

THE CHALLENGES OF 3D PRINTING TO THE REPAIR-RECONSTRUCTION DOCTRINE IN PATENT LAW

Kelsey B. Wilbanks*

INTRODUCTION

Patent law is no stranger to technological innovation. Just recently, courts have handled the legal uproar over smartphones,¹ new forms of biotechnology,² and more.³ Three-dimensional (“3D”) printing has now emerged,⁴ and patent law will once again need to adapt.

Three-dimensional printing is new technology that allows consumers to manufacture a seemingly endless variety of items in the comfort of their homes. Although innovators have recently used 3D printers to make remarkable creations like functional guns, it is becoming more common for average tinkerers to 3D print replacement parts for broken home objects.

* George Mason University School of Law, J.D. Candidate, May 2014; Notes Editor, *GEORGE MASON LAW REVIEW*, 2013-2014; Missouri State University, B.S., Entertainment Management, December 2010. This Comment received the *George Mason Law Review*'s 2013 Adrian S. Fisher Award for best student article, and it was featured as a condensed presentation at the “ConFABulation Symposium on 3D Printing in the Classroom” in Largo, Maryland. I would like to first thank my husband Jason for his help in developing this topic. I would also like to thank the organizers of the ConFABulation Symposium, John Anderson and Jonathan Monaghan, and its participants for their helpful comments. Finally, I would like to thank Professor Adam Mossoff, my friends Josh Cox, Tashina Harris, and Martin Desjardins, my cousin Penny Caudle, my mother Joyce, and the rest of my family for their help in writing and editing this piece.

¹ See *Microsoft Corp. v. Motorola, Inc.*, 854 F. Supp. 2d 993, 998 (W.D. Wash. 2012) (discussing patent rights regarding technology in Motorola's smartphones, Microsoft's Xbox console, and certain Windows products); see also Nick Wingfield, *Jury Awards \$1 Billion to Apple in Samsung Patent Case*, N.Y. TIMES (Aug. 24, 2012), <http://www.nytimes.com/2012/08/25/technology/jury-reaches-decision-in-apple-samsung-patent-trial.html>. But note that Judge Koh has since reduced the damage award of \$1 billion to Apple and ordered a new trial to determine the proper damage amount. Ian Sherr, *U.S. Judge Reduces Apple's Patent Award in Samsung Case*, WALL ST. J. (Mar. 1, 2013, 5:57 PM), <http://online.wsj.com/article/SB10001424127887323478304578334540541100744.html>.

² See *Bowman v. Monsanto Co.*, 133 S. Ct. 1761, 1769 (2013) (ruling unanimously that farmers commit patent infringement when they replant harvested seeds containing a patented trait to produce a second crop without the patent holder's permission).

³ See Michael Borella, *CLS Bank Int'l v. Alice Corp. (Fed. Cir. 2013) (en banc) – Judge Lourie's Concurrence*, PATENT DOCS (May 15, 2013), <http://www.patentdocs.org/2013/05/cls-bank-v-alice-corp-fed-cir-2013-en-banc-judge-louries-concurrence.html> (discussing how certain software method claims do not meet patent eligibility requirements).

⁴ Andy Greenberg, *Meet The 'Liberator': Test-Firing the World's First Fully 3D-Printed Gun*, FORBES (May 5, 2013, 5:30 PM), <http://www.forbes.com/sites/andygreenberg/2013/05/05/meet-the-liberator-test-firing-the-worlds-first-fully-3d-printed-gun/>.

Common sense tells us that replacing a few parts to an object is “repair,” a perfectly legal activity. But if a consumer reproduces several parts of a patented combination with 3D printing, the activity might be subject to legal restriction. As more consumers learn how to 3D print their own replacement parts, they will become less dependent on traditional manufacturers. Patent holders may wish to strictly enforce their rights and commence lawsuits against consumers. If a patent holder can prove that a consumer has “reconstructed” an object instead of repairing it, the consumer will be liable for patent infringement.

The upcoming shift in the replacement-part industry as a result of the growing popularity of 3D printing necessitates redefined standards in patent law to better distinguish between lawful object “repair” and unlawful “reconstruction.” This Comment proposes that the Supreme Court adopt redefined standards to make the analysis more clear, consistent, and predictable for patent holders and users of 3D print technology.

If a consumer lost the battery cover of a remote control, she would probably tape the batteries in place until she buys a newer model. Under patent law, this quick fix is within a consumer’s legal right to repair and preserve an object’s useful life.⁵ Unfortunately for the frugal consumer, quick fixes have not been as readily available for other items, and the cost for replacement parts and service can be quite expensive. For instance, a popular “Bugaboo” baby stroller has an average cost of \$1,000.⁶ If the stroller’s handle lock breaks, repair parts and service can cost around \$250.⁷ Retailers have been able to charge such high fees because consumers have not had the capability to manufacture their own replacement parts. Without the possibility of a “do-it-yourself” fix, a new family faced with the decision between a \$250 repair bill and a \$1,000 price tag for a new stroller will usually choose to pay for the repair and preserve its investment. As 3D printing technology develops and becomes more widespread, it will change the entire cost calculus for repair, making replacement parts easier to create and more affordable than before.⁸

A 3D printer is a machine that can convert a blueprint design into a 3D object.⁹ Three-dimensional printers read the design and then precisely disperse materials in small increments to build an object upward, layer by layer.

⁵ 5 DONALD S. CHISUM, CHISUM ON PATENTS § 16.03[3], at 16-449 to -450 (2012).

⁶ Shop, BUGABOO, <http://www.bugaboo.com/all-products> (last visited Sept. 10, 2012).

⁷ John Biggs, *Dad Fixes Broken Bugaboo With DIY 3D-Printed Parts*, TECHCRUNCH (Oct. 4, 2011), <http://techcrunch.com/2011/10/04/dad-fixes-broken-bugaboo-with-diy-3d-printed-parts/>.

⁸ See generally Christopher Barnatt, *3D Printing*, EXPLAINING THE FUTURE (last updated May 5, 2013), <http://www.explainingthefuture.com/3dprinting.html> (providing “an overview of 3D printing technologies and their present and likely future application”).

⁹ Michael Weinberg, *It Will Be Awesome If They Don’t Screw It Up: 3D Printing, Intellectual Property, and the Fight over the Next Great Disruptive Technology*, PUB. KNOWLEDGE 2 (Nov. 2010), <http://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf>.

er.¹⁰ This technology has allowed for the creation of items like functioning guns and tools and has fostered development of printers capable of “printing” concrete housing structures.¹¹ At a more basic level, 3D printers allow users to create home objects and component parts, like the battery cover for a remote control or a new handle lock for a baby stroller.¹² By creating replacement parts for several household objects via 3D printing, consumers could potentially save money that might have otherwise been spent on repairs or replacements.¹³

Although consumers will be able to preserve their belongings more easily and affordably with 3D printing, the process is subject to possible legal restriction.¹⁴ Under patent law, the purchaser of a patented object acquires several rights, including the right to use and repair the object.¹⁵ Not within this list of consumer rights, however, is the right to reproduce or reconstruct a patented item entirely, or to use unapproved parts to repair or reconstruct the item.¹⁶ Once a patented object is broken or completely spent to the extent that it is no longer usable, patent law requires the consumer to purchase a new product to continue its use.¹⁷ If a person reconstructs a patented item after its use is spent, the person commits patent infringement

¹⁰ *Id.*

¹¹ See Rich Brown, *You Don't Bring a 3D Printer to a Gun Fight – Yet*, CNET (Sept. 6, 2012, 4:00 AM), http://news.cnet.com/8301-11386_3-57499326-76/you-dont-bring-a-3d-printer-to-a-gun-fight-yet/ (noting the fears and legal concerns about fully functional 3D-printed guns); Brad McCarty, *This Giant 3D Printer Can Construct a House in as Little as 20 Hours*, THE NEXT WEB (Aug. 12, 2012), <http://thenextweb.com/shareables/2012/08/12/this-giant-3d-printer-can-construct-house-little-20-hours/> (discussing the development of 3D print technology that can build homes with indoor plumbing in as little as twenty hours); ObjetGeometries, *Printing a Giant Wrench with a 3D Printer*, YOUTUBE (July 19, 2011), http://www.youtube.com/watch?v=WmDz7Q9_h6c (showing the 3D printing process of building a wrench with moving parts).

¹² See Biggs, *supra* note 7.

¹³ See, e.g., *id.*

¹⁴ Brian Rideout, *Printing the Impossible Triangle: The Copyright Implications of Three-Dimensional Printing*, 5 J. BUS. ENTREPRENEURSHIP & L. 161, 174-75 (2011); Peter Hanna, *The Next Napster? Copyright Questions as 3D Printing Comes of Age*, ARS TECHNICA (Apr. 6, 2011, 12:35 AM), <http://arstechnica.com/tech-policy/2011/04/the-next-napster-copyright-questions-as-3d-printing-comes-of-age/>; see also Peter Jensen-Haxel, Comment, *3D Printers, Obsolete Firearm Supply Controls, and the Right to Build Self-Defense Weapons Under Heller*, 42 GOLDEN GATE U. L. REV. 447, 448-49 (2012) (predicting the legal implications of 3D-printed guns).

¹⁵ CHISUM, *supra* note 5, § 16.03[3], at 16-449 to -450; F. SCOTT KIEFF ET AL., PRINCIPLES OF PATENT LAW: CASES AND MATERIALS 1093 (5th ed. 2011).

¹⁶ See CHISUM, *supra* note 5, § 16.03[3], at 16-450; KIEFF ET AL., *supra* note 15, at 1093.

¹⁷ See CHISUM, *supra* note 5, § 16.03[3], at 16-450; Mark D. Janis, *A Tale of the Apocryphal Axe: Repair, Reconstruction, and the Implied License in Intellectual Property Law*, 58 MD. L. REV. 423, 427 (1999); Christina M. Sperry, Note, *Building a Mystery: Repair, Reconstruction, Implied Licenses, and Hewlett-Packard Co. v. Repeat-O-Type Stencil Manufacturing Corp.*, B.U. J. SCI. & TECH. L., Spring 1999, ¶ 10.

through reconstruction.¹⁸ This rule may seem straightforward—once an item breaks completely, buy a new one—but in application, courts have had a difficult time drawing lines between innocent repairs and infringing reconstructions.¹⁹ The distinction between repair and reconstruction will become even more relevant and complex as consumers use 3D printing to replace multiple parts of an object simultaneously or sequentially throughout its life.

To protect their revenue streams against profit losses, patent holders could react to the 3D printing advancement by trying to impose some additional restrictions on unpatented component parts, or by filing patent infringement litigation against consumers. Given the current state of the repair-reconstruction patent standards, any litigation could create unpredictable and inconsistent outcomes.

In anticipation of the rapidly expanding 3D printer movement, the Supreme Court needs to clarify the repair and reconstruction standards to achieve consistency in application of the law and to provide consumers with certainty and fairness. Consumers should be able to embrace this technology, and as such, consumers have a right to know with certainty that their 3D printed objects are legal before stepping into the courtroom.

