

United States District Court,
S.D. New York.

CONVOLVE, INC. and Massachusetts Institute of Technology,
Plaintiffs.

v.

COMPAQ COMPUTER CORP. and Seagate Technology LLC,
Defendants.

No. 00CV5141GBD

Aug. 9, 2005.

MEMORANDUM DECISION AND ORDER

DANIELS, J.

Plaintiffs Convolve, Inc. ("Convolve") and Massachusetts Institute of Technology ("M.I.T.") (collectively, "plaintiffs") bring suit, alleging that defendants Compaq Computer Corp. ("Compaq") and Seagate Technology LLC ("Seagate") (collectively, "defendants") have infringed several of their patents. Plaintiffs seek injunctive relief and monetary damages. A *Markman* hearing was held to address the construction of the patent claims.

FACTS

Plaintiff Convolve owns United States Patent Nos. 5,639,267 ("the '267 patent") and 6,314,473 ("the '473 patent"). Plaintiff M.I.T. owns United States Patent No. 4,916,635 ("the '635 patent"). Plaintiffs allege patent infringement, trade secret misappropriation, and breach of contract. Specifically, plaintiffs assert infringement of claims 1-4, 11, 21, and 24 of the '635 patent, claims 19, 29, 39, and 55 of the '267 patent, FN1 and claims 1, 3, 4, and 7-15 of the '473 patent.

FN1. The parties indicated at the *Markman* hearing that infringement of the '267 patent is no longer being asserted, and did not raise the issue of claim construction of the '267 patent at the hearing.

The '635 patent, entitled "Shaping Command Inputs to Minimize Unwanted Dynamics," discloses a method to reduce vibration and noise in physical systems. One example given is of a load-bearing crane which, as the load is moved, develops vibrations within the system. As the operator moves the crane, the load begins to swing. This swing and resulting vibration can increase stress on the crane, forcing the operator to wait for the load to come to rest before performing another operation, such as lowering the load to the ground. The '635 patent discloses a method for reducing unwanted dynamics, such as the swinging of the crane load, by translating the sequence of operations performed by the operator into a sequence of operations that achieves the same end position while minimizing the unwanted dynamics introduced into the system. The method of

altering the inputs to a system is generally referred to within the art as "input shaping." ('635 patent Col. 1 line 29).

The '473 patent, entitled "System for Removing Selected Unwanted Frequencies in Accordance with Altered Settings in a User Interface of a Data Storage Device" discloses the application of input shaping to computer disk drives. Computer disk drives consist of platters coated with a magnetic substance, and a sensor attached to an arm which scans over the platters as they rotate. The spinning of the platters and movement of the arm introduce vibrations into the disk drive. The arm must be precisely positioned over the platter to accurately read the data contained therein, and vibration increases the time for the arm to reach the correct location. Performance of hard drives can be increased by spinning the platters or moving the arm more rapidly, at the cost of increased vibration. As disk drive capacity increases, the arm must become increasingly precise. All of these factors indicate the desirability of eliminating vibration in disk drives. The '473 patent translates the signals sent to the disk drive into a sequence which reduces unwanted vibration caused by the movement of the arm. The patent identifies certain frequencies which, when reduced, cause the disk drive to operate more quietly, and other frequencies that allow the arm to seek the correct position more quickly. ('473 patent Col. 7 lines 16-20).

CLAIM CONSTRUCTION

Patent infringement analysis involves two steps. In the first step the court determines the proper construction of the patent claims by establishing the scope and boundaries of the subject matter that is patented, as a matter of law. In the second step, the trier of fact compares the properly constructed patent with the alleged infringing device to determine if infringement has occurred. Claim construction is a question of law for the court. FN2 *See* Markman v. Westview Instruments, Inc., 52 F.3d 967 (Fed.Cir.1995), *aff'd*, 517 U.S. 320 (1996). The claims of a patent define "the metes and bounds of the right which the patent confers on the patentee to exclude others from making, using, or selling the protected invention." Corning Glass Works v. Sumitomo Elec. U.S.A., Inc., 868 F.2d 1251, 1257 (Fed.Cir.1989). Proper interpretation looks first to the intrinsic evidence: the language of the claims themselves, the patent specification, and the prosecution history if it is in evidence. *See* Gart v. Logitech, Inc., 254 F.3d 1334, 1340 (Fed.Cir.2001). The claims are at the center of the analysis. *See* Interactive Gift Express, Inc. v. Compuserve, Inc., 256 F.3d 1323, 1331 (Fed.Cir.2001). There is a heavy presumption that claim terms have the plain and ordinary meaning given to them by one of ordinary skill in the art. *See* Bell Atl. Network Servs., Inc., v. Covad Communications Group, Inc., 262 F.3d 1258, 1268 (Fed.Cir.2001). Where the claim language is unambiguous, the intrinsic record should only be consulted to determine whether a deviation from the plain meaning is required. FN3 *See* Interactive Gift Express, Inc., 256 F.3d at 1331. Dictionaries may be used at any point in litigation to aid the court in better understanding both the technology and terminology used by those skilled in the art, but the dictionary definition cannot indicate a meaning different from the intrinsic record. *See* Texas Digital Sys., Inc. v. Telegenix, Inc., 308 F.3d 1193, 1202 (Fed.Cir.2002).

FN2. The purpose of construing patent claims is to define the scope of the coverage of the claim by interpreting the words and terms of art used as they would be understood at the time the claim was made by one reasonably skilled in the relevant art. Claim construction "is the judicial statement of what is and is not covered by the technical terms and other words of the claims." Network, LLC v. Central Corp., 242 F.3d 1347, 1352 (Fed.Cir.2001).

