard

prior art twist drill. See Ex-1004, ¶96. Once again, regardless of whether chips are evacuated immediately after cutting, Bannister's chips are smaller than they would be if Bannister had only a single cutting blade and not a stepped configuration. Ex-1004, ¶¶231-33.

26. To the extent that Patent Owner is actually advancing yet another construction where any further breaking of chips after they are initially formed occurs inside the chip evacuation flutes, Bannister teaches this. I agree with Dr. Endres that it is at least possible that in some conditions, a drill's flute sidewalls interfere with continuous chips and strain them sufficiently to break them. See Endres tr. at 68:24-71:12. To my knowledge, Patent Owner has not provided any evidence that Bannister's drill is not theoretically capable of forming discontinuous chips in this manner. To summarize, a POSA would understand that Bannister's drill would be capable of forming discontinuous chips broken apart at least partially by interference between chips and the sidewall of Bannister's flute. Thus, even if Patent Owner attempts to rely on yet another construction of this term to salvage its position that Welty does not crush chips into finer chips, this position is without merit.

C. The Claims Do Not Require Curved Major and Minor Cutting Edges

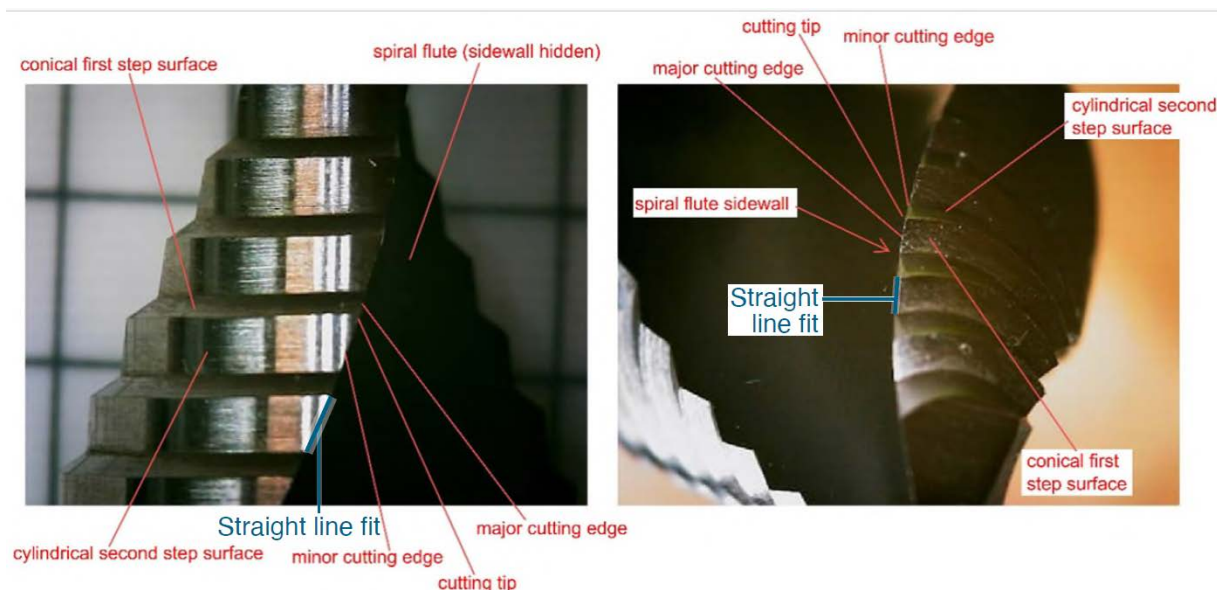
27. I understand Patent Owner argues that Bannister does not teach the major and minor cutting edges of the independent claims because it fails to

disclose major and minor cutting edges that are curved. The claims do not require the recited major and minor cutting edges to be curved. Instead, the claims more generally recite “a major cutting edge defined by the intersection of the conical first step surface and the sidewall of the spiral flute” and “a minor cutting edge defined by the intersection of the cylindrical second step and the and the sidewall of the spiral flute.” Ex-1001, Claims 1 and 8.

