PROTECTING THE NEXT SMALL THING: NANOTECHNOLOGY AND THE REVERSE DOCTRINE OF EQUIVALENTS

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ABSTRACT

If even a fraction of the predictions about nanotechnology are realized, our society will be a dramatically different and better place than it is today. Yet, due to the infancy of the field, it is still unclear how traditional patent doctrine will be applied to nanotechnology. As it stands, the creators of nanoscale versions of traditional products might face infringement claims from traditional patent holders. The reverse doctrine of equivalents serves as a possible mechanism to equitably excuse the literal infringement of traditional patents by nanotech inventors in a way that encourages the progress of science.

INTRODUCTION

¶1 The promises of nanotechnology[2] are legion. At the most radical, futurists envision nanoscale assemblers with the capability to build even the most complex products from the bottom up, one atom at a time.[3] Others envision that nanotechnology will enable drug delivery systems that can administer medicine locally.[4] While advances of this magnitude currently exist only in creative imaginations, there have already been dramatic advances in manipulating matter at nanometer dimensions, and ambitious researchers are already exploring the possibility of nanocomputing.[5]

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[2] The best working definition of nanotechnology uses size as its defining feature. The nanoscale is roughly between 1 and 100 nanometers, or 1 to 100 billionths of a meter. SOCIETAL IMPLICATIONS OF NANOSCIENCE AND NANOTECHNOLOGY 1 (M.C. Roco and W.S. Bainbridge, eds., 2001) [hereinafter Societal Implications].

[3] George M. Whitesides, *The Once and Future Nanomachine*, SCI. AM., Sept. 16, 2001, at 78.

[4] *Id.*

[5] *E.g.*, Ron Dagani, *Building from the Bottom Up*, CHEM. AND ENG'G NEWS, Oct. 16, 2000, at 27.

¶2 However, commercialization of nanotech products so far has been modest, focused on enhancing traditional products such as stain-resistant pants and transparent sunscreen.[6] Yet even this limited commercialization is creating a stir on Wall Street.[7] Indeed, the National Science Foundation estimates that nanotechnology will grow to a $1 trillion industry in 10 to 15 years,[8] and the government has earmarked approximately $3.7 billion for research and development.[9]

¶3 Given what is at stake and the high expectations put on the burgeoning industry, it is imperative for current patent doctrine to effectively respond to this new technology. At one level, it is particularly fortunate that the nanotechnology revolution is still some years in the offing, giving scholars the time to discuss the issues thoroughly.

¶4 In order to obtain a patent, certain statutory requirements must be satisfied; the invention must be novel, nonobvious and useful.[10] While nanotechnology falls squarely within the traditional doctrines of patent law in many respects,[11] it also raises unique questions.[12] For example, can a miniature replica of a traditional product satisfy the nonobvious requirement for patentable subject matter?[13] It is well settled that pure miniaturizations are obvious in light of prior art,[14] but it is an open question whether nanoscale miniaturizations will clear the nonobviousness hurdle by virtue of the fundamentally different laws of physics at play at such small dimensions.[15]

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[6] Justin Gillis and Jonathan Krim, *If It's Nano, It's BIG*, WASH. POST, Feb. 22, 2004, at F01.
[7] *Id.*
[8] SOCIETAL IMPLICATIONS, *supra* note 2, at 3-4.
[9] 21st Century Nanotechnology Research and Development Act, Pub. L. No. 108-153 (S. 189), § 1-5 (2003) (codified at 15 U.S.C. § 7501—05) (the § 5 appropriations add up to slightly under $3.7 billion).
[10] *See* 35 U.S.C. §§ 101—03 (2000).
[11] Barry Newberger, *Intellectual Property and Nanotechnology*, 11 TEX. INTELL. PROP. L.J. 649, 654 (2003).
[12] *See* Michael P. Williams, *Questions about Patents and Nanotechnology*, N.Y.L.J., Sept. 13, 2003, at t7 (discussing practical intellectual property issues in nanotechnology today); *see also* Frederick A. Fielder & Glenn H. Reynolds, *Legal Problems of Nanotechnology: An Overview*, 3 S. CAL. INTERDISC. L.J. 593 (1994) (discussing more abstract aspects of intellectual property in nanotechnology).
[13] *See* Williams, *supra* note 12, at t7.
[14] *Id*.
[15] *Id*.