FN3. Intrinsic evidence consists of the patent itself: the claims, the specification, and the prosecution

history, if in evidence. *See Zodiac Pool Care, Inc. v. Hoffinger Indus., Inc.*, 206 F.3d 1408, 1414 (Fed.Cir.2000).

Furthermore, claims must be read in light of the specification, of which they are a part. *See Markman*, 52 F.3d at 979. Claim terms must be constructed so as to be consistent with their use in the specification. FN4 The presumption that claim terms have their ordinary meaning is rebutted when the inventor has demonstrated a clear intent to act as his own lexicographer. *See C.R. Bard, Inc. v. United States Surgical Corp.*, 388 F.3d 858 (Fed.Cir.2004) (providing an explicit definition or words of manifest exclusion demonstrate disavowal of claim scope). The specification also contains a preferred embodiment of the invention, which discloses the best mode of practicing the invention contemplated by the inventor. The preferred embodiment does not impart a limitation on the claims. The prosecution history, a contemporaneous record of proceedings before the Patent and Trademark Office, must also be considered if it is in evidence. Amendments made by the patentee to overcome or distinguish a reference serve to limit claim terms, as do statements made to the examiner during prosecution. However, if the applicant wishes to disclaim claim scope during prosecution, such disclaimer must be clear and unambiguous. *See Invitrogen Corp. v. Biocrest Mfg., L.P.*, 327 F.3d 1364, 1367 (Fed.Cir.2003).

FN4. The specification acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication. *See Vitronics*, 90 F.3d at 1582; *see also Markman*, 52 F.3d at 979. Because the specification contains a written description of the invention which must be clear and complete enough to enable those of ordinary skill in the art to practice the invention, the specification "is the single best guide to the meaning of a disputed term." *Vitronics*, 90 F.3d at 1582.

After the intrinsic evidence has been considered, the court may look to extrinsic evidence to guide the interpretation. Extrinsic evidence includes expert and inventor testimony, treatises, and all other evidence external to the text of the patent and the prosecution history. *See Markman*, 52 F.3d at 979-90.

THE '635 PATENT

The '635 patent is directed to a method for removing unwanted dynamics from a physical system. The patent discloses a method, called "shaping," which modifies inputs to a system so as to minimize those unwanted dynamics. In the preferred embodiment, a mathematical model of the system is generated, from which the response of the system to an input can be determined. ('635 patent Col. 4 lines 63-69). Based on this model, a sequence of inputs FN5 is generated such that the unwanted dynamics of each individual input cancels out the unwanted dynamics of the others when an impulse is applied to the system. In different refinements of the system, the number of inputs in the generated sequence is increased. ('635 patent Cols. 5-7). As more inputs are added to the sequence, the ability of the model to reduce unwanted dynamics to an acceptable level is improved. ('635 patent Col. 6 lines 12-49). The ability of the model to maintain unwanted dynamics below an acceptable level is termed "robustness." ('635 patent Col. 4 lines 14-18).

FN5. The preferred embodiment discusses this sequence as "a sequence of impulses" ('635 patent Col. 4 lines 8-14), however dependent claims 2-6 disclose numerous variations on the form of the sequence.

The parties dispute the meaning of several terms which appear in multiple claims. Each of the terms has the

same meaning unless otherwise noted. Claim 1 is cited by both parties as a representative claim. (Pls.' Claim Construction Br. For U.S. Patent No.'s '635, '267, and '473 at 37; Defs.' Responsive Claim Construction Brief for U.S. Patent Nos. '635 and '267 at 9).

A. CLAIM 1:

1. Input

The first element of claim 1 provides: "A method for generating an *input* to a physical system to minimize unwanted dynamics in the physical system response ..." ('635 patent Col. 10 lines 41-42) (emphasis added).

Plaintiffs allege that the term "input" encompasses any "information that is delivered to the system from outside the system", relying on the plain dictionary definition of the term. (Pls.' Claim Construction Br. At 39). The dictionary definition of "input" is "data or similar information fed into a computer or accounting machine." *Merriam-Webster's Third New International Dictionary Unabridged*, Merriam-Webster, Inc., 1993.FN6 Defendants respond, relying principally on the specification, that an "input" is "the second signal that is applied to a control system to cause a desired action in the control system such that the altering of the first signal to create the second signal is unaffected by the actual action of the control system." (Joint Claim Construction and Prehearing Statement at Exhibit B, '635 Patent 1). The principal distinction in defendants' definition is that the signal sent to the physical system is "an altered signal generated outside the control loop." (Defs.' Proposed Claim Construction Order for U.S. Patent Nos. '635; '267 and '473 at 10).

Defendants seek to exclude situations where the input shaping is performed within the control loop. The control loop is a configuration where a system receives an input, acts in response to it, then measures whether the system reached the desired state. If the system did not respond as anticipated, then the system is adjusted repeatedly until the correct state is reached.

FN6. While this definition has not been offered into evidence by either party, dictionaries are usable "As resources and references to inform and aid courts and judges in the understanding of technology and terminology ... at any stage of a litigation, regardless of whether they have been offered by a party in evidence or not." *Texas Digital Sys. V. Telegenix, Inc.*, 308 F.3d 1193, 1203 (Fed.Cir.2002).