Part I of this Comment begins by discussing the rapidly advancing 3D printer technology, noting some of the most remarkable creations born from 3D printing and describing its current availability to consumers. Part I then explains basic patent law principles and how 3D printing has disruptive potential in patent law. Part II describes the complex legal standard that attempts to distinguish between permissible repair and infringing reconstruction, and how that standard could produce undesirable outcomes in light of 3D printing and wide availability of low-cost replacement parts. Finally, Part III of this Comment proposes three recommendations for clearer, more reliable standards to prevent arbitrary litigation, provide consumers with certainty, and achieve judicial consistency. The Comment concludes by urging courts to adopt one of the redefined, recommended standards.

¹⁸ See, e.g., *Cotton-Tie Co. v. Simmons*, 106 U.S. 89, 93-94 (1882); see also CHISUM, *supra* note 5, § 16.03[3], at 16-450.

¹⁹ CHISUM, *supra* note 5, § 16.03[3], at 16-450 (“The line between permissible ‘repair’ and impermissible ‘reconstruction’ is a difficult one to draw and is the subject of numerous cases.”); see also, e.g., *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 362-63 (1961) (Brennan, J., concurring); *Husky Injection Molding Sys. Ltd. v. R & D Tool & Eng’g Co.*, 291 F.3d 780, 784-85 (Fed. Cir. 2002); KIEFF ET AL., *supra* note 15, at 1093.

I. FAST ADVANCING 3D PRINT TECHNOLOGY AND ITS DISRUPTIVE
POTENTIAL IN PATENT LAW

A. *3D Printing Process and Product*

“Printing” has assumed a new, three-dimensional form.²⁰ Although most people associate the word “printing” with an inkjet machine that produces flat, two-dimensional (“2D”) images on paper, 3D printing now allows a home user to produce a broad selection of tangible, 3D objects from scratch.²¹

The 3D printing process begins with a digital 3D blueprint design, more commonly known as a computer-aided design (“CAD”) file.²² Users can create CAD files by scanning objects with a 3D scanner or by drawing objects manually on a CAD program.²³ With a 3D scanner, a person typically points and skims a laser around an object to capture contour details, and the scanner instantly generates a CAD file.²⁴ This “point and click and print” world of laser photography is advancing rapidly alongside 3D printers. For instance, several companies have developed 3D scanning programs for smartphones.²⁵ Alternatively, with a computer CAD program, a person can manually create a digital model and save it as a CAD file.²⁶ After using either method to create a CAD file, a person sends the file to a 3D printer and its contents are “sliced” into layers, ready for printing.²⁷

²⁰ Weinberg, *supra* note 9, at 2.

²¹ Andrew Coutts, *Is the 3D Printing Industry About to Start Turning Out Lawsuits?*, DIGITAL TRENDS (Oct. 1, 2012), <http://www.digitaltrends.com/cool-tech/3d-printing-and-copyright-lawsuits/>; Hanna, *supra* note 14.

²² Weinberg, *supra* note 9, at 2.

²³ *Id.* at 2-3; *see also* Hanna, *supra* note 14.

²⁴ *See* Hugh Evans, *3D Printing: The Game Changer*, T. ROWE PRICE (May 2012), <http://individual.troweprice.com/public/Retail/Planning-&-Research/Connections/3D-Printing/The-Game-Changer?PlacementGUID=771937F9-D3C7-4D40-9B2F-241745C88301> (“So now you can picture yourself walking down the street, point, click, get a CAD file, and click again, and it’s printed out an hour later. You saw a flower, you pointed and clicked, and now you’ve printed a replication of that flower, and it’s on your desk.”).

²⁵ *See, e.g.*, Jesse Emspak, *Use Your Smartphone as a 3-D Scanner*, DISCOVERY NEWS (Feb 24, 2013, 9:46 AM), <http://news.discovery.com/tech/apps/smartphone-3d-scanner-130224.htm>; *see also* TRIMENSIONAL, <http://www.trimensional.com/>.

²⁶ Weinberg, *supra* note 9, at 2.

²⁷ Jensen-Haxel, *supra* note 14, at 450; Rideout, *supra* note 14, at 163; Marshall Brain, *How Stereolithography 3-D Layering Works*, HOWSTUFFWORKS, <http://computer.howstuffworks.com/.htm> (last visited June 26, 2013); *Layer by Layer: How 3D Printers Work*, ECONOMIST (Apr. 21, 2012), <http://www.economist.com/node/21552903>.

A 3D printer works similarly to its traditional 2D counterpart, the inkjet printer.²⁸ But instead of dispersing ink onto paper, a 3D printer releases materials like metal, plastic, powder, and rubber-like substances onto a base to build an object upward, layer by layer.²⁹ The base tray is lowered fractionally as each layer is added.³⁰ After the layers are set, they are fused together and the object is further solidified.³¹

This layering process, also called “additive manufacturing,” can be more precise than making and cutting parts from a mold, and it allows for elaborate structures and internal moving parts.³² A 3D printer can print an object pre-assembled, rather than requiring manual labor to put pieces together.³³ Of course, a 3D printer can also print simple, separate replacement parts.³⁴

Personal 3D printers can print objects in a wide variety of colors and sizes.³⁵ They can now print in high resolution, with vibrant colors.³⁶ The possible size of printed objects is only limited by the size and capability of the printer making them.³⁷ On a small scale, consumers can print objects like figurines and gears.³⁸ On a larger scale, engineers are developing giant 3D printers that will be able to print concrete housing structures with internal plumbing in as little as twenty hours.³⁹

²⁸ Rideout, *supra* note 14, at 163; Hanna, *supra* note 14; *see also* Coutts, *supra* note 21; *Layer by Layer*, *supra* note 27.

²⁹ James F. Bredt, *New Life for 3D Printing*, R&D (Apr. 19, 2012, 12:03 PM), <http://www.rdmag.com/articles/2012/04/new-life-3d-printing>; *Layer by Layer*, *supra* note 27. In addition to the materials listed, 3D printers are capable of printing with glass and ceramic. *Layer by Layer*, *supra* note 27 (describing materials that can be 3D printed now); Joris Peels, *You Can Now 3D Print in Glass with Shapeways*, SHAPEWAYS (Apr. 14, 2010, 1:00 PM), <http://www.shapeways.com/blog/archives/401-you-can-now-3d-print-in-glass-with-shapeways.html>.

³⁰ Brain, *supra* note 27; *Layer by Layer*, *supra* note 27.

³¹ Jensen-Haxel, *supra* note 14, at 448; Hanna, *supra* note 14; *Layer by Layer*, *supra* note 27 (describing layers being cured by ultraviolet light).

³² Clint Boulton, *Printing Out Barbies and Ford Cylinders*, WALL ST. J. (June 5, 2013, 8:30 PM), <http://online.wsj.com/article/SB10001424127887323372504578469560282127852.html>; Rideout, *supra* note 14, at 163.

³³ Weinberg, *supra* note 9, at 2.

³⁴ *Id.*

³⁵ *Id.* at 4.

³⁶ *ProJet 1500*, 3D SYSTEMS, <http://www.3dsystems.com/3d-printers/personal/projet-1500#.Uf7TdayeZ6Z> (last visited July 23, 2013).

³⁷ Hanna, *supra* note 14.

³⁸ Coutts, *supra* note 21.

³⁹ McCarty, *supra* note 11.

B. Consumer Cost and Availability

Three-dimensional printers have been used in business since the early 1990s, costing about \$15,000 to \$25,000 each.⁴⁰ CAD programs are also extensively used in several professions—including architecture, interior design, engineering, and fashion—to digitally depict physical objects before production.⁴¹ Because of the precision and convenience that 3D printing allows, it “has become a favoured way of prototyping new products without” costly manufacturing lines.⁴²

Three-dimensional printer enthusiasts and developers are lowering the cost of basic 3D printing systems, thus redefining the consumer end of the market.⁴³ A growing range of 3D printing products and kits are now available for consumer home use.⁴⁴ Consumers can build their own 3D printers with help from online communities that share designs and other information about how to build a 3D printer.⁴⁵ Two examples of these communities are “RepRap” and “Fab@Home.”⁴⁶ For consumers not inclined to construct their own 3D printer, home versions of 3D printers can now be purchased for about \$500 to \$2,000.⁴⁷ Three-dimensional printers are constantly improving and becoming more mainstream.⁴⁸ Materials for the printers are also relatively affordable, comparable to the cost of ink for home printers,

⁴⁰ See David Braue, *Let's Get Physical: How 3D Printing Works*, APC (Nov. 29, 2011, 6:00 AM), <http://apcmag.com/lets-get-physical-how-3d-printing-works.htm>; Bredt, *supra* note 29.

⁴¹ See, e.g., Candace Lombardi, *CAD Software Is the New Black*, CNET NEWS (Dec. 7, 2007, 4:00 AM), http://news.cnet.com/CAD-software-is-the-new-black/2100-1012_3-6221810.html; *What Design Professions Use AutoCAD Drafting Software?*, DEGREE DIRECTORY.ORG, http://degreedirectory.org/What_are_Some_Common_Design_Professions_that_Use_AutoCAD_Drafting_Software.html (last visited June 26, 2013).

⁴² Braue, *supra* note 40.

⁴³ *Id.*; Bredt, *supra* note 29.

⁴⁴ Jensen-Haxel, *supra* note 14, at 452; Rideout, *supra* note 14, at 163; Barnatt, *supra* note 8; Braue, *supra* note 40.

⁴⁵ Jensen-Haxel, *supra* note 14, at 452; Barnatt, *supra* note 8.

⁴⁶ Barnatt, *supra* note 8; see also Braue, *supra* note 40.

⁴⁷ See Jensen-Haxel, *supra* note 14, at 452 (discussing generally the increasing accessibility of 3D printers due to decreasing cost); see also Barnatt, *supra* note 8 (discussing the costs of the Cube Personal 3D printer); Brown, *supra* note 11 (predicting that a 3D printer may be a new way of making guns because such printers can now be purchased for \$500); Ron Schenone, *How 3D Printing Could Change Our World*, LOCKER GNOME (July 26, 2012), <http://www.lockergnome.com/blade/2012/07/26/how-3d-printing-could-change-our-world> (noting that the cost to buy a 3D printer has already fallen precipitously and predicting it will continue to drop over the next few years); Weinberg, *supra* note 9, at 1 (stating that 3D printers can be purchased for around \$1,000); *Store - 3D Printers*, MAKERBOT, <http://store.makerbot.com/3d-printers.html> (last visited June 26, 2013) (showcasing MakerBot's current line of available 3D printers and attendant prices).