¶5 Nanotech inventors also face uncertainty about the extent of their patent rights given the patent rights of inventors of traditional products.[16] Patents with broad claims, that lack reference to scale, on traditional products might allow traditional patent holders to exact royalties from their nanoscale counterparts.[17] Furthermore, bargaining between the traditional and nanoscale manufacturers might break down because of the diverging valuations that the parties place on their assets.[18] Parties might value their contributions inaccurately because of the uncertainties inherent in developing new technology.[19]

¶6 This iBrief examines the reverse doctrine of equivalents and concludes that it can be used to cure this infirmity.[20] At its most vigorous, the doctrine can cure an impasse between bargaining parties in individual cases by entirely excusing literal infringement.[21] Still, in a more limited sense, the mere existence of the reverse doctrine of equivalents can improve the bargaining position of nanotech inventors.[22] Favoring nanotech inventors is desirable because it encourages the progress of science and hastens the commercialization of nanotechnology research, especially in a situation where the harm to traditional manufacturers is minimal.

I. THE REVERSE DOCTRINE OF EQUIVALENTS

¶7 A "wholesome realism" drives the doctrine of equivalents, compelling a finding of infringement even though the accused device escapes infringement literally but still performs substantially the same function, in substantially the same way, with substantially the same purpose as the claimed subject matter.[23] The doctrine of equivalents is a double-edged sword because that realism also compels the equitable excuse of literal infringement in a certain subset of situations.[24] A clear formulation of the reverse doctrine of equivalents was given by Justice Jackson in *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*:[25]

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[16] Wei Zhou, *Ethics of Nanobiotechnology at the Frontline*, 19 SANTA CLARA COMPUTER & HIGH TECH L.J. 481, 487 (2003).
[17] *Id.*
[18] Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75, 89 (1994).
[19] *See id.* at 84-89 (describing examples of bargaining breakdowns during the development of new technology).
[20] *Id.* at 91.
[21] *See id.*
[22] *See id.* at 97.
[23] Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608 (1950).
[24] *Id.*
[25] 339 U.S. 605 (1950).

> [W]here a device is so far changed in principle from a patented article that it performs the same or a similar function in a substantially different way, but nevertheless falls within the literal words of the claim, the doctrine of equivalents may be used to restrict the claim and defeat the patentee's action for infringement.[26]

In effect, when an accused device is so different from the claimed invention, a ruling of noninfringement may be justified even though the accused device falls squarely within the claims.[27] Indeed, some have suggested that the reverse doctrine of equivalents is more aptly termed the "doctrine of nonequivalence".[28]

¶8 In *Texas Instruments, Inc. v. U.S. Int'l Trade Comm'n*,[29] the U.S. Court of Appeals for the Federal Circuit articulated the rule with greater specificity.[30] In order for a defendant to prevail, two requirements must be satisfied.[31] First, the accused infringer must have literally infringed the accuser's patent claims.[32] Literal infringement occurs when the language of the claim, "reads directly, unequivocally, and word-for-word" on the accused device.[33] In *Graver Tank*, the Supreme Court called literal infringement a "dull and very rare type of infringement,"[34] however in practice, literal infringement occurs often due to uncertainty about the scope of the claim language.[35]

¶9 Second, in order to avoid infringement, the accused device must be "sufficiently different" from the accuser's device.[36] Like the straightforward application of the doctrine of equivalents, the standard of nonequivalence is also a factual inquiry.[37] While rare, instances of nonequivalence have occurred.[38] In *Leesonia Corp. v. United States*,[39] the court held that the defendant's battery did not infringe the plaintiff's patent