28. The claims do not literally recite anything that requires curved cutting edges. I understand Patent Owner’s position is that this necessarily results from the intersection of the sidewall of a spiral flute and the respective step surfaces. This is incorrect for numerous reasons. First, I disagree with Patent Owner’s conclusion that curved cutting edges must always result from the intersection of a spiral sidewall of a spiral flute and conical and cylindrical step surfaces. Patent Owner’s analysis is simplistic and fails to take into account the complex geometry that is used on actual drills. A POSA would recognize that an embodiment of the claims can have straight major and minor cutting edges formed by the intersection of a spiral flute sidewall and conical and cylindrical step surfaces by manipulating various geometries that are consistent with these features. Starting with the spiral flute, the flute can have various cross-sectional shapes based on how it is manufactured. For example, it can be cut into the drill using a grinding wheel having a semicircular cut pattern or that of another shape. The spiral flute can also

be formed with a helix angle at any of an infinite number of angles between vertical and horizontal, relative to the axis of the drill. The conical step surfaces can also be formed at any of an infinite number of angles between vertical and horizontal, relative to the axis of the drill. The conical and cylindrical step surfaces can have axial, radial, and diametral relief with various geometries. By manipulating any of the above, a POSA can form cutting edges having a desired shape such as straight line segments.

29. To support its contention that the major and minor cutting edges of the claimed drill have to be curved, Patent Owner presents two photographs of the 3/4" Matco Tools Hyper-Step Part No. DBHS48 (alleged to be within the scope of at least claims 1 and 8 of the '583 patent) allegedly showing this. These photos do not clearly show curved cutting edges. I have replicated the photos below and added straight lines in blue, which fit well to different cutting edges.



30. Regardless of any dispute about what the above images show, Patent Owner's expert concedes that this configuration does not necessarily require straight major cutting edges. According to Dr. Endres, for a given combination of major cutting edge angle and flute helix angle, the major cutting edges will be straight. Ex-1046, 85:20-88:5. Viewing prior art two-blade twist drills, it is readily apparent that the major cutting edges, which are formed by the intersection of conical flank surfaces (analogous to the claimed conical step surfaces) and spiral flute sidewalls, can be straight:

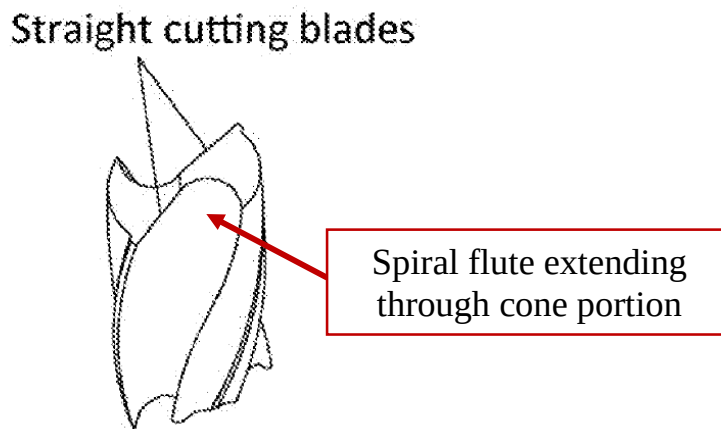
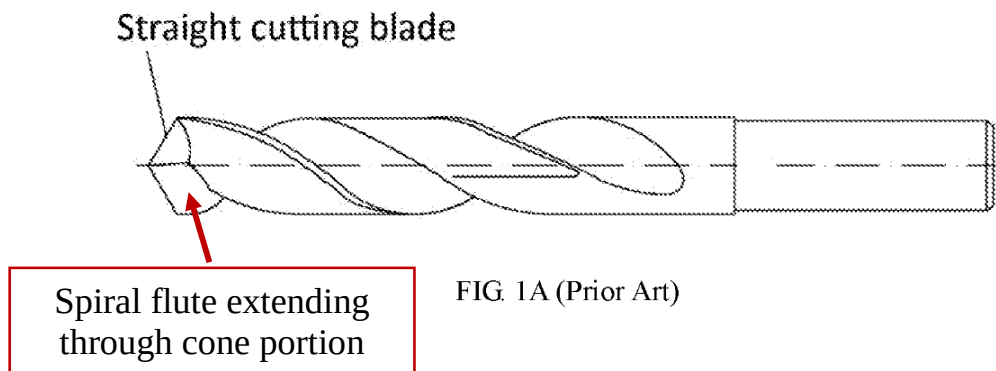


FIG. 1C (Prior Art)

Ex-1001, FIGs. 1A-1C.

31. I also disagree with Patent Owner's conclusion that the claims require curved major and minor cutting edges because there is no requirement that the claimed spiral flute have a sidewall that is spiral the entire length of the flute. In my opinion, the claims are broad enough to allow a spiral flute that, as in

Bannister, has a portion of its sidewall that is straight on the leading edge of the cone portion while still maintaining its generally spiral shape. I understand that Patent Owner does not actually challenge that Bannister has a spiral flute extending along the cone portion. I interpret the claims to encompass a spiral flute that has a straightened sidewall with straight major and minor cutting edges, as in Bannister. Indeed, a drill like that described in the '583 patent could be formed with straight cutting edges.