⁴⁸ Braue, *supra* note 40; Weinberg, *supra* note 9, at 1.

with common plastic materials used in the printers selling for about \$50 per spool.⁴⁹

Although the average \$1,000 price tag on a current home 3D printer is lower than the former commercial cost, the price is still high for a typical consumer. But history shows that prices will rapidly drop as the technology advances.⁵⁰ Recall the early dot matrix color printer that sold to consumers for \$500 in the early 1990s.⁵¹ It was considered state-of-the-art at the time, but today a consumer can purchase a LaserJet printer with Wi-Fi for only \$105.⁵² Consumer homes already have desktop 3D printers, and as with 2D printers, costs will almost certainly continue to fall.⁵³

Consumers who do not want to buy a 3D printer can still easily print 3D objects.⁵⁴ Online services like Shapeways, Sculpteo, and i.materialize print consumer CAD design submissions and ship the objects to consumers.⁵⁵ These services charge a modest fee, often between \$2 and \$150, depending on the object.⁵⁶ For example, Shapeways has printed several consumer objects such as phone cases, jewelry, lamps, bookends, and dice.⁵⁷ Shapeways has also printed product replacement parts, such as the previously discussed “Bugaboo” stroller part, laptop hardware pieces, battery covers, and various hinges.⁵⁸ Retail stores will also offer 3D printing services soon.⁵⁹ Staples, the office supply chain, has already contracted with the 3D printing company Mcor Technologies to develop a “Staples Easy 3D” printing service for its copy centers.⁶⁰ As with the services discussed above, customers will submit their CAD files online, and Staples will offer in-store pickup of the finished products.⁶¹

Consumers can create their own customized 3D designs with CAD programs or 3D scanning, but they can also use premade designs from databases online.⁶² This option is especially appealing to consumers who are

⁴⁹ See Brown, *supra* note 11.

⁵⁰ Schenone, *supra* note 47.

⁵¹ *Id.*

⁵² *Id.*

⁵³ Barnatt, *supra* note 8; see also MAKERBOT, *supra* note 47 (showcasing a series of currently available 3D printers and prices).

⁵⁴ Jensen-Haxel, *supra* note 14, at 452-53.

⁵⁵ Rideout, *supra* note 14, at 164; Barnatt, *supra* note 8; Braue, *supra* note 40.

⁵⁶ See, e.g., Biggs, *supra* note 7; SHAPEWAYS, <http://www.shapeways.com/search?q=replacement&s=50> (search “replacements” in navigation bar at top of page) (last visited June 26, 2013).

⁵⁷ Gallery, SHAPEWAYS, <http://www.shapeways.com/gallery> (last visited May 16, 2013).

⁵⁸ See Evan Ackerman, *3D Printing Could Be the Best Way to Fix Nearly Everything*, DVICE (Aug. 4, 2011, 3:47 PM), <http://dvice.com/archives/2011/08/3d-printing-cou.php>; SHAPEWAYS, *supra* note 56.

⁵⁹ See, e.g., Mike Senese, *Staples Announces In-Store 3-D Printing Service*, CNN TECH (Dec. 1, 2012, 8:34 AM), <http://www.cnn.com/2012/11/30/tech/innovation/staples-3-d-printing/index.html>.

⁶⁰ *Id.*

⁶¹ *Id.*

⁶² See, e.g., Hanna, *supra* note 14.

not tech-savvy. Websites like Thingiverse, The Pirate Bay, and Shapeways contain a bank of free, downloadable, and ready-to-use CAD files for a wide array of objects.⁶³ Many of the designs are created by other users and uploaded to the websites.⁶⁴ In minutes, a consumer can download a premade CAD file and submit it to services like Shapeways or Staples for printing.⁶⁵

With all of these 3D print options, consumers will soon be able to create many objects through a process that is “as simple as microwaving a baked potato.”⁶⁶ Three-dimensional printers have already been used to create printed tools, human tissues, working guns, automobile parts, toys, popular board games, component parts like hinges and handles, and many everyday objects.⁶⁷

C. *Patent Law and the Repair-Reconstruction Doctrine*

Article I, Section 8, Clause 8 of the United States Constitution grants Congress the authority to make a national patent law framework that rewards patent holders with exclusive rights for limited times over their creations.⁶⁸ Congress enacted the United States patent law, which states, “whoever without authority makes [or] uses . . . any patented invention, within the United States . . . during the term of the patent . . . infringes on the patent.”⁶⁹

Pursuant to the law, once an object is patented, copies of the object infringe upon that patent, regardless of whether the copier knows about the patent.⁷⁰ Few exceptions exist, and a copier is usually liable for patent in-

⁶³ Rideout, *supra* note 14, at 164-65; Brown, *supra* note 11; *see also* THE PIRATE BAY, <http://thepiratebay.sx/> (last visited June 26, 2013).

⁶⁴ Rideout, *supra* note 14, at 164.

⁶⁵ *See Gallery, SHAPEWAYS, supra* note 57; Senese, *supra* note 59.

⁶⁶ Coutts, *supra* note 21.

⁶⁷ *See* Brown, *supra* note 11; Andy Greenberg, \$25 Gun Created With Cheap 3D Printer Fires Nine Shots, FORBES (May 20, 2013, 11:51 AM), <http://www.forbes.com/sites/andygreenberg/2013/20/25-gun-created-with-cheap-3d-printer-fires-nine-shots-video/>; *see also* andrew239, 3D Printer Making a Wrench, LIVE LEAK (July 10, 2011), http://www.liveleak.com/view?i=0b5_1310330270; Layer by Layer, *supra* note 27 (discussing 3D printer production of bodily tissues); McCarty, *supra* note 11 (discussing the current capabilities and future potential for 3D printers in constructing houses); Lily Hay Newman, Man 3D-Prints Spare Part to Avoid Huge Ripoff, GIZMODO (Aug. 4, 2011, 5:25 PM), <http://gizmodo.com/5827836/man-3d+prints-spare-part-to-avoid-huge-ripoff> (reviewing the previously discussed Bugaboo pram replacement part story).

⁶⁸ U.S. CONST. art. I, § 8, cl. 8 (“The Congress shall have Power . . . [t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries . . .”).

⁶⁹ 35 U.S.C. § 271(a) (2006).

⁷⁰ Weinberg, *supra* note 9, at 8. However, it is not infringement to copy a once-patented item if the patent has expired. Patents expire after twenty years. 35 U.S.C. § 154(a)(2).

fringement even if the copied object is only for home or personal use.⁷¹ The patent holder's right to exclude others and enjoy profits from the patent comes from some of the legal rights associated with real property.⁷²

After purchasing a patented product, a consumer has the right to use it free of control by the patent owner.⁷³ This authority also gives a consumer the right to repair the object and use replacement parts to preserve its useful life.⁷⁴ But the authority to make repairs on a patented device does not include the right to completely recreate it after the device is worn out and spent.⁷⁵ Sometimes repairs can be extensive enough to constitute reconstruction.⁷⁶ When someone reconstructs a patented product "as to 'in fact make a new article,'" the person commits patent infringement through impermissible reconstruction.⁷⁷ Reconstruction is beyond the scope of a patented product's permissible uses, and it violates the patent owner's right to exclude others.⁷⁸ Thus, if a consumer wishes to continue using a patented product after its useful life is spent, patent law only allows the consumer to buy a replacement or repair the item with approved parts.⁷⁹

D. *The Disruptive Potential of 3D Printing in the Repair-Reconstruction Doctrine*

Three-dimensional printing technology has disruptive potential in patent arenas because it greatly simplifies the reproduction of physical, potentially patented objects. This disruptive potential is similar to the risks once

⁷¹ *Id.* The narrow "experimental use" common law exception may apply if the consumer has no commercial goal and copies the object only for curiosity or amusement, but discussion of that doctrine is outside of the scope of this Comment. See *Embrex, Inc. v. Serv. Eng'g Corp.*, 216 F.3d 1343, 1349 (Fed. Cir. 2000) (per curiam) (discussing "a narrow defense to infringement" for when an object copy is made for amusement, "idle curiosity," or "strictly philosophical inquiry" (quoting *Roche Prods., Inc. v. Bolar Pharm. Co.*, 733 F.2d 858, 863 (Fed. Cir. 1984) (internal quotation marks omitted))).

⁷² See Adam Mossoff, *Exclusion and Exclusive Use in Patent Law*, 22 HARV. J.L. & TECH. 321, 323 (2009).

⁷³ See *Jazz Photo Corp. v. Int'l Trade Comm'n* (*Jazz 2001*), 264 F.3d 1094, 1105 (Fed. Cir. 2001); see also CHISUM, *supra* note 5, § 16.03[3], at 16-449.

⁷⁴ See *Jazz 2001*, 264 F.3d at 1104-05 (arguing that the replacement of worn or spent unpatented parts to preserve the object's original utility falls within permissible repair); see also CHISUM, *supra* note 5, at 16-449 to -450; Sperry, *supra* note 17, ¶ 10.

⁷⁵ *Wilson v. Simpson*, 50 U.S. (9 How.) 109, 123-24 (1850); see also CHISUM, *supra* note 5, §16.03[3], at 16-450; Janis, *supra* note 17, at 427; Sperry, *supra* note 17, ¶ 10.

⁷⁶ KIEFF ET AL., *supra* note 15, at 1094.

⁷⁷ *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 346 (1961) (quoting *United States v. Aluminum Co. of Am.*, 148 F.2d 416, 425 (2d Cir. 1945)); see also Sperry, *supra* note 17.

⁷⁸ KIEFF ET AL., *supra* note 15, at 1093; see also CHISUM, *supra* note 5, § 16.03[3], at 16-450.

⁷⁹ *Wilson*, 50 U.S. (9 How.) at 123; see also CHISUM, *supra* note 5, § 16.03[3][b], at 16-458; Sperry, *supra* note 17, ¶ 21.

faced by authors of printed text with the advent of the printing press.⁸⁰ Before the printing press, books were extremely expensive and generally inaccessible to the masses.⁸¹ When a citizen needed information, a king's messenger or other representative delivered it.⁸² The invention of the printing press allowed the average citizen to obtain textual materials in ways not previously imagined, and it eventually led to the passage of copyrights and other laws to manage published material.⁸³ Similarly, 3D printing allows consumers to independently use a creation process that was once cost-prohibitive and limited to high-investment manufacturing plants.⁸⁴ As a result, 3D print technology, like the printing press, is likely to create issues within several areas of the law.⁸⁵ In particular, the advancement of 3D printing will require patent law to better define the difference between legal repair and infringing reconstruction.⁸⁶

Three-dimensional printing allows consumers with broken objects around the house to recreate many product parts by simply downloading, scanning, or creating the CAD file and printing it in plastic, metal, or other materials.⁸⁷ As previously discussed, one consumer fixed his expensive baby stroller by creating a handle lock with a 3D printer.⁸⁸ Another consumer printed a plastic handlebar piece for a Ford truck, and another printed

⁸⁰ Hanna, *supra* note 14; see generally, e.g., Jensen-Haxel, *supra* note 14 (discussing the legal controversy associated with firearms and 3D printing).

⁸¹ 21st Century Fluency Project, *The Age of Disruptive Innovation*, A+ EDUCATORS, 6 (2013), <http://www.4aplus.com/download/effective-schools-2013/Ian%20Jukes%203.7%20keynote%20Age%20of%20Disruptive%20Innovation%20Perspective.pdf>.

⁸² *Id.*

⁸³ *Id.*; Weinberg, *supra* note 9, at 1.

⁸⁴ See Braue, *supra* note 40.