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[26] *Id* at 608-09.
[27] JANICE M. MUELLER, AN INTRODUCTION INTO PATENT LAW 245 (2003).
[28] Texas Instruments, Inc. v. U.S. Int'l Trade Comm'n, 846 F.2d 1369, 1371 (Fed. Cir. 1988).
[29] 846 F.2d 1369 (Fed. Cir. 1988).
[30] *Id.* at 1371.
[31] *Id.*
[32] *Id.*
[33] SRI Int'l v. Matsushita Elec. Corp. of Am., 775 F.2d 1107, at 1118 (Fed. Cir. 1985).
[34] Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 607 (1950).
[35] MUELLER *supra* note 27, at 238.
[36] *Texas Instruments*, 846 F.2d, at 1371.
[37] ROBERT L. HARMON, PATENTS AND THE FEDERAL CIRCUIT 346 (6th ed., 2003). *But see* Kalman v. Kimberly-Clark Corp., 713 F.2d 760,771 (Fed. Cir. 1985) (treating reverse doctrine of equivalents as a legal issue).
[38] CHISUM ON PATENTS §18.04[4][c] (2004).
[39] 530 F.2d 896, 905-06 (Ct. Cl. 1976)

on an electrode structure because it had "nothing of a similar nature," even though the defendant's battery fell within the properly construed scope of the plaintiff's claims.[40] Similarly in *Gardner v. Ford Motor Co.*,[41] infringement was excused because the accused subject matter was far removed from the "principle, structure and operation" of the claimed subject matter.[42]

¶10 The reasoning behind *Precision Metal Fabricators Inc. v. Jetstream Systems Co.*[43] is also telling. Like *Gardner*, the finding of nonequivalence was grounded on the fact that both inventions had different principles of operation.[44] Yet importantly, the court also indicated that the presence of incidental similarities that failed to enhance the defendant's machine at the expense of the plaintiff militated against a finding of infringement.[45]

¶11 Nanotechnology fits snugly within this general emphasis on principles of operation and incidental similarities. Nanomachines work on entirely different principles of operation than traditional machines. Indeed, nanomachines must contend with entirely different laws of physics. While the argument for incidental similarity is slightly weaker because the general design of nanomachines might bear some similarity to their traditional counterparts at an abstract level, an incidental similarity argument is still strong because of the vast disparity of scales, the additional technical considerations of working at a nanoscale, and the unlikelihood of competition between nanomanufacturers and traditional manufacturers.

¶12 Even so, it cannot be overlooked that the overwhelming majority of courts acknowledge the existence of the reverse doctrine of equivalents but find it inapplicable to the cases before them.[46] Understandably, the subset of cases where the accused device can both satisfy the literal infringement test and still be sufficiently different from the accuser's device is narrow.[47] Furthermore, an accused infringer cannot successfully invoke the reverse doctrine of equivalents by merely claiming that their product is superior.[48]

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[40] *Id.* at 905-06.
[41] 17 USPQ2d 1177, 1186 (W.D. Wash. 1990)
[42] *Id.* at 1186.
[43] 693 F. Supp. 814, 819 (N.D. Calif. 1988)
[44] *See id.* at 819.
[45] *See id.*
[46] CHISUM, *supra* note 38, at §18.04[4][c].
[47] See HARMON, *supra* note 37, at 345.
[48] Studiengesellschaft Kohle, M.B.H. v. Dart Indus., Inc., 726 F.2d 724, 728 (Fed. Cir. 1984) ("That Dat's catalysts may be superior to those actually invented, disclosed, and contemplated by Ziegler et al. would not by itself remove Dart's catalysts from the scope of claims 1 and 4").