The plain meaning of "input" is consistent with its use throughout the patent. Particularly relevant are two uses in claim 11. The preamble provides: "Method for shaping an arbitrary command input to a dynamic physical system ..." ('635 patent Col. 11 lines 17-19). The third element provides: "controlling the physical system based on the shaped command input ..." ('635 patent Col. 11 lines 24-25). Any interpretation of the term "input" must be consistent across these uses. There is a "presumption that the same terms appearing in different portions of the claims should be given the same meaning unless it is clear ... that the terms have different meanings at different portions of the claims." *Fin Control Systems Pty, Ltd., v. OAM, Inc.*, 265 F.3d 1311, 1318 (Fed.Cir.2001). The use in the preamble of claim 11 clearly indicates that the "input" therein is the input to the physical system that is going to be shaped, as the second element provides that the input is shaped by "convolving the impulse sequence with the arbitrary command input." ('635 patent Col. 11 lines 22-23). The use in the third element is modified by "shaped command," indicating that the input has been shaped as disclosed in the first two elements. The plain meaning of "input" offered by plaintiffs is consistent with all these uses. "Input" covers, generally, a piece of information which is delivered to a system. In the preamble of claim 11, this input is the unshaped input to a physical system which the invention addresses. In element three, it is the shaped element produced by the invention.

Defendants offer two main arguments for their proposed construction. The first is that the patent only discloses a system where the shaped command input is generated outside the control loop. (Defs.' Responsive Claim Construction at 11). An inquiry into whether or not a patent adequately discloses an invention is a question of validity. *See, e.g., Moba v. Diamond Automation*, 325 F.3d 1306 (Fed.Cir.2003). It is improper to determine validity before properly constructing the claims. *See Markman*, 52 F.3d 967. It is apparent that plaintiffs have not disclaimed the situation where input shaping is performed within the control loop. Whether or not they have adequately disclosed a method which can be used within the control loop is question of validity. Plaintiffs have asserted a construction that is supported by the plain language of the specification, and accordingly bear the risk that the patent will subsequently be found invalid.

Defendants' second argument is that Plaintiffs' construction "would necessarily cover an unaltered input that would result in the very unwanted vibrations the alleged inventions are intended to eliminate." (Defs.' Responsible Claim Construction at 10). This assertion lacks merit. Adopting plaintiffs' construction merely indicates that an "input" follows the plain and ordinary meaning of the term. Concerns that the patent will be broadened beyond what is claimed, "a method for generating an input ... to minimize dynamics," are unfounded as infringement requires that each limitation of the claim be met, either literally or under the 'doctrine of equivalents.' *See Frank's Casing Crew & Rental Tools, Inc., v. Weatherford Int'l, Inc.*, 389 F.3d 1370, 1377 (noting "literal infringement requires that each and every limitation set forth in a claim appear in an accused product"); *Riles v. Shell Exploration and Production Co.*, 298 F.3d 1302, 1309 (stating "[i]nfringement under the doctrine of equivalents requires that the accused product contain each limitation of the claim or its equivalent.") An accused infringer must meet the other limitations of the claim in order to infringe, including that the method "minimize unwanted dynamics." If an input does not "minimize unwanted dynamics," then it is not covered by claim 1 because it has failed to meet all the elements of that claim.

Accordingly, plaintiffs' proposed construction for the term "input" is adopted. The term "input," as used in independent claims 1, 11, 21, and 24, and dependent claim 2, is interpreted to mean: "information that is delivered to the system from outside the system."

2. Expressions

The first element of claim 1 provides: "*establishing expressions* quantifying the unwanted dynamics of the physical system" ('635 patent Col. 10 lines 44-45) (emphasis added).

Plaintiffs argue that the term "expression" indicates any means of symbolizing, and so in this context, an "expression" would be anything that quantifies the unwanted dynamics of the system. (Pls.' Claim Construction Br. For U.S. Patent No.'s '635, '267, and '473 at 40). Plaintiffs base this meaning on the dictionary definition of an expression. The dictionary definition most relevant to the context of the patent is: "A sign or a character or a finite sequence of signs or characters (as logical or mathematical symbols) representing a quantity or operation." *Merriam-Webster's Third New International Dictionary Unabridged*, Merriam-Webster, Inc., 1993. Defendants insist that the meaning be limited to mathematical equations which are in the time domain. (Defs.' Proposed Claim Construction Order for U.S. Patent Nos. '635, '267, and '473 at 1). A mathematical equation in the time domain is one which expresses some value, here the unwanted dynamic, as a function of time.

The correct interpretation must be consistent with the use of the term in the specification. *See Texas Digital*, 308 F.3d at 1202. The terms "expression" and "expressing" or "expressed" appear several times in the

specification: "establishing expressions quantifying the unwanted dynamics" ('635 patent Col. 3 lines 62-63); "a system's unwanted dynamic response will be expressed as a function of its transient input" ('635 patent Col. 4 lines 54-57); "[t]he same result can be obtained mathematically by adding two impulse responses and expressing the result for all times greater than the duration of the input" ('635 patent Col. 5 lines 17-21); "[e]limination of vibration after the input has ended requires that the expression for A_{amp} equal zero at the time at which the input ends ..." ('635 patent Col. 5 lines 44-46); "[i]n order to quantify the residual vibration level for a system, a vibration-error expression must be defined ..." ('635 patent Col. 6 lines 1-3); "[i]t can be shown that the same expressions that guarantee zero derivatives with respect to frequency also guarantee zero derivatives with respect to damping ratio" ('635 patent Col. 6 lines 41-44); "[t]hese sequences can be obtained by expressing the same (or some other equivalent) constraint equations ..." ('635 patent Col. 7 lines 10-12).