⁸⁵ See Jensen-Haxel, *supra* note 14, at 448 (discussing the possible legal implications of 3D printing firearms); Rideout, *supra* note 14, at 161 (analyzing the first copyright infringement action taken in connection with a CAD design and resulting 3D-printed object); Hanna, *supra* note 14 (discussing the same); see also Daniel Harris Brean, *Asserting Patents to Combat Infringement via 3D Printing: It's No "Use"*, 23 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. (forthcoming 2013) (manuscript at 781), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2088294 (discussing the intellectual property and contributory infringement implications of 3D printing); Larry N. Zimmerman, *Printers Get Interesting, Finally*, J. KAN. B. ASS'N, Jan. 2012, at 15 (discussing the possible legal controversy that could stem from 3D printing).

⁸⁶ Weinberg, *supra* note 9, at 13-14. This Comment is based on US law. For a discussion on how European Community and U.K. law apply, see Simon Bradshaw, Adrian Bowyer & Patrick Haufe, *The Intellectual Property Implications of Low-Cost 3D Printing*, 7:1 SCRIPTED 5, 24, 27 (2010), available at <http://www.law.ed.ac.uk/ahrc/script-ed/vol7-1/bradshaw.pdf>. But see Ryan Whitwam, *Why the 3D Printing Revolution Won't Happen in Your Garage*, EXTREME TECH (Aug. 22, 2012, 8:03 AM), <http://www.extremetech.com/extreme/134833-why-the-3d-printing-revolution-wont-happen-in-your-garage> (questioning the average consumer's need for a 3D printer to make replacement parts).

⁸⁷ Hanna, *supra* note 14; Akhil, *The Scary Side of 3D Printing*, SPARKY HUB (Sept. 2, 2012), <http://www.sparkyhub.com/the-scary-side-of-3d-printing/>.

⁸⁸ See Biggs, *supra* note 7.

a new dial for a clothes dryer.⁸⁹ Likewise, a consumer could easily print a remote control's battery cover if the original piece became broken or disappeared.

When consumers print one small piece of a much larger combination, as described above, common sense tells us that the activities are simple cases of repair. This inclination is typically correct under the law. Someone who lawfully purchases a patented product may legally repair it by replacing an unpatented part of the whole combination, once or repeatedly.⁹⁰ However, the difference between repair and reconstruction becomes more complicated when a consumer replaces several parts simultaneously or makes multiple repairs to preserve an object's utility.⁹¹ In the case of the remote control, what if a consumer concurrently printed and installed a new battery cover, a new set of buttons to replace worn numbers, and new casing pieces for most of the remote control's structure? Is that repair or reconstruction?

The following section explains the current distinction in patent law between permissible repair and infringing reconstruction, and how the current, unclear standards will produce inconsistent and unsavory legal results when consumers use 3D printing to replace parts for common home objects.

II. THE SHORTCOMINGS OF THE REPAIR-RECONSTRUCTION DOCTRINE WHEN APPLIED TO 3D PRINTING

A. *Repair or Reconstruction? The Legal Standards*

For years the Supreme Court and lower courts have struggled to differentiate between permissible repair and infringing reconstruction.⁹² As it currently stands, the ambiguous standard seems to resemble a famous test for obscenity—"I know it when I see it."⁹³

⁸⁹ See megaduty, *Fix Your Ford with a 3D Printer*, INSTRUCTABLES (May 13, 2012), <http://www.instructables.com/id/Fix-your-Ford-with-a-3D-printer/>; Luke Chilson, *What to Do with a 3D Printer: Fix the Dial on the Clothes Dryer*, PROTOPARADIGM (Jan. 3, 2012), <http://www.protoparadigm.com/blog/2012/01/what-to-do-with-a-3d-printer-fix-the-dial-on-the-clothes-dryer/>.

⁹⁰ *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 346 (1961).

⁹¹ See *Husky Injection Molding Sys. Ltd. v. R & D Tool & Eng'g Co.*, 291 F.3d 780, 784-85 (Fed. Cir. 2002); *Jazz Photo Corp. v. Int'l Trade Comm'n (Jazz 2001)*, 264 F.3d 1094, 1105-06 (Fed. Cir. 2001); CHISUM, *supra* note 5, § 16.03[3][e], at 16-498 to -499.

⁹² *Husky*, 291 F.3d at 784-85; see also CHISUM, *supra* note 5, § 16.03[3][e], at 16-498 to -499.

⁹³ See *Jacobellis v. Ohio*, 378 U.S. 184, 197 (1964) (Stewart, J., concurring) ("I shall not today attempt further to define the kinds of material I understand to be embraced within that shorthand description; and perhaps I could never succeed in intelligibly doing so. But I know it when I see it, and the motion picture involved in this case is not that.").

1. The Supreme Court's Unavailing Attempts to Distinguish Repair and Reconstruction

The Supreme Court first tackled the issue of repair versus reconstruction in 1850 in the case of *Wilson v. Simpson*.⁹⁴ The defendant in *Wilson* had purchased a patented wood-planing machine and, without asking the patent holder, had replaced the machine's cutting knives after they wore out.⁹⁵ The knives typically wore out after ninety days of use, even though the machine's framework lasted for several years.⁹⁶ The Court held that the defendant could legally replace the knives because the knives were temporary compared to the use of the whole, and their replacement "[did] not alter the identity of the machine, but preserve[d] it."⁹⁷ The Court declined to create a bright-line rule, but in finding permissible repair, it emphasized the replacement part's limited life and the patent holder's intent.⁹⁸

About thirty years later, the Supreme Court faced the issue again, but this time it ruled that the defendant's activities constituted impermissible reconstruction.⁹⁹ In *Cotton-Tie Co. v. Simmons*,¹⁰⁰ the plaintiff had a patent on cotton bale ties, composed of a buckle and a band.¹⁰¹ The tie was designed to wrap around cotton bales until they arrived at a cotton mill, where the band was cut.¹⁰² The defendant bought severed ties from cotton mills as scrap, and then riveted the bands back together to form a usable tie.¹⁰³ Because the ties were voluntarily destroyed, the Court found their capacity for use as a tie was also destroyed, and riveting them back together amounted to infringing reconstruction.¹⁰⁴

In 1961, the Supreme Court confronted the issue again in *Aro Manufacturing Co. v. Convertible Top Replacement Co. (Aro I)*.¹⁰⁵ The Court had

⁹⁴ 50 U.S. (9 How.) 109 (1850); see also CHISUM, *supra* note 5, § 16.03[3][a], at 16-454.

⁹⁵ *Wilson*, 50 U.S. (9 How.) at 125.

⁹⁶ *Id.*

⁹⁷ *Id.* at 126; see also *Heyer v. Duplicator Mfg. Co.*, 263 U.S. 100, 101-02 (1923) (holding that the manufacture, use, and sale of replacement gelatine bands lasting through one hundred copies for use in a patented copying machine was permissible repair under *Wilson*); *Morgan Envelope Co. v. Albany Perforated Wrapping Paper Co.*, 152 U.S. 425, 431-33 (1894) (holding that the manufacture, sale, and use of toilet paper rolls for use in the plaintiff's patented combination of a roll and holder was permissible repair under *Wilson*).

⁹⁸ *Wilson*, 50 U.S. (9 How.) at 125-26.

⁹⁹ *Cotton-Tie Co. v. Simmons*, 106 U.S. 89, 93-95 (1882).

¹⁰⁰ 106 U.S. 89 (1882).

¹⁰¹ *Id.* at 89-91.

¹⁰² *Id.*

¹⁰³ *Id.* at 91-92.

¹⁰⁴ *Id.* at 93-95.

¹⁰⁵ 365 U.S. 336 (1961). The same parties met again in the Supreme Court three years later in *Aro II*, but that litigation focused more on the contributory infringement implications of manufacturing convertible tops, rather than on the direct infringement discussed in this Comment. See *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro II)*, 377 U.S. 476, 479 (1964). For a thoughtful discussion on the

to decide whether the replacement of fabric car convertible tops constituted infringing reconstruction.¹⁰⁶ The fabric was an unpatented part of a combination patent that covered the supporting structures, sealing mechanism, and “flexible top fabric” of car convertible tops.¹⁰⁷ Ruling that the replacement of unpatented spent fabric was permissible repair, the Court explained:

No element, not itself separately patented, that constitutes one of the elements of a combination patent is entitled to patent monopoly, however essential it may be . . . Mere replacement of individual unpatented parts, one at a time, whether of the same part repeatedly or different parts successively, is no more than the lawful right of the owner to repair his property.¹⁰⁸

The *Aro I* Court further provided that reconstruction occurs when a defendant “in fact make[s] a new article” after the patented entity as a whole becomes spent.¹⁰⁹ This broad language created a considerable amount of confusion in later cases.¹¹⁰

Justices outside of the *Aro I* majority tried to refine its result or disagreed with the Court’s decision completely.¹¹¹ Justice Brennan wrote a concurring opinion to *Aro I* in which he argued that rather than a single test, the determination should instead be made using multiple factors, such as the intent of the patent holder and user, as well as the life, importance, and cost of the part replaced in relation to the patented whole.¹¹²

In another concurrence to *Aro I*, Justice Black criticized Justice Brennan’s approach.¹¹³ Justice Black said that whether a patented object is reconstructed does not depend on whether an unpatented part is perishable, the length of time any elements last, or the intentions of a patentee or purchaser.¹¹⁴ He called Justice Brennan’s multifactor approach a “Pandora’s flock of insignificant standards” that would cause confusion and uncertainty, especially when engaging in the “psychoanalysis” necessary to discover the patentee’s or purchaser’s intentions.¹¹⁵ He said the analysis must involve

possible clash between 3D printing and patent contributory infringement, see Brean, *supra* note 85, at 23-27.

¹⁰⁶ *Aro I*, 365 U.S. at 337-39.

¹⁰⁷ *Id.* at 337.

¹⁰⁸ *Id.* at 345-46.

¹⁰⁹ *Id.* at 346 (quoting *United States v. Aluminum Co. of Am.*, 148 F.2d 416, 425 (2d Cir. 1945) (internal quotation marks omitted)).

¹¹⁰ Mark A. Farley, *Infringement Questions Stemming from the Repair or Reconstruction of Patented Combinations*, 68 J. PAT. & TRADEMARK OFF. SOC’Y 149, 162-63 (1986) (mentioning the confusion *Aro I* created in lower federal courts).

¹¹¹ See *Aro I*, 365 U.S. at 346-80 (Black, J., concurring, Brennan, J., concurring, and Harlan, J., dissenting).

¹¹² *Id.* at 363-64 (Brennan, J., concurring).

¹¹³ *Id.* at 346 (Black, J., concurring).

¹¹⁴ *Id.* at 354.

¹¹⁵ *Id.* at 355.

common sense instead of evidentiary standards, and he praised the *Wilson* Court's reluctance to create a bright-line rule.¹¹⁶

But Justice Black's concurrence was less than helpful. Although in his concurrence Justice Black claimed to support the analysis in *Wilson* and to disagree with Justice Brennan's proposed standards, the *Wilson* Court relied heavily on the part's durability and the patent holder's intent—two of Justice Brennan's proposed standards.¹¹⁷ Further, Justice Black admitted that the ruling in *Aro I* would not serve for a case involving the omission of a particularly minor part in the remaking of a patented combination—for example, the omission of a single bolt from a machine.¹¹⁸ Justice Black stated that for such a case, the Court would need to articulate refinements to the simple *Aro I* test, but he did not see the need to articulate those refinements in his concurrence.¹¹⁹

2. Lower Courts' Haphazard Applications of Supreme Court Standards

The Supreme Court precedents discussed above have created confusing and unguided applications of the law in lower courts.