32. Even if curved major and minor cutting edges are inherent limitations of the independent claims, it would not change my conclusion that the challenged claims are invalid. The challenged claims would have been obvious, as set forth below with respect to Ground 3. In other words, even assuming that independent claims 1 and 8 require curved major and minor cutting edges, I nevertheless conclude that these claims are unpatentable as obvious for the same reasons as claims 18 and 22.

D. References May Still Be Combined Even Though They Claim Similar Advantages

33. I understand Patent Owner argues that a POSA would not be motivated to combine the teachings of Bannister with either Zhou or Welty because they discuss advantages that are allegedly redundant to the advantages discussed in Bannister. Response at 31-42. I disagree with this. Patent Owner's argument necessitates that a POSA would believe Bannister teaches the pinnacle of

stepped-tip twist drill design, and that a POSA could not conceive of being able to improve upon it. This is clearly not true, at least as evidenced by the incredible number of advancements in drilling technology that have occurred between 1940 and around 2016 or later. I am informed that the extent to which references are in the same field of technology can support the obviousness of combining those references. A POSA would be motivated to combine Bannister with Zhou and/or Welty because each of these references teach drills having stepped front portions that provide improved drill performance.

34. Accordingly, a POSA would have been motivated to modify Bannister by incorporating features from Welty and Zhou as discussed in the Petition. The Board should find that claims 1, 2, 5, 7, 8, 12, 14, 15, and 19 of the '583 patent are invalid as obvious over Bannister modified by Zhou and/or Welty.

V. Ground 3: Obviousness Based on Bannister in View of Zhou, Welty, and/or the Knowledge of a POSA, and Further in View of Korb

35. Patent Owner's arguments in its Response and the evidence submitted in connection with it do not alter my conclusion that it would be obvious to combine the teachings of Korb with those of Bannister modified by Welty and/or Zhou. Obviousness is not negated by the fact that Korb describes a step drill while the other references discuss twist drills.

36. I understand Patent Owner argues that, even if the combination were made, Bannister combined with Zhou, Welty, and/or Korb would not provide a

spiral arrangement of cutting tips because “a plurality of cutting tips would have to number four or five to arguably form a spiral of any sort.” *Id.* at 42, Ex-2003, ¶42. This is not an element of the challenged claims. It is not discussed anywhere in the ’583 Patent. Patent Owner’s expert, Dr. Endres, admitted that the minimum number of steps on a drill covered by claims 1 and 8 is just two. Ex-1046, 79:21-80:6.

37. I understand Patent Owner more fundamentally argues that a POSA would not make the combination advanced by Petitioner in Ground 3. Patent Owner contends that the application of a step drill is so different from that of a twist drill that a POSA would never consider combining the teachings of step drills with a twist drill. Response at 42-43. A POSA looking to improve the properties of a twist drill would consider the features of any type of drill, so long as they were compatible with the function of the twist drill.

38. In an attempt to counter the obviousness of combining step drill features on a twist drill, Patent Owner appears to assert that the drill described in the ’583 patent cannot be considered a step drill since the axial dimension of each step is so small. Response at 43. However, the distinction between twist drills and step drills is not black and white. Indeed, it was known that a step drill could be used to drill through a workpiece that was thicker than the step height of the step drill. Ex-1004, ¶46. Likewise, a drill described in the ’583 patent could

theoretically be used as a step drill to cut material that is thinner than the height of each step of the stepped tip. The sometimes weak distinction between step drills and twist drills is apparent in Patent Owner's own advertising literature that focuses on the step drill-like nature of its drills, stating "[t]he multi-stepped tip acts like a step drill, allowing for laser like holes through sheet metal." Response at 58, Ex-2041.

39. Returning to the issue of curved major and minor cutting edges, even these are inherent limitations of the independent claims, it would not change my conclusion that the challenged claims are invalid as obvious. As I explained in my previous declaration, it would have been obvious to modify Bannister to have a flute with a sidewall that angles or spirals all the way to the tip of the drill in such a way that the cutting tips are formed spirally. Ex-1004, ¶¶249-55. In the case where this flute has a sidewall that spirals all the way to the tip of the drill, this also leads to the allegedly inherent "curved" major and minor cutting edges. Thus, the claims would have been obvious even if the Board accepts Patent Owner's position that the claims require curved cutting edges. See Ex-1004, ¶¶249-55.