Imposing defendants' "time domain" limitation would be inappropriate. While many of the "expressions" discussed in the specification are solved for time, *see, i.e.*, '635, Col. 5, lines 44-46; '635, Col. 5, lines 44-45, all of these examples occur in the preferred embodiment of the specification. Since limitations cannot be imposed based solely on the preferred embodiment, defendants' argument requires that the patentee evinced a clear intent to act as his own lexicographer. Consistent and explicit use of a claim term in the specification to mean something other than the ordinary meaning indicates this intent. *See Intellicall, Inc. v. Phonometrics, Inc.*, 952 F.2d 1384, 1388 (Fed.Cir.1992) (noting "[s]o long as the meaning of an expression is made reasonably clear and its use is consistent within a patent disclosure, an inventor is permitted to define the terms of his claims.") The patentee did not consistently and uniformly use "expression" to unambiguously refer to time-domain equations, *See, i.e.*, '635, Col. 6, lines 46-48 (referring to a graph in the frequency domain as "the vibration-error expression for the same three sequences of impulses ...") The use in the specification is not sufficiently definite to demonstrate the necessary "unequivocal intent," therefore the plain and ordinary meaning is presumed.

Within the context of the specification, and to be consistent with the plain meaning, "expression" cannot include all possible methods that quantifies a dynamic. There must be a solution that minimizes that which is quantified expression. ('635, Col. 10, lines 50-52). The only type of "expression" offered by plaintiffs which quantifies and can be solved is a mathematical characterization. (Pls.' Reply to Defs.' Responsive Claim Construction Br. for U.S. Patent Nos. '635 and '267 at 3). Plaintiff has argued that "expression" should not be limited to "equations where there must be an equal sign" (Transcript of Proceedings Held on 3/31/2004 at 262). Given the character of the invention, which is designed to meet or exceed a threshold level of unwanted dynamics, there is no reason to impose a requirement for "an equal sign." Accordingly, the term "expression," as used in independent claim 1 is interpreted to mean: "a mathematical characterization that quantifies." FN7

FN7. This interpretation was not offered by either party. The Court of Appeals for the Federal Circuit permits adoption of claim constructions not offered by either party when they are consistent with the standards of claim construction. *See, e.g.*, *Blistad v. Wakalopoulos*, 386 F.3d 1116, 1121-1123 (Fed.Cir.2004).

3. First Constraint

The second element of claim 1 provides: "establishing *first constraints* bounding the available input to the physical system" ('635 patent Col. 10 lines 46-47) (emphasis added).

Plaintiffs argue that the "first constraint" imposes a limit on the "input" generated by the method such that it does not exceed the capabilities of the physical system. The method transforms each input into a sequence of impulses in a way that vibration is reduced. There is no certainty that the physical system is capable of responding to the new sequence of impulses. Defendants argue that the constraint is "a limit on the size of the input." (Defs.' Responsive Claim Construction Brief for '635 and '267 Patents at 15). The term "first constraints" is defined by the language of the specification as the physical limits of what input the system can receive. ('635 patent Col. 7 lines 17-39). Defendants' reading is only justified if the only limitations on the inputs of the system are on the size. For some physical systems this may be the case. The language of the patent itself, however, extends to any limitations on the possible inputs to the physical system, and therefore "first constraint" is not solely a limit on the size of the available input.

Accordingly, the term "first constraint" as used in independent claim 1 is interpreted to mean: "a limit on the input based on the physical system."

4. Second Constraint

The third element of claim 1 provides: "establishing *second constraints* on variation in system response with variations in the physical system characteristics." ('635 patent Col. 10 lines 48-49) (emphasis added).

Plaintiffs argue that in this context "second constraints" refer to robustness. It is undisputed that robustness refers to the ability of the model of the physical system to successfully reduce unwanted dynamics in the physical system when the model is not exact. (Pls.' Claim Construction Br. For U.S. Patent No.'s '635, '267, and '473 at 9; Defs.' Responsive Claim Construction Br. for '635 and '267 Patents at 16). The model of the physical system which quantifies the response of the system to an input will only eliminate all dynamics when the model is exact. An inexact model can be due to operation of the physical system in an environment which can influence its behavior, such as variation in temperature, humidity, or precision of manufactured components of the system. In the crane example, the addition of wind to the system could cause the load to swing in ways that the model cannot anticipate. Plaintiff argues that the term should be given the meaning "constraints on the range of response over a range of differences in the physical system." (Pls.' Claim Construction Br. at 41). Defendants respond that the only valid interpretation of the term is that derivatives of specific time domain equations are set to zero. (Defs.' Responsive Br. for '635 and '267 at 16). This definition is based on an example in the preferred embodiment, where the model for the physical system is expressed as a system of equations. ('635 patent Cols. 5-6). The "time domain equations" referred to by defendants are a set of equations added to the system which constrain the solutions to the system.

Since there is no plain and ordinary meaning for the term "second constraints," its meaning must be found in the specification. The term is defined at the outset to be "variation in system response with variations in system characteristics." ('635, Col. 4, lines 4-5). The preferred embodiment describes the "second constraint" as an additional constraint where the derivatives of the physical response to an impulse are taken with respect to frequency. ('635, Col. 6, lines 12-49). Second constraints are limitations imposed on the "expressions" described in part A.2, *supra*. Expressions are not restricted to equations in the time domain. The expression modeling the physical system could exist in, *i.e.*, the frequency domain. It is nonsensical to impose a constraint on a variable which is not in the equation. Moreover, restricting the term "second constraints" to setting derivatives of an equation to zero ignores the breadth claimed in the patent. The specification contemplates imposing constraints on the expressions modeling the physical system. The full specification, not just the preferred embodiment, breathes meaning into the claims. *See Amhil Enters. v.*

Wawa, Inc., 81 F.3d 1554, 1559 (Fed.Cir.1996) (refusing to limit the claim to the preferred embodiment since "[a] preferred embodiment, however, is just that, and the scope of a patentee's claims is not necessarily or automatically limited to the preferred embodiment. The entire specification, including all of the claims, the prosecution history, and the prior art may all affect the interpretation ultimately placed on claim language.") It would therefore be inappropriate to restrict the meaning of "second constraints" to defendants' interpretation, which emphasizes the preferred embodiment over the specification as a whole, and would be incompatible with the meaning of the term "expression."