In the 1964 case *Monroe Auto Equipment Co. v. Precision Rebuilders, Inc.*,¹²⁰ a district court held that the defendant committed infringing reconstruction by purchasing used shock absorbers as scrap, cutting them, and affixing new seals to them for resale.¹²¹ The court relied on the Supreme Court decision in *Cotton-Tie*, stating that this was reconstruction because the spent shock absorbers were converted from “useless junk” into a second creation.¹²² The court analyzed the intent of the patent holder and user, finding that the shock absorber's design “permit[ted] no access to or severance of the working elements by any ordinary method of detachment.”¹²³ The court also discussed the expected life and importance of the seal in relation to the full shock absorber, saying the seal normally “last[ed] the life of the shock absorber” and that it was “not merely a temporary part.”¹²⁴ Without acknowledging it, and perhaps without knowing it, the court used three out

¹¹⁶ *Id.* at 353-55.

¹¹⁷ *Aro I*, 365 U.S. at 353-55 (Black, J., concurring); see also *Wilson v. Simpson*, 50 U.S. (9 How.) 109, 125-26 (1850).

¹¹⁸ *Aro I*, 365 U.S. at 354-55 (Black, J., concurring).

¹¹⁹ *Id.*

¹²⁰ 229 F. Supp. 347 (D. Kan. 1964).

¹²¹ *Id.* at 352-53.

¹²² *Id.*

¹²³ *Id.* at 352.

¹²⁴ *Id.*

of four of Justice Brennan's proposed standards from his *Aro I* concurrence.¹²⁵

The same year that *Monroe* was decided, the Ninth Circuit heard the case of *Fromberg, Inc. v. Gross Manufacturing Co.*¹²⁶ The defendant bundled and sold "kits" containing a patented "Fromberg" device of Fromberg, Inc. and the defendant's own separately manufactured replacement plugs for the device.¹²⁷ The court explained that under *Aro I*, a person's intent and the "heart" of a patented combination is irrelevant if one element of the combination can be removed while the other elements can be used further.¹²⁸ Since the plug could be easily removed and the other elements of the device could be reused, the court held that the sale of the kit with replacement plugs was legal repair.¹²⁹

Ten years later, *High Voltage Engineering Corp. v. Potentials, Inc.*¹³⁰ presented the Fifth Circuit with what the district court called an "extremely close" case.¹³¹ The defendant was in the business of disassembling and cleaning patented tubes that were covered with grime deposits from heavy use.¹³² The defendant cleaned, resurfaced, and reassembled the tubes, turning them into functioning parts once again.¹³³ Ultimately the court found this activity to be permissible repair.¹³⁴ As in *Monroe*, the court used several of Justice Brennan's factors in its decision without acknowledging it—factors like whether the part was spent, the intent of the patent holder, and the part's cost in relation to the whole.¹³⁵ Even though the tube parts were inoperative and dirty before the defendant cleaned them, the court ruled that the parts were never truly "worn out" or spent.¹³⁶ The court reasoned that the tubes were intended for an extended life rather than a one-time use, and that the coated parts were a small fraction of the cost of the whole tube.¹³⁷ Finally, the court stated that this act was one of disassembling and cleaning, and no real "reconstruction" occurred, as with the retying of cotton bale ties in *Cotton-Tie*.¹³⁸

¹²⁵ See *id.* at 352-53; see also *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 363-64 (1961) (Brennan, J., concurring).

¹²⁶ 328 F.2d 803 (9th Cir. 1964); *Monroe Auto Equip. Co. v. Precision Rebuilders, Inc.*, 229 F. Supp. 347, 347 (D. Kan. 1964).

¹²⁷ *Fromberg*, 328 F.2d at 804-05.

¹²⁸ *Id.* at 808; see also *Aro I*, 365 U.S. at 344.

¹²⁹ *Fromberg*, 328 F.2d at 808.

¹³⁰ 519 F.2d 1375 (5th Cir. 1975).

¹³¹ *High Voltage Eng'g Corp. v. Potentials, Inc.*, 398 F. Supp. 18, 20 (W.D. Tex. 1974), *aff'd*, 519 F.2d 1375 (5th Cir. 1975).

¹³² *Id.* at 19-20.

¹³³ *Id.* at 19.

¹³⁴ *Id.* at 20.

¹³⁵ *Id.*

¹³⁶ *Id.*

¹³⁷ *High Voltage*, 398 F. Supp. at 20.

¹³⁸ *Id.*

In the 1994 case *FMC Corp. v. Up-Right, Inc.*,¹³⁹ a patent owner complained that the difference between repair and reconstruction was too ambiguous and requested that the “court state the standard[s] more clearly in a way that [could] be understood and applied both by patent owners and potential infringers.”¹⁴⁰ The court responded that the facts of the *FMC Corp.* case dealt only with sequential one-part repairs of a patented device rather than several replacements being made at one time, and in such cases, the *Aro I* standard unambiguously notifies patent holders and consumers that the activity is permissible repair.¹⁴¹ The court declined to provide a bright-line test for scenarios in which several replacements are made on one occasion, saying the difference between repair and reconstruction should be determined by “sound common sense and an intelligent judgment.”¹⁴²

One year later, the Federal Circuit ruled in *Sage Products, Inc. v. Devon Industries, Inc.*¹⁴³ that replacement of a removable inner container of a surgical disposal system was permissible repair.¹⁴⁴ The court noted that the patent holder, by suing a defendant who replaced the unpatented inner container part, tried to monopolize a segment of the replacement part market, which was an illegitimate attempt to extend patent rights to an unpatented component.¹⁴⁵

The court in *Sandvik Aktiebolag v. E.J. Co.*¹⁴⁶ used five factors to determine that “re-tipping,” or sharpening, a patented drill constituted infringing reconstruction.¹⁴⁷ The court said the drills were “spent” before fixing, the nature of re-tipping seemed like reconstruction, the tip was not a temporary or detachable part, no industry existed for replacement tips, and the patent holder did not intend for the drills to be re-tipped.¹⁴⁸ Although these factors resemble those cited by Justice Brennan in his *Aro I* concurrence, the *Sandvik* court did not purport to rely on the concurrence in its analysis.¹⁴⁹

In the 2001 Federal Circuit case *Jazz Photo Corp. v. International Trade Commission (Jazz 2001)*,¹⁵⁰ a manufacturer of single-use disposable cameras brought a patent infringement lawsuit against a foreign refurbisher for installing new film, replacing the batteries, and reselling the disposable

¹³⁹ 21 F.3d 1073 (Fed. Cir. 1994).

¹⁴⁰ *Id.* at 1078.

¹⁴¹ *Id.*

¹⁴² *Id.* at 1079.

¹⁴³ 45 F.3d 1575 (Fed. Cir. 1995).

¹⁴⁴ *Id.* at 1579.

¹⁴⁵ *Id.*

¹⁴⁶ 121 F.3d 669 (Fed. Cir. 1997).

¹⁴⁷ *Id.* at 673.

¹⁴⁸ *Id.* at 674.

¹⁴⁹ *Id.*

¹⁵⁰ 264 F.3d 1094 (Fed. Cir. 2001).

cameras.¹⁵¹ The Federal Circuit court found that the activities performed in refurbishing cameras—removing the cover, cutting open the plastic casing, inserting new film, replacing the winding wheel and battery, resetting the counter, resealing the outer case, and adding a new cover—all constituted permissible repair.¹⁵² Relying on *Aro I*, the court reasoned that the activities involved with changing and replacing film constituted replacement of an unpatented part, and the replacement of unpatented parts is “characteristic” of repair.¹⁵³

The year after *Jazz 2001*, the Federal Circuit heard *Husky Injection Molding Systems Ltd. v. R & D Tool & Engineering Co.*,¹⁵⁴ which involved the unpatented mold and carrier plate parts of a patented machine.¹⁵⁵ The defendant sold new molds and carrier plates for use in the patented machines.¹⁵⁶ In its holding, the court set apart three different repair-reconstruction situations.¹⁵⁷ The first situation occurs when an entire patented object is exhausted and the accused infringer remakes it.¹⁵⁸ The second situation happens when a worn-out part is replaced.¹⁵⁹ In the third situation, the basis for its holding, the court stated that replacing a series of spent parts to enable a patented object to carry out any function different from the original intended use is considered permissible repair.¹⁶⁰ The court noted that at the very least, if a part being serviced is “readily replaceable,” whether it is spent or still usable, the activity is repair.¹⁶¹

After *Husky*, the Federal Circuit heard three more camera refurbishing cases with facts similar to those in *Jazz 2001*.¹⁶² In the 2005 case *Fuji Photo Film Co. v. Jazz Photo Corp. (Jazz 2005)*,¹⁶³ a refurbisher claimed repair as an affirmative defense.¹⁶⁴ Because of the defense, the burden of proof shifted and required the refurbisher to present enough evidence to show that the activities were permissible repair.¹⁶⁵ The refurbisher did not meet its burden, since it only presented evidence of activities taking place in three of its

¹⁵¹ *Id.* at 1098.

¹⁵² *Id.* at 1110-11.

¹⁵³ *Id.* at 1107, 1110-11.

¹⁵⁴ 291 F.3d 780 (Fed. Cir. 2002).

¹⁵⁵ *Id.* at 782.

¹⁵⁶ *Id.* at 783.

¹⁵⁷ *Id.* at 785-86.

¹⁵⁸ *Id.* at 785.

¹⁵⁹ *Id.*

¹⁶⁰ *Husky*, 291 F.3d at 786.

¹⁶¹ *Id.* at 787.

¹⁶² See CHISUM, *supra* note 5, § 16.03[3], at 16-449.

¹⁶³ 394 F.3d 1368 (Fed. Cir. 2005).

¹⁶⁴ *Jazz 2005*, 394 F.3d at 1373.