40. I do not find Patent Owner's argument that it would not have been obvious to modify Bannister to have a flute with a sidewall that maintains its spiral shape all the way to the tip of the drill to be persuasive. Although Korb shows an angled flute that leads to spirally formed cutting tips, Durfee does this same thing

with a flute that is helical. Ex-1011, FIGs 1, 4-6. It would have been obvious to modify Bannister with Durfee for the same reasons it would have been obvious to modify Bannister with Korb. Patent Owner's contention that "[i]t was not at all obvious to combine step-like features, similar in a way to those found in step drills, to the exterior of the cone portion of a twist drill," Response at 24, is not credible. I understand Bannister to teach a twist drill with step-like features, similar to those found on step drills, on the exterior of its cone portion. Numerous other prior art references have done this as well, such as Welty, Zhou, and Sheldon. *See generally* Exs. 1006-1008, 1014. Likewise, the Tool and Manufacturing Engineers Handbook from 1983 shows and describes a twist drill with steps:



Step drill

Ex.1017 at 23, 25 ("Step drills have two or more diameters ground into the lands of the drill. Normally, the drill will be of the two-flute style[.]").

41. Modifying Bannister to have a spiral flute sidewall along the cone portion, rather than having a straight cut along the leading edge, is a very minor modification to Bannister. Doing so would be a matter of routine engineering design choice. As I have previously explained, modifying Bannister to have a spiral flute sidewall along the cone portion leading edge would lead to improved

swarf evacuation, Ex-1004, ¶¶249-55, which can result in less likelihood of tool fracture and improved workpiece finish. It would also eliminate a manufacturing step by allowing the flute to be ground in a single operation rather than two (i.e., one grind to form the spiral flute and a second to grind back the leading edge of the cone portion to be straight). This would not be a major redesign of Bannister, but would in fact simplify Bannister and give it advantages. It would make no sense that a POSA would not seek to improve upon Bannister's teachings just because Bannister already improves upon standard twist drills. Drills are competitive and commoditized products where innovators are always looking for improvements that can give even marginal advantages over the competition.

42. In Bannister, it has been assumed that the leading edge is formed by grinding back the leading edge of the cone portion where it meets a spiral flute in order to form a straight leading edge with straight cutting edges. It is also possible that in the alternative, Bannister shows a spiral flute that intersects the leading edges of a cone portion in such a way that the major cutting edges are all straight as a natural consequence of the particular cone angle and flute helix angle in a manner similar to the twist drills having spiral flutes and straight cutting edges shown in FIGs 1A-1C of the '583 Patent. If this is the case, even a trivial adjustment to the spiral flute helix angle or to the point angle of the cone portion would result in spirally-formed cutting tips and curved cutting edges if all other

parameters are unchanged. Such an adjustment would be obvious for the same reasons discussed above.

43. Lastly, to counter obviousness, Patent Owner argues that the “unique tip geometry of Mr. Wang’s patented design” removed the problem of “walking” when a large diameter enters a workpiece, which was conventionally solved by using a separate drill to drill a pilot hole. Response at 43-44. This is inaccurate. A POSA would recognize that the problem of “walking” occurs when the drill first contacts the workpiece. To the extent claimed drill eliminates or reduces walking, a POSA would recognize that it is due to the tip of the drill having a split-point tip design. The split-point tip design was known well before the ’583 patent and is not inventive. Ex-1004, ¶¶48-49; Ex-1045, ¶¶18-19. It was obvious to include a split-point tip to provide its well-known advantages.

44. PO has failed to overcome the *prima facie* case that claims 13, 18 and 22 are obvious over Bannister in view of Zhou or Welty, and further in view of Korb.

VI. Patent Owner’s Arguments Regarding Secondary Considerations Do Not Alter My Opinion That the Challenged Claims Are Obvious

45. Patent Owner claims that the design shown in the ’583 patent allows “a faster penetration rate and thus reduced time to produce a given hole.” Response at 44. This was disclosed in the prior art, *e.g.* “[an] object of my invention is to provide a drill having a plurality of boring portions which successively increase in

diameter from the initial cutting step so that the work may be easily drilled.” Ex-1008, p. 1, col. 1:18-22. Furthermore, a POSA would have known that step drills can penetrate quickly into a workpiece and this so-called “advantage” could not have been unexpected.