Indeed, the most likely scenario is simply that the accused infringer has merely developed the same device.[49]

¶13 Moreover, a recent court ruling has cast serious doubt on the fate of the reverse doctrine of equivalents. In *Tate Access Floors, Inc. v. Interface Architectural Res., Inc.*,[50] the Federal Circuit explained that it is disinclined to apply the reverse doctrine because the disclosure requirements enacted after *Graver Tank* are coterminous with the broadest reaches of the reverse doctrine.[51] In other words, properly construed claims of a traditional product should be specific enough that it should not read on the nanoproduct in the first instance. Insofar as this is the case, it is good news for nanotechnologists hoping to protect their work with confidence; either way their products will be held as noninfringing. However, it is difficult to understand how a court could possibly construe traditional dimensions as part of claims that have a specification entirely devoid of any mention of scale. It is unlikely that the specification and claims of a traditional product will mention scale at all since before nanotechnology scale was a non-issue. Another reason why claims are rarely limited to scale is the rational fear of needlessly limiting the scope of the claims.

¶14 In any event, since it is uncertain how infringement suits of this ilk will play out in the courts, the prudent move is to explore all alternatives, including the reverse doctrine of equivalents. Despite the Federal Circuit's critical stance on the reverse doctrine of equivalents, it is still good law.[52] And despite the Federal Circuit's serious doubts, it is still possible to see how a nanotechnology improver of a traditional product could cogently craft a defense by using the reverse doctrine of equivalents.

¶15 For a nanoimprover to successfully employ the reverse doctrine of equivalents she would have to pass the two-pronged test that Judge Newman set forth in *Texas Instruments*.[53] First, it is possible to imagine a scenario where a nanoproduct literally infringes a traditional product. For a simplified illustration, consider the development of a playable nanoguitar by researchers at Cornell University.[54] A "guitarist" uses a laser to pluck strings 100 atoms wide to produce notes 17 octaves higher than normal

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[49] *See* HARMON, *supra* note 37, at 345.
[50] 279 F.3d 1357, 1368 (Fed. Cir. 2002)
[51] *Id.*
[52] *See* Dan L. Burk and Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1657-58 (2003).
[53] Texas Instruments, Inc. v. U.S. Int'l Trade Comm'n, 846 F.2d 1369, 1371 (Fed. Cir. 1988).
[54] George Johnson, *Ideas & Trends: Atomic Scales; Striking Notes of Progress on the World's Tiniest Guitar*, N.Y. TIMES, Nov. 9, 2003, Late Edition – Final, at § 4, p. 12.

human hearing.[55] Still, imagine an extremely broad patent on a traditional guitar without reference to scale that claims broadly a six-stringed instrument. In theory, the plaintiff might be able to prove that the claimed invention reads on the nanoguitar.

¶16 Second, the accused infringer would have the burden of showing that its product is sufficiently different from the claimed subject matter such that the reverse doctrine of equivalence applies. The nanotechnologist could make a strong argument that there are sufficient differences by pointing to the unique behavior of matter at such a small scale. The nanomachinist must take into account drastically different considerations during the design process compared to what a traditional machinist need consider. For example, smaller than a critical size, "the electron structure, conductivity, reactivity, melting temperature, and mechanical properties" are all different than the macroscale equivalent.[56] At the same time, nanoscale interactions start to be dominated by quantum mechanics.[57] The leading report on the societal implications of nanotechnology by the National Science Foundation has gone so far as to say that, "[t]he nanoscale is not just another step toward miniaturization, but a qualitatively different scale."[58]

¶17 Of course, the example posed by the nanoguitar is perhaps too simple. Due to the proliferation of increasingly specific patent rights (in other words, the development of a patent thicket, in the field of, for example, guitars), it is unlikely that there exist patents broad enough to cover the still rudimentary advances of nanotechnology. However, it does not take much imagination to realize that this situation will loom large when nanotechnologists begin to develop mechanical parts with increasing specialization. When that day comes, as a legal matter, the reverse doctrine of equivalents should be available to nanodevelopers.

II. APPLICATION OF THE REVERSE DOCTRINE OF EQUIVALENTS CAN CURE BARGAINING BREAKDOWNS

¶18 Strong intellectual property rights are desirable in fields of developing technologies because early protection provides an incentive for initial development. [59] Early protection also provides the innovator the

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[55] *Id.*

[56] CHARLES P. POOLE, JR. & FRANK J. OWENS, INTRODUCTION TO NANOTECHNOLOGY xi (2003).

[57] SOCIETAL IMPLICATIONS, *supra* note 2, at 1.