¹⁶⁵ *Id.* (“The burden of establishing an affirmative defense is on the party raising the defense.” (quoting *Jazz Photo Corp. v. Int’l Trade Comm’n (Jazz 2001)*, 264 F.3d 1094, 1102 (Fed. Cir. 2001)) (internal quotation marks omitted)).

eight factories.¹⁶⁶ At trial in a lower court, a jury found that the refurbisher had reconstructed more than 39 million of the manufacturer's used cameras.¹⁶⁷ The Federal Circuit later affirmed the lower court's ruling.¹⁶⁸

The next year, in *Jazz Photo Corp. v. United States* (*Jazz 2006*),¹⁶⁹ an importer of refurbished disposable single use cameras succeeded on the issue of permissible repair.¹⁷⁰ Relying on *Jazz 2001*, the Federal Circuit determined that replenishing the film in the cameras "did not in fact make a new single use camera" to warrant a ruling of reconstruction.¹⁷¹

In the last of the single-use disposable camera cases, *Fuji Photo Film Co. v. International Trade Commission* (*Fuji 2007*),¹⁷² the Federal Circuit reviewed findings of International Trade Commission ("ITC") enforcement proceedings regarding the permissible repair or infringing reconstruction of single-use disposable cameras.¹⁷³ In contrast with the previous ITC proceedings, but as with the other two camera refurbishing cases, the court held that the processes were permissible repair.¹⁷⁴

Even though several cases analyzed the difference between repair and reconstruction, "difficult questions remain" for future cases.¹⁷⁵ The Supreme Court in *Aro I* comes the closest to defining a rule, but as shown, lower courts have applied the *Aro I* standard in different ways.¹⁷⁶ The standards will not provide enough guidance to fairly and consistently distinguish between permissible repair and infringing reconstruction in potential future cases involving 3D-printed replacement parts.

B. Likely Consequences of the Ambiguous Standard and 3D Printing

Under the doctrine outlined above, consumers can lawfully recreate an unpatented part of a patented combination and use it to replace a part that is spent.¹⁷⁷ But as the process of creating replacement parts becomes easier and cheaper with 3D printing, consumers will become increasingly likely to 3D print and install several replacement parts at once. Consumers will need

¹⁶⁶ *Id.* at 1373-74.

¹⁶⁷ *Fuji Photo Film Co. v. Jazz Photo Corp.*, 249 F. Supp. 2d 434, 441 (D.N.J. 2003), *aff'd*, 394 F.3d 1368 (Fed. Cir. 2005).

¹⁶⁸ *Jazz 2005*, 394 F.3d at 1370.

¹⁶⁹ 439 F.3d 1344 (Fed. Cir. 2006).

¹⁷⁰ *Jazz 2006*, 439 F.3d at 1346.

¹⁷¹ *Id.* at 1354.

¹⁷² 474 F.3d 1281 (Fed. Cir. 2007).

¹⁷³ *Fuji 2007*, 474 F.3d at 1285.

¹⁷⁴ *Id.* at 1298; *see also* CHISUM, *supra* note 5, § 16.03[3][d], at 16-487.

¹⁷⁵ *Husky Injection Molding Sys. Ltd. v. R & D Tool & Eng'g Co.*, 291 F.3d 780, 786 (Fed. Cir. 2002).

¹⁷⁶ *See Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 346 (1961).

¹⁷⁷ Weinberg, *supra* note 9, at 9.

to replace fewer objects with new purchases. As consumers grow less dependent on traditionally manufactured objects, patent holders will likely view 3D printing of replacement parts as piracy or theft.¹⁷⁸ Consumers will fight to maintain their right to 3D printed replacement parts, as patent holders will fight to restrict it.¹⁷⁹ This struggle will probably result in litigation, which will test the current repair-reconstruction legal doctrine. In that test, the doctrine will fail to provide predictable, consistent applications of the law for cases of multiple replacement parts that are 3D printed and installed during one period.

1. An Attempt to Impose Tighter Restrictions

In response to widespread replacement part 3D printing, businesses will try to protect their revenue streams.¹⁸⁰ Michael Weinberg, a copyright and technology attorney working for Public Knowledge, a consumer protection group, describes this possibility:

As incumbent companies begin to see small-scale 3D printing as a threat, they will inevitably attempt to restrict it by expanding intellectual property protections. In doing so they will point to easily understood injuries to existing business models (caused by 3D printing or not) such as lost sales, lower profits, and reduced employment.¹⁸¹

Companies and other patent holders may try to impose restrictions on unpatented component parts, which would essentially penalize repair.¹⁸² Such restrictions could include product labels that read “For Single Use Only,” or certain registered CAD files branded with “do not manufacture” watermarks.¹⁸³ Alternatively, patent holders may push for an expanded scope for patent protection and the creation of some sort of license or protection system for unpatented parts of combination patents.¹⁸⁴ To an extent, if successful, the maneuver would effectively force consumers to buy more patented products instead of repairing them.¹⁸⁵ But it is highly unlikely that these restrictions would pass muster in court, because courts have repeated-

¹⁷⁸ *Id.*

¹⁷⁹ *Id.* at 13-14.

¹⁸⁰ *Id.* at 15.

¹⁸¹ *Id.*; see also Coutts, *supra* note 21 (quoting Weinberg, *supra* note 9, at 15).

¹⁸² Weinberg, *supra* note 9, at 13.

¹⁸³ See *Cotton-Tie Co. v. Simmons*, 106 U.S. 89, 91, 93-95 (1882) (discussing the legal implications of a product label that read “Licensed to use once only”); Sperry, *supra* note 17, ¶¶ 5-62 (discussing case law on single-use-only labels); Coutts, *supra* note 21 (discussing the restriction on reproducing CAD files with “do not copy” watermarks).

¹⁸⁴ Weinberg, *supra* note 9, at 8.

¹⁸⁵ *Id.* at 13-14.

ly denied extending patent protection over individual, unpatented parts of a combination.¹⁸⁶

2. Individual Lawsuits Against Bragging Bloggers

Consumers frequently use the Internet's blogs and forums to share their 3D printing success stories and tutorials, and many of these stories involve 3D-printed replacement parts.¹⁸⁷ Inevitably, some patent holders will discover these online postings that involve their patented items. Most patent holders will probably tolerate 3D printing by consumers as low-level interferences not worth pursuing.¹⁸⁸ Other patent holders who wish to strictly enforce their patent rights, however, could sue the consumers for infringing reconstruction.¹⁸⁹

For instance, the man who fixed his expensive stroller handle has posted online instructions for others who encounter the same stroller handle misfortune.¹⁹⁰ The instructions contain a CAD file and explain exactly how to 3D print and install the handle lock piece.¹⁹¹ Assuming for illustration purposes that the Bugaboo brand owns a patent on the stroller,¹⁹² if this man added more tutorials for different parts of the stroller to the site, Bugaboo may begin to view his 3D printing activity as infringing reconstruction.

¹⁸⁶ See, e.g., *Sage Prods., Inc. v. Devon Indus., Inc.*, 45 F.3d 1575, 1579 (Fed. Cir. 1995). When the sale of a patented product is conditioned on the sale of an unpatented product in a "tying" arrangement, the lawsuit usually focuses on antitrust claims. See, e.g., *Ill. Tool Works, Inc. v. Indep. Ink, Inc.*, 547 U.S. 28, 31 (2006) (examining antitrust claims to determine whether a patent holder for inkjet printers could require its consumers to purchase its unpatented replacement ink). But this issue can also arise in the context of repair-reconstruction, which is the focus of the *Sage Products* case.

¹⁸⁷ See, e.g., dscott4, *How to Repair a Bugaboo Pram with 3D Printing*, INSTRUCTABLES (Aug. 2, 2011), <http://www.instructables.com/id/How-to-repair-a-Bugaboo-Pram-with-3D-Printing/>.

¹⁸⁸ By allowing minor 3D printing infringements to go unpunished, patent holders would be carrying out the idea central to the principle of "live and let live" at the boundary. This principle, usually traced to Baron Bramwell's opinion in the English nuisance case *Bamford v. Turnley*, suggests that two parties are always better off suffering some small nuisance in exchange for increased freedom of action. *Bamford v. Turnley*, (1862) 122 Eng. Rep. 27, 32-33.

¹⁸⁹ In support of the "live and let live" principle, Professor Richard Epstein explains that "[d]emanding a complete cessation of harm places a huge crimp on productive activity." Richard A. Epstein, *Property Rights, State of Nature Theory, and Environmental Protection*, 4 N.Y.U. J.L. & LIBERTY 1, 15 (2009). If patent owners disregard the principle, use blogs to discover possible minor infringements, and then sue to strictly enforce their patent rights, it could instill fear in consumers and place a similar crimp on the innovative use of 3D printing for home replacement parts. Consumers are especially likely to fear the repercussions of this process if the repair-reconstruction legal doctrine remains convoluted.

¹⁹⁰ See dscott4, *supra* note 187.

¹⁹¹ *Id.*

¹⁹² A quick search of the United States Patent and Trademark Office database seems to reveal that the Bugaboo brand owns patents on the stroller structures. See <http://appft1.uspto.gov/netahtml/search-bool.html> (search "Bugaboo").

This is especially true if the company has reason to believe the man printed and replaced several parts at once. Under these facts, Bugaboo could use the website as evidence and bring an infringement lawsuit against the man for possible reconstruction of the stroller. This same scenario can happen to any consumer who posts their 3D-printed replacement part stories to a public online forum.

3. Mass Litigation Reminiscent of the RIAA's Campaign Against Music File Sharing

If people adopt the same norms for downloading and 3D printing patented objects as people adopted for music sharing in the late 1990s, the lesson from the music industry is that patent holders will have to teach the public the illegality of infringement through litigation.¹⁹³

"Online piracy became a major concern for the music industry" after Napster and other peer-to-peer ("P2P") software networks emerged.¹⁹⁴ The recording industry faced a dramatic, long-term decline in sales in part due to rampant music sharing.¹⁹⁵ To protect the music industry, the RIAA first tried to shut down P2P networks directly through lawsuits with claims of contributory and vicarious infringement.¹⁹⁶ The RIAA won a victory against Napster, but individuals flocked to decentralized networks like Grokster to continue downloading free music.¹⁹⁷ Litigation against individuals may have been the RIAA's last option to save its revenue streams.¹⁹⁸

Around 2003, the RIAA launched a mass litigation campaign against people who were downloading and sharing MP3 files.¹⁹⁹ The RIAA used investigators to identify the individuals, their download patterns, and their Internet Protocol ("IP") addresses.²⁰⁰ Equipped with the IP addresses, the

¹⁹³ See generally Kristina Groennings, *Costs and Benefits of the Recording Industry's Litigation Against Individuals*, 20 BERKELEY TECH. L.J. 571 (2005) (discussing the use of increased litigation as a last recourse for the music industry to combat reduced sales resulting from increased online file sharing).

¹⁹⁴ James Dye, *Who's Walking the Plank?: The Recording Industry's Fight to Stop Music Piracy*, PITT. J. TECH. L. & POL'Y, Fall 2005, at 4.

¹⁹⁵ See Groennings, *supra* note 193, at 572-73.

¹⁹⁶ See, e.g., *id.* at 573.

¹⁹⁷ See *A&M Records, Inc. v. Napster, Inc.*, 239 F.3d 1004, 1028-29 (9th Cir. 2001); see also Groennings, *supra* note 193, at 573.

¹⁹⁸ Groennings, *supra* note 193, at 572-73.

¹⁹⁹ John Schwartz, *Music Industry Returns to Court, Altering Tactics on File Sharing*, N.Y. TIMES, Jan. 22, 2004, at C1, available at http://www.nytimes.com/2004/01/21/business/21WIRE-MUSIC.html?_r=1098849600&en=6fbab6ab32a03237&ei=5070&hp.

²⁰⁰ Catherine Rampell, *How It Does It: The RIAA Explains How It Catches Alleged Music Pirates*, CHRON. HIGHER EDUC. (May 13, 2008), <http://chronicle.com/article/How-It-Does-It-The-RIAA-Ex/786/>.