Accordingly, the court finds the term "second constraint" as used in independent claim 1 is interpreted to mean: "variation in system response with variations in system characteristics."

5. Minimize

The term "minimize" appears in both the preamble and the fourth element of claim 1: "finding a solution which is used to generate the input which *minimizes* the value of the expressions while satisfying the first and second constraints ..." ('635 patent Col. 10 lines 50-51) (emphasis added).

Plaintiffs argue that the term "minimize" should be understood to mean "reduce to a minimum." Defendants argue that "minimize" should be "reduce to zero." Neither party has indicated that this term is used in any way other than its ordinary meaning. The dictionary definition of "minimize" is "to reduce to the smallest possible number, degree, or extent." *Merriam-Webster's Third New International Dictionary Unabridged*, Merriam-Webster, Inc., 1993. Plaintiffs assert that within the context of the claim, "minimize" does not require reduction to zero. In support of their argument, plaintiffs recite the claim language that expressions are "minimized" subject to the constraints in the other elements of the claim. The constraints, as constructed *supra*, impose strict requirements on the input generated. Physical systems have a range of inputs which they are designed to receive. The input must be within this range ('635 patent Col. 7, lines 36-39) ("If at any time during the convolution, the actuator limit is exceeded, the sequence is unacceptable."), and within the range of tolerances the system permits ('635 patent Cols. 5-7). Within these constraints, and subject to real world conditions, the claimed method cannot necessarily eliminate all vibrations. (Decl. of Dr. Bell para. 20-21). *See also* '635 patent Col. 6, lines 8-11 ("Acceptable response is defined as less than 5% of total move size residual vibration.")

Defendants correctly indicate that the abstract of the patent states an objective "to eliminate unwanted dynamics", and a disclosed method in the specification which describes amplitudes of undesired vibrations as being reduced to zero. ('635 patent abstract; Col. 5, lines 44-61). Reducing unwanted dynamics to zero is only one step of the method taught by the invention. The abstract provides "A sequence of impulses is determined which eliminates unwanted dynamics of a dynamic system." ('635 patent abstract). This "sequence of impulses" is not the "input which minimizes the value of the expressions." In the preferred embodiment, the method taught determines how to translate an arbitrary input into another input. If the model is perfect with respect to the real-world operating environment, the patent contemplates eliminating all residual vibration. The imposition of the first and second constraints, above, are specifically imposed because of the difficulty of formulating a model which can capture every variation of the system's environment. *See* '635 patent Col. 5 lines 67-68 ("The two-impulse input, however, cancels vibration only if the system natural frequency and damping ratio are known exactly.") Interpreting "unwanted dynamics" to incorporate a threshold for acceptable residual vibration is consistent with the specification and the awareness of this difficulty. The disclosed method establishes a model which, in an idealized and abstracted world, eliminates a dynamic, such as vibration, from the system. ('635 patent Col. 5-6, lines 67-3) (noting

that "vibrations [are canceled] only if the system natural frequency and damping ratio are known exactly.") The preferred embodiment specifically accommodates for uncertainty in the natural frequency of the system, and to variations in the damping ratio. This is exactly what is contemplated by the "first constraints" and "second constraints" in the '635 patent claims. Defendants concede that they have no support for the assertion that reducing resulting vibrations to zero is possible.FN8

FN8. Mr. Akerley, attorney for defendant Seagate, adduced at the *Markman* hearing:

MR. AKERLEY: ... I'm not going to stand here and tell you that we can ever reduce those vibrations to an absolute zero.

THE COURT: ... what you're arguing that the plaintiff got a patent for, you're saying to me is impossible?

MR. AKERLEY: No.

THE COURT: Any of your experts opine that they know of such a system that reduces vibration to zero?

MR. AKERLEY: No.

Transcript of *Markman* Hearing at 131.

Reading a limitation into the claims which is so substantial as to exclude the preferred embodiment, when an alternative interpretation is clearly consistent with the language of the specification, is unwarranted. *See Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed.Cir.1994). The preferred embodiment contemplates a model where unwanted dynamics are reduced as much as possible, but with a tolerance for error. This tolerance would not be necessary if the invention reduced unwanted dynamics to zero in every instance. Presumably this is why plaintiffs opted for a broader term, encompassing solutions where the input is reduced as much as possible subject to constraints, but not necessarily to zero.

Accordingly, the term "minimize" as used in independent claims 1 and 11 is interpreted to mean: "reduce to a minimum."

6. Find A Solution

The third element of claim 1 provides: "*finding a solution* which is used to generate the input which minimizes the value of the expressions ..." (emphasis added).

Plaintiffs assert that the term "finding a solution" means "determining an answer." Defendants initially contended that "finding a solution" means "the sequence of impulse signals or finite duration pulses that sets the expressions of the amplitude of the resonant vibration equal to zero" (Defs' Responsive Brief for '635 and '267 Patents at 18), but conceded plaintiffs' definition at the *Markman* hearing (Transcript of Proceedings Held on 3/30/2004 at 176). Accordingly, the term "finding a solution," as used in independent claims 1 and dependent claims 2-4, is interpreted to mean: "determining an answer."