46. Patent Owner claims that the design shown in the ‘583 patent results in “improved durability due to better distribution of the thermal load (heat) and mechanical load (force) generated at the cutting edge during cutting. Response at 44. This was disclosed in the prior art, *e.g.* “shall generate less heat in cutting.” Ex-1006, p. 1, col. 1:5. A POSA would understand that mechanical load is distributed over the different steps of a stepped drill as shown in at least Ex-1006, Ex-1007, Ex-1008, Ex-1010, Ex-1011, and Ex-1012. This so-called “advantage” could not be considered unexpected.

47. Patent Owner claims that the design shown in the ’583 patent results in improved chip evacuation as a result of a plurality, and for larger bits many, chips having narrower width than for a standard twist drill where the chip width is approximately equal to the cutting lip length where the narrower chips are also weaker and have a tendency to fracture into short lengths. Response at 44. A POSA would realize that the drills having stepped points as shown in at least Ex-1006, Ex-1007, Ex-1008, Ex-1010, Ex-1011, and Ex-1012 would produce chips that are narrower than for a standard twist drill of similar diameter, and that such

narrower chips would be weaker and tend to fracture into shorter lengths. Bannister explicitly states an object of his drill is to “be effective to clear the hole being drilled of chips as they are formed.” Ex-1006, p. 1, col. 1:9-11. This so-called “advantage” could not be considered unexpected.

48. Patent Owner claims that the design shown in the ’583 patent results in reduced or eliminated bit walking during cutting. Response at 44. A POSA would have known that the use of a split-tip point on a drill bit results in the reduction of elimination of bit walking, especially when the drill initially contacts the workpiece. This advantage was also discussed in the prior art, *e.g.* “[the drill] shall be readily started into the material to be drilled.” Ex-1006, p. 1, col. 1:7-8. This so-called “advantage” could not be considered unexpected.

49. Patent Owner claims that the design shown in the ’583 patent results in allowing users to drill large-diameter holes in thin workpieces like sheet metal with a twist drill...without the need to first drill a pilot hole (and thus eliminating the need to switch drill bits). A POSA would have known that the stepped drills shown in at least Ex-1006, Ex-1007, and Ex-1008 would permit the drilling into a workpiece without requiring a pilot hole. Bannister explains this is exactly how his drill works. See Ex-1006, p. 2, col. 2:49-55. This so-called “advantage” could not be considered unexpected.

50. Many of the advantages that Patent Owner imputes to the allegedly

inventive claims can be attributed to the prior art split point tip feature, which is not new or inventive. A POSA would recognize that split point tip geometry is known to provide at least these advantages:

- **Reduced Drilling Force:** Split point tips are designed to penetrate materials more easily, requiring less force during drilling. The geometry of the split point allows the bit to start cutting immediately upon contact with the material, minimizing the need for excessive pressure.
- **Faster Penetration:** The split point design helps to reduce the "walking" or wandering of the drill bit when it first contacts the material. This results in faster and more accurate drilling as the bit can quickly engage and maintain its position.
- **Self-Centering:** The split point design facilitates self-centering, meaning the bit is more likely to stay on target without the need for a center punch or pilot hole. This is particularly useful when starting a hole on a smooth or uneven surface.
- **Improved Precision:** Split point tips provide better precision. The immediate cutting action allows for more controlled drilling and minimizes the likelihood of the bit slipping off the intended drilling spot.

51. Many of the advantages that Patent Owner imputes to the allegedly inventive claims can be attributed to the stepped design of prior art step drills. Step

drills are not new or inventive. A POSA would recognize that step drills have at least the following advantages:

- **Reduced Cutting Force:** Because the successive cutting edges are engaged gradually, the axial force and torque are less than if the entire diameter were drilled at once.
- **Deburring:** Each step can act to deburr the hole created by the previous step, thus improving surface finish.
- **Reduced Chatter and Vibration:** Step drills may exhibit less chatter and vibration compared to twist drills. The stepped design can help distribute cutting forces more evenly, resulting in smoother drilling operation and improved surface finish.
- **Ability to Enlarge Existing Holes:** Step drills are particularly useful in enlarging existing holes, where they can start with a hole having a small diameter and then gradually increase it without the risk of catching or grabbing the material.

VII. Conclusion

52. In signing this declaration, I understand that the declaration will be filed as evidence in the contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in this case and that such cross-examination will take

place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

53. I declare that all statements made herein of my knowledge are true, and all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: January 16, 2024

By: 
Steven R. Schmid Ph.D.