RIAA went to court, filed “John Doe” lawsuits, and obtained subpoenas.²⁰¹ The RIAA then sent the subpoenas to the relevant Internet service providers, ordering them to turn over personal information associated with each IP address.²⁰² Once an individual’s name was known, the RIAA amended its original complaint and moved forward with the copyright infringement lawsuit.²⁰³

The RIAA also sent pre-litigation settlement agreements to several individuals, asking each person to pay \$2,000 to \$4,000 to avoid litigation.²⁰⁴ The consumers who opted out of settlement were summoned into court and took part in costly litigation.²⁰⁵ Though the RIAA was harshly criticized for these lawsuits, it pointed to its severely hit revenue streams to defend itself.²⁰⁶

Like MP3 music files, CAD files can be easily stored, shared, and retrieved over the Internet, and several networks for sharing CAD files already exist.²⁰⁷ When patent holders and manufacturers see a drop in revenues that could be attributable to CAD file sharing and 3D printing, they might mimic the RIAA’s strategy and sue home users.²⁰⁸ The RIAA, after all, has seen several long-term benefits as a result of its litigation efforts.²⁰⁹ The lawsuits caused an initial and possibly lasting decrease in file sharing on popular P2P sites.²¹⁰ Some studies also show that the litigation has deterred casual downloaders and changed the public’s perception of downloading.²¹¹ Additionally, it has helped foster growth for legal downloading sites like iTunes.²¹²

The RIAA’s individualized lawsuits dealt with fairly straightforward cases.²¹³ When an individual was found to have downloaded a music file

²⁰¹ Schwartz, *supra* note 199.

²⁰² *Id.*

²⁰³ *Id.*

²⁰⁴ *12-Year-Old Settles Music Swap Lawsuit*, CNN (Feb. 18, 2004, 1:09 AM), <http://www.cnn.com/2003/TECH/internet/09/09/music.swap.settlement/>.

²⁰⁵ Plaintiff’s Fourth Amended Complaint, at 3-6, *Andersen v. Atl. Recording Corp.* (D. Or. 2010) (No. 07-934), 2008 WL 1923481, available at <http://www.scribd.com/doc/26112092/Fourth-Amended-Complaint-in-Andersen-v-Atlantic-Records> (last visited June 28, 2013).

²⁰⁶ Press Release, Recording Indus. Ass’n of Am., RIAA Sends More Law Pre-Lawsuit Letters to Colleges with New School Year (Sept. 20, 2007), available at <http://www.riaa.com/newsitem.php?id=-8061-3114-41BB-491B8B32A357>; see also Groennings, *supra* note 193, at 572-73.

²⁰⁷ See Brown, *supra* note 11.

²⁰⁸ Schenone, *supra* note 47; see also Zimmerman, *supra* note 85.

²⁰⁹ Groennings, *supra* note 193, at 577-86.

²¹⁰ *Id.* at 577.

²¹¹ *Id.* at 577-80.

²¹² *Id.* at 576; Schwartz, *supra* note 199.

²¹³ See *A&M Records, Inc. v. Napster, Inc.*, 239 F.3d 1004, 1013 (9th Cir. 2001) (noting that “as much as eighty-seven percent of the files available on Napster may be copyrighted and more than seventy percent may” belong to the RIAA (quoting *A & M Records, Inc. v. Napster, Inc.*, 114 F. Supp. 2d 896, 911 (N.D. Cal. 2000) (internal quotation marks omitted))).

without permission from the copyright holder, it constituted direct copyright infringement.²¹⁴ What differs and complicates matters in a case with patent law, CAD files, and 3D printing, is that consumers can download and print multiple component parts of a patented object instead of directly copying or sharing the whole object.²¹⁵

If patent holders or manufacturers bring infringing reconstruction lawsuits against consumers for 3D printing replacement parts, those consumers would have a more difficult time predicting the litigation outcomes than the consumers who faced RIAA copyright lawsuits. The legal uncertainty will confuse consumers and affect their legal decisions, especially whether to settle outside of court.

4. A Hypothetical Analysis of Probable Litigation

Since patent holders will be able to monitor a consumer's file sharing with online blogs or in the same fashion as the RIAA, they will be able to target consumers who create or download several parts to a patented combination.²¹⁶ For instance, in the earlier remote control example, a patent holder could see that a consumer has downloaded the CAD files for the battery cover, buttons, and most of the casing to its patented remote control.

If the consumer could prove that he or she implemented the parts at different times, perhaps the changes would be permissible repair under the *Aro I* timing standard. However, if the consumer printed and replaced each part on the same occasion, he or she would be looking to the other vague standards announced in *Aro I* and its progeny, such as whether the consumer "in fact ma[d]e a new article."²¹⁷ The consumer would be left guessing at the result of any potential litigation.

Although the courts reassure rights holders and consumers that the cases will be judged using "sound common sense and an intelligent judgment," legal outcomes can seem arbitrary and the standard provides no consumer certainty.²¹⁸ Seeing that "common sense" and "intelligent judgment" are both standards that rely heavily on subjective assessments, no consumer or patent holder can predict how a certain judge or set of judges will feel about a product that has been fixed. A consumer fixing multiple parts of a remote control at one point in time is afforded no certainty before litigation as to whether creating those parts constitutes repair or reconstruction.

²¹⁴ *Id.* at 1013-14.

²¹⁵ See Biggs, *supra* note 7.

²¹⁶ See Schwartz, *supra* note 199.

²¹⁷ *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 346 (1961) (quoting *United States v. Aluminum Co. of Am.*, 148 F.2d 416, 425 (2d Cir. 1945)).

²¹⁸ *FMC Corp. v. Up-Right, Inc.*, 21 F.3d 1073, 1079 (Fed. Cir. 1994) (quoting *Goodyear Shoe Mach. Co. v. Jackson*, 112 F. 146, 150 (1st Cir. 1901)).

The current standards will also cause inconsistent applications of the law. Using the remote control illustration, in which a consumer replaces several parts at once, consider how the results of litigation could vary under the frameworks set forth in *Wilson*, *Cotton-Tie*, *Aro I*, and the lower court decisions previously discussed.

Under *Wilson*, what matters most is the replacement part's durability in relation to the whole and the patent holder's intent in the object's construction.²¹⁹ The plastic battery cover, buttons, and casing of a remote control are fairly durable in relation to the remote control's lifetime as a whole. None of those parts tend to wear quickly, especially compared to the planing machine knives that lasted for about ninety days in *Wilson*.²²⁰ Further, each piece is carefully crafted to fit with other pieces—remote control buttons are perfectly fitted underneath the casing, which is usually secured tightly with all other parts, and the battery cover only snaps off to allow battery replacement.²²¹ Considering the durability of these pieces with the construction of an average remote, it is fairly clear that none of those pieces are intended to be readily replaceable. It seems as though the Court in *Wilson* would rule that the consumer was not preserving the remote, but instead that he or she was altering its identity and reconstructing it.

By the standards of *Cotton-Tie*, on the other hand, a court could find that the remote control replacement pieces were a permissible repair, since the pieces were never voluntarily or completely destroyed, recreated, and then put back together.²²²

Since in this scenario a consumer would create more than one piece to the remote, the “one part rule” from *Aro I* would not apply; instead, the *Aro I* Court would analyze whether the new pieces “in fact ma[d]e a new article.”²²³ The three remote control pieces could be seen as making up a larger proportion of the remote control's whole than repaired fabric makes of a patented convertible top. Thus, using only the analysis within the *Aro I* opinion, the three-piece remote control scenario would likely be deemed impermissible reconstruction. The determination would be based on how “new” of an article the court feels the remote control has become; however, the Court in *Aro I* did not articulate what renders an object “new.”²²⁴

Lower courts could also come to different conclusions under this remote control scenario. The court in *FMC* refused to give a test for scenarios where several replacement parts were installed on one occasion, so the

²¹⁹ See *supra* notes 94-98 and accompanying text.

²²⁰ *Wilson v. Simpson*, 50 U.S. (9 How.) 109, 125 (1850).

²²¹ See generally Robert Fabricant, *The Peculiar Logic of Remote Control Design*, DESIGN MIND (Nov. 2, 2009), <http://designmind.frogdesign.com/blog/the-peculiar-logic-of-remote-control-design.html> (showing various pictures of different remote control designs).

²²² See *supra* notes 100-104 and accompanying text.

²²³ See *supra* notes 105-119 and accompanying text.

²²⁴ See *supra* notes 105-119 and accompanying text.

analysis would have to center around the court's "sound common sense and an intelligent judgment."²²⁵ The way that "sound common sense" is exercised is just as much a mystery as the way the *Aro I* Court determined an article's "newness."²²⁶ Since the *FMC* court followed the *Aro I* decision closely, the *FMC* court would most likely consider the replacements to be impermissible reconstruction because the parts make up such a large proportion of the remote control.

When applying the remote control scenario to the *Sandvik* court's multifactor approach, it seems as if the pieces constitute impermissible reconstruction.²²⁷ The remote control pieces could be seen as "spent" before fixing; the nature of the fix could seem like reconstruction in light of a whole remote control; most of the pieces are not temporary or detachable; no prominent industry existed for replacement parts of remote control pieces; and the patent holder does not likely intend for its remote controls to be reworked.

Under *Sage*, the remote control pieces would probably constitute impermissible reconstruction, since the plastic casing and buttons do not seem to be readily removable parts like the *Sage* disposal system's inner container.²²⁸ But one could make an argument that the pieces are readily removable, since the consumer disassembled the remote and put it back together with the new pieces. If this argument was successful, the replacement could be considered permissible repair. This precedent, like several of the other cases, could result in either outcome.

For instance, under the *Husky* analysis, and depending on the functionality of the remote control prior to the replacements, the replacements could be viewed as either repair or reconstruction.²²⁹ Recall that the *Husky* court defined three repair-reconstruction situations. The remote control scenario could fit within the first situation, which occurs when an entire patented object is exhausted and the accused infringer remakes it.²³⁰ The court did not require that the object be remade completely, but instead discussed "practical reconstruction" when an object is taken from useless to functioning.²³¹ The court drew comparisons to the voluntarily severed bands in *Cotton-Tie*.²³² Even though the remote control in this scenario was not voluntarily broken, but was simply worn, one can argue that prior to instal-

²²⁵ See *FMC Corp. v. Up-Right, Inc.*, 21 F.3d 1073, 1079 (Fed. Cir. 1994) (quoting *Goodyear Shoe Mach. Co. v. Jackson*, 112 F. 146, 150 (1st Cir. 1901)).

²²⁶ See *supra* notes 105-119 and accompanying text.

²²⁷ See *supra* notes 146-149 and accompanying text.

²²⁸ See *supra* notes 143-145 and accompanying text.

²²⁹ See *supra* notes 154-161 and accompanying text.

²³⁰ *Husky Injection Molding Sys. Ltd. v. R & D Tool & Eng'g Co.*, 291 F.3d 780, 785 (Fed. Cir. 2002).