THE '473 PATENT

The '473 patent is generally directed to a system for reducing unwanted dynamics in disk drives. Dynamics can arise in a disk drive due to the movement of the drive arm, an internal mechanism, over the platters within the disk containing the data. Reducing these dynamics can provide faster seek time, by reducing the time it takes for the drive arm to settle over a specific location of the platter, or lower noise level since noise in hard drives is caused by vibration. The '473 patent discloses an application of the methods for shaping inputs to a disk drive, and providing a user interface to select between a faster seek time or lower noise level. As for the other two patents, '267 and '635, each term has the same meaning in all the allegedly infringed claims unless otherwise noted.

A. CLAIM 10:

1. User Interface

The first element of claim 10 provides:

providing a *user interface* for controlling one of a seek time of the data storage device and an acoustic noise level of the data storage device; (emphasis added)

There are two disputes over the term "user interface." The first dispute is whether a "user interface" is limited to being either a graphic user interface (GUI) or electromechanical switches, or whether a "user interface" more broadly encompasses any means to alter the drive performance parameters. The second dispute is whether the "user interface" can only be used by the human end-user of the system. Plaintiffs assert that a "user interface" broadly encompasses any means to alter the parameters. They further contend that a "user interface" can more generally be used by any person or other system which is capable of setting the parameters.

Within the relevant art, FN9 there are distinctions between a "user interface" and a "graphic user interface." The dictionary meaning of "User interface" is "the means of communication between a human user and a computer system, referring in particular to the use of input/output devices with supporting software. Examples include the graphical user interface (GUI) and command-line interface (CLI)." *A Dictionary of Computing*, Oxford University Press, 1996. Defendants assert that the specification indicates that "user interface" should be construed as "a graphic user interface ('GUI') of a type common to windowing operating systems such as Microsoft Windows or electro-mechanical switches." ('473 patent Col. 6:44-9:44). This fails to distinguish between a "user interface" and a "graphic user interface". Defendants claim the specification defines the term "user interface" to be synonymous with "graphical user interface":

FN9. The '473 patent discloses an invention for improving the performance of computer disk drives. The relevant art here is the field of computer engineering.

[A]s an alternative to the GUI, or to supplement the GUI, the disk drive may include one or more electro-mechanical manual switches for controlling all or part of the drive's operation in the manner set forth above. (473 patent Col. 9:38-42).

This language, however, clearly indicates the breadth of the term "user interface" to include both a GUI or electromechanical switches. This language indicates that a GUI is one type of "user interface," and an electro-mechanical switch is another, albeit simpler, type of "user interface." The "alternative to the GUI" and "supplement the GUI" language indicates that the electro-mechanical switch is not intended to limit the definition of "user interface," but rather demonstrates the range of user interfaces encompassed by the invention. *See Johnson Worldwide Assocs. v. Zebco Corp.*, 175 F.3d 985, 991 (Fed.Cir., 1999) ("Varied use of a disputed term in the written description demonstrates the breadth of the term rather than providing a limited definition.") Defendants' construction would require that "user interface" ensnare both a complex and simple user interface, but not the spectrum of user interfaces in between. The inventor did not demonstrate a manifest intent to disclaim every type of user interface not disclosed in the specification.

Plaintiffs' construction of "user" as "a person or device that uses the user interface" is too broad. It fails to give meaning to the adjective "user," which distinguishes the interface from other types of interfaces used in the computing field, for example, an advanced programming interface (API) which allows one software program to "interface" with another. The plain meaning of "user interface" requires a user, and the term "interface" typically indicates a means by which anything can interact with a device. Plaintiffs maintain that the term "user" cannot be limited to "a person" because this would exclude the situation where a person indirectly uses the interface. They argue, in essence, that any device can be broken down into a series of simpler devices. A potential infringer could, therefore, circumvent the patent by placing an intermediary device between the user and the invention. For instance, when using a GUI, the user typically positions the cursor on the screen using a mouse. A potential infringer could claim that the user is interfacing with the mouse, and the mouse is interfacing with the computer, thereby avoiding infringement. To avoid such pedantic arguments by accused infringers, the term is constructed specifically to include circumstances where a person has, at some point, dictated what the parameters should be. A patent cannot be constructed to deprive a claim term of all meaning, and plaintiffs' construction of "user interface" would render "user" meaningless.

Defendants also contend that the user of the "user interface" must be the human end-user of the drive. They claim that the description of the GUI in the specification compels an interpretation imposing the end-user restriction. However, the user can be any person who wants to make use of the device; in this case, setting the drive parameters. The plain meaning of "user" does not require an individual who is the end-user of a product. Even the word "end-user" militates against the proposed construction: "end" modifies "user," so in its regular usage "user" must mean something other than end-user. To impose a definition more limited than the normal meaning, there must be a clear intent on the part of the author to use the more limited definition. *Johnson Worldwide Assoc.*, 175 F.3d at 990 (stating that anything other than the "ordinary and accustomed meaning" inheres only "if the patentee has chosen to be his or her own lexicographer by clearly setting forth an explicit definition for a claim term" ... [or] ... "the term or terms chosen by the patentee so deprive the claim of clarity that there is no means by which the scope of the claim may be ascertained from the language used.")(internal citations omitted). Defendants do not assert that the term end-user appears in the patent, nor does any language limiting the potential user of the product appear.

Claim terms are to be given their normal broad meaning absent an explicit disavowal of scope. *See* Novartis Pharm. Corp. v. Eon Labs Mfg., 363 F.3d 1306, 1314 (Fed.Cir.2004). The "Windows-like operating system," one of the types of user interfaces defendants claim fits under their definition, is still a user interface when it is used by a technician configuring the computer before sale. There is no contemplation within the patent that only the end-user of the drive be able to use the interface, and defendants' examples also militate toward no limitation based on the type of user.