[58] *Id.*

[59] Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U CHI. L. REV. 1017, 1040-44 (1989) (presenting a general summary of the Kitchean Prospect Theory).

means for efficient coordination of subsequent development.[60] A strong patent portfolio is integral to start-up companies hoping to attract venture capital.[61] Solid intellectual property is even more critical in light of venture capital's current skepticism of nanotechnology start-ups.[62] Indeed, many nanotechnologists are already seeking patent protection: one estimate places the number of patents on nanotechnology between 1996 and 2004 at over 3,000,[63] and that number is only expected to grow.[64]

¶19 Blocking patents can occur when an inventor obtains a broad patent on a pioneering product and then another inventor subsequently patents a radical improvement on the original device.[65] The claims of the first "pioneering" patent may read on the subsequently patented developments of the improver.[66] When this occurs, the improver can exclude, or block, the pioneer from practicing the improvement, but at the same time, the pioneer can in turn block the improver from practicing the improvement itself.[67] Traditionally, the way to break this stalemate is through cross-licensing.[68] In other words, a bargain will be struck between pioneers and improvers.[69]

¶20 However, breakdowns in the bargaining process do occur.[70] According to Professor Robert Merges, breakdowns are more likely to occur when parties hold diverging valuations of the products.[71] Pioneering patent holders might overvalue their product, knowing that they are in the superior bargaining position.[72] On the other hand, improvers might overvalue their product because of the inherent uncertainty that arises from technological change.[73] More generally, "attribution bias" is a well-studied

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[60] *Id*.
[61] Mark Lemley, *Rational Ignorance at the Patent Office*, 95 N.W. U.L. REV 1495, 1505-06 (2001).
[62] *See* Gillis and Krim, *supra* note 6 (noting that venture capitalists, burned by the dot com bubble, are thinking twice before investing in nanotechnology).
[63] *See* Williams, *supra* note 12, at t7.
[64] Lance D. Reich, *Protecting Tiny Gizmos: The Patent and Trademark Office is Preparing for Nanotech Applications*, 26 NAT'L L. J., Jan. 26. 2004, No. 22, at S1.
[65] INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 114 (Robert P. Merges, Peter S. Mennell & Mark A. Lemley, eds., Aspen Publishers, 2003).
[66] *Id*.
[67] *Id*.
[68] MUELLER, *supra* note 27, at 368.
[69] Merges, *supra* note 18, at 78.
[70] *Id*. at 84.
[71] *Id*. at 89.
[72] While the pioneer may be excluded from practicing the improvement, the pioneer can exclude the improver from practicing their entire invention. *Id*. at 82.
[73] *See id*. at 84-89.

phenomenon where individual contributors value their contribution more highly than their opponent's contribution when they are engaged in a competitive setting.[74] Incorrect assessments complicate bargaining because the other party must determine whether the assessment was made in good faith or was a part of a bargaining strategy.[75]

¶21 Even though it is rarely invoked, the reverse doctrine of equivalents remains a favorite among scholars.[76] Professor Merges argues that employing the reverse doctrine of equivalents is one way to break the bargaining stalemate.[77] Merges notes that while the reverse doctrine of equivalents is applied infrequently, the threat alone can force pioneers to lower their terms.[78] In other words, the pioneer is willing to accept less money from the licensee because of the threat, albeit small, that the court will apply the doctrine.[79]

¶22 Indeed, the problem at issue here, the possibility of a bargaining breakdown between pioneers working on a traditional scale and nanoscale improvers, is one that is amenable to the reverse doctrine of equivalents release valve. Dan Burk and Mark Lemley write, "[t]he doctrine can apply to radical improvements in any area of technology, and it has indeed been used to cover technological paradigm shifts within an industry."[80] They explain that the reverse doctrine of equivalents is better suited for industries where radical changes predominate over incremental ones.[81] The traditional computer software industry is a field where changes occur incrementally and consequently the reverse doctrine of equivalents would not be a good fit.[82] However, nanotechnology represents a drastic paradigm shift from traditional manufacturing because of the different physical laws applicable to nanoscale dimensions. Insofar as nanoscale improvers must face unique challenges in the development of their inventions, nanotechnology presents a prime candidate for successful implementation of the doctrine.