Defendants contend that plaintiffs' proposed construction could be read to include disk drives that have been irrevocably configured at the factory. This meaning is beyond the scope of a "user interface." A user interface enables the alteration of parameters of the system. Drives manufactured in such a way as to only be capable of a one-time setting, which is then fixed in the hardware, do not possess a capability to alter the parameters. They only have a capability to set the parameters once. This is beyond the ordinary meaning of "user interface" in the art.

Accordingly, the term "user interface," as used in independent claims 1, 10, 11, and dependent claims 4, 12, and 13, is interpreted to mean:

"hardware, firmware, or a combination thereof that allows a person, directly or indirectly, to alter parameters."

2. Data Storage Device

The first element of claim 10 also provides:

... for controlling one of a seek time of the *data storage device* and an acoustic noise level of the data storage device; (emphasis added)

The term "data storage device" is used several times in claim 10. The interpretation of this term is linked with the interpretation of "outputting," below. Plaintiffs assert that the data storage device comprises the electromechanical components of the disk drive that perform commands specified by a controller. Defendants assert that "data storage device" should be understood to mean a hard disk drive, including controller electronics. Defendants' construction would exclude from the scope of the claim those devices where shaped commands were generated within the drive itself.

The meaning adduced by both parties to "data storage device" is that it is a disk drive. Plaintiff states that those skilled in the art of control systems typically use a term to refer to that which is controlled, and that therefore what a layperson considers a disk drive would be characterized by a control engineer as a disk drive and a controller. (Pls.' Claim Construction Br. For U.S. Patent No.'s '635, '267, and '473 at 26). The specification supports such a construction. The patent in Col 10:1-21 describes a preferred embodiment of the control of a disk drive. Included in this description is the possibility that the processor controlling the disk drive is located in the PC, or, "alternatively, a separate controller dedicated to the disk drive which receives commands from [that] processor." '473 patent Col 10:6-8. Defendants claim that the specification discloses only two possible structures which can control the disk drive: the first is a processor within the PC, and the second is a controller which receives "commands" from that processor. (Defs.' Responsive. Claim Construction Br. for '473 Patent at 5). Since the third element of claim 10 uses the term "command" to refer to shaped inputs, defendant infers that the commands must be shaped by the processor located within the PC. Defendant combines a context-specific use within one claim with a more general use in the

specification. The term "command" as it is used in the specification refers to signals communicated from a keyboard or mouse (Col.6:19), to a signal which will be shaped (Col.8:12), and to signals in a disk drive generally (Col.2:22-28). Claim 10 refers to a specific kind of "command," one that has been shaped by a processor. The command referred to in Col. 10:6-8 could therefore be a signal which has been shaped by a disk drive engine running on a processor in the PC, or an unshaped signal from the PC which will be shaped by a processor dedicated to the disk drive and not located in the PC. Defendants argue that since "disk drives," as lay people use the term, commonly include on-board electronics dedicated to controlling the drive, a construction that permits on-board electronics to send "commands" is not supported. Such a configuration is within the scope of the claim. Accordingly, the term "data storage device," as used in claim 10, is interpreted to mean:

"a computer disk drive, including all electronic and mechanical components, which receives shaped commands from a processor which may be integrated into the drive."

3. Outputting Commands to the Data Storage Device

The third element of claim 10 provides: "*outputting commands to the data storage device* causing the data storage device to alter seek trajectory ..." (emphasis added).

The parties dispute whether the underlined portion of the claim imposes a limitation that the commands must be generated in the computer. Plaintiffs asserts that the commands can originate from any source. Defendants seek to exclude from the scope of the claims situations where electronics located within the disk drive itself perform a shaping method on commands sent to the data storage device. The specification discloses in the preferred embodiment a software application, the disk drive engine, which "generates and outputs commands to the disk drive." ('473 patent, Col. 6 lines 43-45). This application is executed either on the main processor of the computer of which the disk drive is a component, or "a separate controller dedicated to the disk drive which receives commands" from the main processor of the computer. ('473 patent, Col. 10 lines 6-8). Defendants' argument depends in part on their construction of data storage device to include any electronics built into a commercially packaged disk drive. The construction of "data storage device" adopted is consistent with the claim language requiring that commands be "output" to the data storage device. This reduces the question to the source of any "output."

Defendants are correct that plaintiffs do not provide any guidance regarding the source of the "commands" being "output." In order for the claim to be self-consistent, the "commands" must be the "input signals to the data storage device." The dictionary definition of "output" is "the result of data-processing activity when it is presented external to the system ... it may be ready for input to another system or process ..." A *Dictionary of Computing*, Oxford University Press, 1996. Within the context of the invention, the disclosed method for shaping inputs is performed. The result of this method, in the form of "commands," are sent (as output) from the processor performing the shaping to the data storage device (as input). The word "output" when applied to a signal does not inherently require that the signal be sent from a different device than that receiving the signal. A feedback system "outputs" a signal to itself, which it then uses as an input.

Accordingly, the term "output," as used in independent claims 1, 7-11, and 14-15, is interpreted to mean: "sending a command to a device, which may originate from within the device."

4. By Shaping Input Signals and Selected Unwanted Frequencies

The third element of claim 10 also provides:

"... causing the data storage device to alter seek trajectory shape *by shaping input signals* to the data storage device to reduce *selected unwanted frequencies* from a plurality of frequencies ..." (emphasis added)

The two underlined terms are in dispute. Plaintiff argues that the term "shaping" includes frequency-based filtering, and that "selected unwanted frequencies" can be some or all of the unwanted frequencies. Defendant insists that filtering, which is found in prior art references, cannot be encompassed by the invention. They also argue that the term "selected" precludes selection of all unwanted frequencies.

Defendants' assertion that including filtering in the term "shaping" would result in invalidity is premature. The specification unambiguously indicates that shaping includes conventional filtering techniques. (473 patent, Col. 22:60-67). The patentee's offered construction does not conflict with the explicit language of the claim, and follows from the plain meaning of the term. *Rhine v. Casio*, 183 F.3d 1342, 1346 (Fed.Cir.1999) (the court should "sustain the patent and the construction claimed by the patentee himself, if this can be done consistently with the language which he has employed.") This construction may later be found invalid, but it is inappropriate to argue invalidity during claim construction. *Rhine v. Casio*, 183 F.3d 1342, 1346 (Fed.Cir.1999) (defendant "cannot avoid a full-blown validity analysis by raising the specter of invalidity during the claim construction phase.")

Accordingly, the term "shaping" as used in claim 10 is interpreted to mean: "applying a transformation to a signal."

The third element of claim 10 also provides: "shaping input signals to the data storage device to reduce *selected unwanted frequencies*" ('473 patent Col. 44 lines 43-45) (emphasis added).

Plaintiffs assert that "selected unwanted frequencies" should be interpreted to mean some unwanted frequencies, and could include, but need not include, all unwanted frequencies. (Pls.' Claim Construction Br. For U.S. Patent No.'s '635, '267, and '473 at 29). Defendants respond that selected cannot encompass all unwanted frequencies. (Defs' Responsive Brief for '473 Patent at 24).

Neither party has presented any special meaning of the term "selected" in the art. The dictionary definition most relevant to the context of the patent is "choose from a number or group." *Merriam-Webster's Third New International Dictionary Unabridged*, Merriam-Webster, Inc., 1993. Plaintiffs note particularly that when the method reduces certain specific unwanted frequencies, such as would be the case if less than all unwanted frequencies are selected, other unwanted frequencies may also be reduced. (Transcript of *Markman* Hearing on 3/31/2004 at 278). As a natural consequence of the robustness built into the system, plaintiffs maintain, when any specific frequency is reduced, there will be collateral reductions in other frequencies. (Transcript of *Markman* Hearing at 279). These arguments do not directly address the question of "selection" of frequencies. A method which reduces frequencies other than those selected is not excluded from the patent since there is no limiting language requiring that only specific frequencies are reduced.

Defendants agree on the ordinary meaning of the term "selected" (Transcript of *Markman* Hearing at 254), but assert that the prosecution history of the '473 patent discloses a surrender of any method where all unwanted frequencies are reduced. In an interview on May 9, 2001, the PTO asserted that U.S. Patent 6,011,373 (hereinafter "McConnell patent") teaches selection by the user between fast response time and noise reduction mode. Plaintiffs amended the language "reduce unwanted frequencies" to "reduce selected unwanted frequencies from a plurality of frequencies" in the '473 patent. The PTO rejected the "reduce

unwanted frequencies" language since "McConnell et al teach that the user can select between the fast response time and noise reduction modes. However, McConnell et al can't reduce selected unwanted frequencies ..." (Akerley Dec. Exh. V, PLFS-C 008898). The McConnell invention "allow[s] the user to select a command input from a given group of command inputs ... by ranking the importance of three characteristics ... response time, robustness, and noise generation potential." (McConnell patent Col. 11 lines 21-25). Whereas the '473 patent identifies specific unwanted frequencies to reduce, and generates a command input which reduces them, the McConnell patent takes a set of pre-determined command inputs, categorizes these commands by the three characteristics above, and applies the input best suited to the user's preference.

Amendments made during prosecution are a guide to understanding the language of the patent, although they do not "enlarge, diminish, or vary the limitations in the claim." Markman, 52 F.3d at 980. Plaintiffs did not give up any claim to a reduction of all unwanted frequencies. The amendment made to overcome rejection by the PTO clearly indicates that the '473 patent is differentiated from the McConnell patent by the fact that the McConnell patent does not perform selective reduction of unwanted frequencies. The McConnell patent applies methods known to reduce all frequencies, and picks one based on the user specified criteria. The term "selected" was imposed to distinguish the '473 patent from the McConnell patent, and it is a significant distinction that the '473 patent targets specific frequencies to reduce as opposed to indiscriminately reducing all frequencies. The fact that under this interpretation the '473 patent could result in a reduction of more than the selected frequencies is unimportant. The inventor has disclosed a method which provides that certain targeted frequencies will definitely be reduced, which the PTO considered sufficiently novel in light of the prior art to grant a patent.

Accordingly, the term "selected unwanted frequencies" as used in claim 10 is interpreted to mean: "at least the chosen unwanted frequencies."

CONCLUSION

Based on the foregoing, the term "input" means "information that is delivered to the system from outside the system"

The term "expression" means "a mathematical characterization that quantifies."

The term "first constraint" means "a limit on the input based on the physical system."

The term "second constraint" means a "variation in system response with variations in system characteristics."

The term "minimize" is interpreted to mean "reduce to a minimum."

The term "find a solution" is interpreted to mean "determining an answer."

The term "user interface" is constructed to mean "hardware, firmware, or a combination thereof that allows a person, directly or indirectly, to alter parameters."

The term "data storage device" is constructed to mean "a computer disk drive, including all electronic and mechanical components, which receives shaped commands from a processor which may be integrated into

the drive."

The term "outputting commands" is constructed to mean "sending a command to a device, which may originate from within the device."

The term "shaping input signals" is constructed to mean "applying a transformation to a signal."

The term "selected unwanted frequencies" is interpreted to mean "at least the chosen unwanted frequencies."

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Convole, Inc. v. Compaq Computer Corp.

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