¶23 At the other side of the table, the bargaining position of the nanotechnologist is improved under this regime. Furthermore, the extent of the improvement is modified by the frequency that the courts invoke the doctrine.[83] The more frequently it is used to excuse infringement, the better

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[74] Michael A. Heller and Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698, 701 (1998).
[75] Merges, *supra* note 18, at 90.
[76] MUELLER, *supra* note 27, at 245-46.
[77] Merges, *supra* note 18, at 91.
[78] *Id.* at 97.
[79] *Id*.
[80] Burk and Lemley, *supra* note 52, at 1657.
[81] *Id.* at 1658.
[82] *Id.*
[83] *See* Merges, *supra* note 18, at 95.

the bargaining position of the improver becomes.[84] As it stands, the likelihood of a successful defense based on the reverse doctrine of equivalents is low.[85] However, by using the reverse doctrine of equivalents more liberally in specific cases, courts can incrementally improve the bargaining positions of all nanotechnology actors.

¶24 Some might argue that the intellectual property rights of nanoimprovers are strengthened at the expense of the intellectual property rights of traditional manufacturers. Why shouldn't traditional manufacturers reap the rewards of nanotechnology as well? After all, on some level aren't the traditional manufacturers the ones ultimately responsible for the creation of the machinery in the first place? There are three responses to these compelling points. First, manufacturers of traditional products are not likely to be in the best position to take advantage of the nanotechnological applications of their products. The adaptation of traditional products to the nanoscale is likely to involve nontrivial costs in obtaining the relevant expertise and upgrading machinery. Nimble nanotechnology companies, already outfitted with the necessary technical expertise, are the logical developers of the new technology.

¶25 Second, it is not clear that nanoscale miniaturizations will adversely affect the commercial sales of traditional manufacturers. Nanoguitars will never compete with traditional ones. As long as humans remain on a traditional scale, there will always be a demand for products that can be easily manipulated. Thus, traditional manufacturers need not fear that their sales will be decimated because the vastly smaller products will fill a unique commercial niche.

¶26 A third reason why traditional manufacturers should not be granted a monopoly over their nanotechnological counterparts is that granting such a monopoly does not promote an underlying function of the patent system. Courts and commentators have recognized that patents promote scientific progress through providing inventors with an incentive to invent.[86] In this case, traditional manufacturers never contemplated nanoapplications and never needed such prospects as incentives to invent the traditional products that they invented. Thus, as motivations stand today, awarding a traditional manufacturer with a monopoly would confer a windfall on the traditional manufacturer.

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[84] *Id.*
[85] *See* CHISUM, *supra* note 38, at §18.04[4][c].
[86] *See* Eisenberg, *supra* note 59, at 34-35.

CONCLUSION

¶27 By all indications, the development, let alone commercialization, of nanomachines is still years in the making.[87] Yet, considering the concerted efforts and progress towards the rudimentary technology necessary to build nanomachines, it is only a matter of time before the dreams of nanoengineers become a reality. Hopefully, the delayed arrival of the nanotechnology revolution will allow a thoughtful and thorough debate about the application of patent doctrine to this new field. There are many indications that scholars have already begun to engage in this debate.

¶28 It is likely that manufacturers patented traditional products by using claims that lack limitations on scale. These claims might encompass the miniaturizing work of nanotechnologists even though those nanoscale counterparts are substantially different than the traditional products by virtue of the drastically different physical properties of matter at such small sizes. When this is the case, the reverse doctrine of equivalents should be available to nanotechnologists to excuse literal infringement. At the very least, it is imperative that the reverse doctrine of equivalents remain good law even if the courts still decline to apply it in most cases, since even its threat influences bargaining between rational actors in a way that favors the progress of science and the commercialization of its fruits.

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[87] *See* Reich, *supra* note 64, at S1.