²³¹ *Id.* (quoting *Morgan Envelope Co. v. Albany Perforated Wrapping Paper Co.*, 152 U.S. 425, 434 (1894) (internal quotation marks omitted)).

²³² *Id.*

lation of the replacement parts the remote was “useless” if all of the painted numbers were worn off of the buttons, making it almost impossible to use correctly, or if certain important buttons were not able to function. The buttons, battery cover, and casing replacements could all together amount to “practical reconstruction” under *Husky*’s first situation, since the remote control would go from useless to functioning with the replacements.²³³ But if the remote were still functioning at all before the replacements, the *Husky* court would rule that the activity was repair, since it was not “useless” and no “practical reconstruction” occurred.²³⁴

The remote control scenario does not fit within the second or third situations outlined in *Husky*. In the second outlined situation, one spent part is replaced.²³⁵ Since the remote control scenario involves multiple parts, it would not be analyzed using this framework. In the third situation, the court explained that replacing a series of spent parts to enable a patented object to carry out any function different from the original intended use is considered permissible repair.²³⁶ If the remote control user could prove that he or she was trying to achieve a new function with the improved remote, the scenario could fall under this category and it could be designated as permissible repair. However, the different function in *Husky* was that the newly shaped molds allowed the patented machine to create objects of different shapes.²³⁷ The new remote control parts, no matter how much they would be altered, would probably still have the end function of changing channels and adjusting television settings. The new parts would probably not allow the remote to perform any new function, and consequently, the facts would not fall under this third outlined situation.

The *Husky* court ruled that at the very least, if a part is readily replaceable, whether it is broken or still functioning, the replacement activity is akin to repair.²³⁸ Whether parts are “readily replaceable” is a judgment left to the courts, but as discussed above under the *Wilson* analysis, and in light of the overall design of a remote control, the buttons and casing parts appear to be relatively difficult to remove and replace. Thus, under *Husky*, this factor cuts toward impermissible reconstruction.

Finally, under *Jazz 2001* and its sequels, it is even less clear whether the remote control scenario would constitute permissible repair or reconstruction. In their findings that refurbishing the single-use disposable cameras constituted permissible repair, every court emphasized the fact that the film was the main component being replaced, and film was a removable

²³³ See *supra* notes 154-161 and accompanying text.

²³⁴ See *supra* notes 154-161 and accompanying text.

²³⁵ *Husky*, 291 F.3d at 785.

²³⁶ *Id.* at 786 (citing *Wilbur-Ellis Co. v. Kuther*, 377 U.S. 422, 425 (1964)).

²³⁷ *Id.* at 783.

²³⁸ *Id.* at 786-87.

and readily replaceable part.²³⁹ As discussed, based on the structure of the remote, the courts would probably find that the remote control buttons and casing are not readily replaceable parts within the whole. The act of concurrently replacing those parts would then be considered an impermissible reconstruction. However, much as the *Jazz 2001* court found that changing and replacing film was permissible repair, the court could also say that the buttons, battery cover, and casing pieces were all unpatented parts of a patented whole, and that replacement of unpatented component parts is a characteristic of permissible repair.²⁴⁰

From the above case analysis, only one thing is certain—the current standards will create confusing, inconsistent applications of the law when 3D printing of multiple replacement parts becomes commonplace.

III. THREE PROPOSALS FOR CLEARER, MORE RELIABLE STANDARDS

Even though some of the consumers prevailed with repair rulings in the cases described above, the consumers still expended high costs for litigation defense and probably had no idea what the outcome would be when going into court. This is troubling since patent holders could institute litigation against consumers for creating home object replacement parts with 3D printers.

The Supreme Court should therefore redefine the repair-reconstruction standard to reduce litigation, allow consistent application of the law, and provide consumers with certainty. The following recommendations may better define the difference between permissible repair and infringing reconstruction, or at least provide consumers who are accused of infringement with a more predictable litigation process.

A. *If the Entire Device Is Not Copied, It's Not Reconstruction: An All-or-Nothing Standard*

One possible redefined standard is if a consumer shows that an object created (perhaps with a 3D printer) results in a unique change of any kind to the patent combination in question, then the alteration automatically falls under permissible repair. Using the remote control hypothetical, if the consumer changed the shape of the plastic casing to fit the consumer's hand, or made the rubber buttons thicker, the consumer's replacement of multiple parts would automatically fall under permissible repair. Unless a patent

²³⁹ See *supra* notes 150-174 and accompanying text.

²⁴⁰ *Jazz Photo Corp. v. Int'l Trade Comm'n (Jazz 2001)*, 264 F.3d 1094, 1102-03, 1110-11 (Fed. Cir. 2001).

holder can prove that a consumer replicated all aspects of the device, the patent holder gets nothing.²⁴¹

This standard would take the *Aro I* decision a step further. *Aro I* currently holds that making sequential replacements of one unpatented part or different parts within a patented device is permissible repair.²⁴² The proposed “all or nothing” standard would extend *Aro I* to hold that making replacements of any combination of unpatented parts, sequentially or on one occasion, is permissible repair so long as some aspect of the object is different than it was before. *Husky* lends some support to this idea, since the court held that simultaneous replacement of multiple parts was repair as long as the parts gave a patented device a different purpose.²⁴³

John Locke’s labor-mixing principles also support this framework. Locke’s theory of property ownership holds that personal property is acquired through a human mixing his labor with natural resources.²⁴⁴ In Locke’s *Second Treatise on Civil Government*, he questioned what right an individual has to claim a piece of property when the planet was given to all of humankind in common.²⁴⁵ Locke reasoned that each person has property in his own body, so any labor from the body and the “[w]ork of his [h]ands” is property owned by that person.²⁴⁶ When a person mixes labor with something, the person removes it from the common state of nature and acquires a right to ownership.²⁴⁷

Locke’s property theory can apply to patents since patents are a form of property.²⁴⁸ Using the framework of Locke’s theory, when a consumer mixes her labor with a patented object to somehow modify the patented object, the consumer should not be liable for reconstruction, because the consumer would acquire an ownership interest in the new, different object.²⁴⁹ In the context of 3D printing and the remote control hypothetical, if a consumer changes the shape of the remote control’s plastic casing or increases the thickness of the buttons, the consumer exerts labor through the 3D printing process and attaches that labor to the remote control. The consumer would not own the patent to the new or previous model, but he or she

²⁴¹ This proposed standard deviates from the patent law doctrine of equivalents. See *infra* note 250.

²⁴² See *supra* notes 105-116 and accompanying text.

²⁴³ *Husky*, 291 F.3d at 786.

²⁴⁴ JOHN LOCKE, *TWO TREATISES OF GOVERNMENT* 305-06 (Peter Laslett ed., Cambridge Univ. Press 1960) (1690).

²⁴⁵ *Id.*

²⁴⁶ *Id.*

²⁴⁷ *Id.*

²⁴⁸ See Eric R. Claeys, *On Cowbells in Rock Anthems (and Property in IP): A Review of Justifying Intellectual Property*, 49 SAN DIEGO L. REV. 1033, 1044 (2012) (reviewing ROBERT P. MERGES, *JUSTIFYING INTELLECTUAL PROPERTY* (2011)); Adam Mossoff, *Saving Locke from Marx: The Labor Theory of Value in Intellectual Property Theory*, 29 SOC. PHIL. & POL’Y 283, 285 (2012).

²⁴⁹ See *supra* note 244-247 and accompanying text.

would acquire an ownership interest in that specific remote control without fear of being liable for reconstruction.

Of course, this proposed standard would not pass without criticism. It could be criticized for unjust enrichment concerns, in which individuals would be free from reconstruction liability if they modified one insignificant part of a patented item using the 3D printing process.²⁵⁰ Justice Black pointed out this dilemma in his *Aro I* concurrence, explaining that each part of a patented machine could be remade except for a single bolt omitted to make it technically different from the patented combination.²⁵¹ As previously discussed, Justice Black did not lay out any proposed test or standard for this scenario in his concurrence.²⁵²

Even though this “all or nothing” standard could disturb the monopolies patent holders enjoy by extending the lines for permissible repair, patent holders would still have complete ownership over their patented combinations. Using a 3D printer to recreate and replace several parts to a patented combination, a consumer would only escape liability if he could prove that he has mixed labor with the object and altered some part of the whole.²⁵³ This framework is preferable to the current vague combination of standards because it would allow for more consistent application of the law, give patent holders and consumers more certainty, and encourage further innovation.

B. *Giving More Fairness to Defendants by Shifting the Burden of Proof*

If the vague, conceptual “new article” standards remain the same, then perhaps the burden of proof could be altered to provide more fairness to defendants who assert repair as an affirmative defense.

In a patent infringement lawsuit, when a defendant uses repair as a defense, the burden typically shifts to the defendant, and the defendant must then present enough evidence to prove that the activity was not an infring-

²⁵⁰ This proposed standard would essentially displace the doctrine of equivalents, a patent concept that originated to prevent minor alterations from evading infringement. See *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 21 (1997) (“[A] product or process that does not literally infringe upon the express terms of a patent claim may nonetheless be found to infringe if there is ‘equivalence’ between the elements of the accused product or process and the claimed elements of the patented invention.” (quoting *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 609 (1950)); see also *Graver Tank*, 339 U.S. at 607 (“One who seeks to pirate an invention . . . may be expected to introduce minor variations to conceal and shelter the piracy. Outright and forthright duplication is a dull and very rare type of infringement. To prohibit no other would place the inventor at the mercy of verbalism and . . . would deprive him of the benefit of his invention . . .”).

²⁵¹ *Aro Mfg. Co. v. Convertible Top Replacement Co. (Aro I)*, 365 U.S. 336, 354-55 (1961) (Black, J., concurring).

²⁵² See *supra* note 119 and accompanying text.

²⁵³ See *supra* notes 244-248 and accompanying text.

ing reconstruction.²⁵⁴ With a new and improved burden-shifting analysis, if the defendant simply explains that he or she was only replacing what was necessary to preserve the object's life, or shows that any part is different from the actual patented combination, the burden would automatically shift to the plaintiff.²⁵⁵ The plaintiff would then have the burden of showing that the defendant's item was in fact a new article.²⁵⁶

In this framework, the burden is more appropriately placed on the plaintiff to show that the defendant's work was so similar to the original object that it amounted to reconstruction. This analysis is sensible because, as the party that brought the lawsuit, the plaintiff should have the heightened responsibility of proving that a defendant's object actually infringes—rather than a defendant having to prove that certain activity does not infringe.

Applying this burden-shifting analysis to *Sandvik*, the burden would first be placed on the defendant who re-tipped drills. The defendant could give testimony explaining that he only re-tipped the drills to preserve the object's life, or the defendant could provide any evidence showing that the drill tips were somehow different from the plaintiff's patented combination. If the defendant chooses the latter option, he might explain that the drill tips were shaped in a different way. At that point, when the defendant explains his repair intentions or shows that he did not make an exact reconstruction of the patented object with replacements, the burden would appropriately shift back to the plaintiff. The plaintiff would have to present enough evidence to show that the defendant did not repair a spent piece of the object, but instead created a "new article." The outcome of the case may be the same, but at least the defendant would not have to attempt to explain, using imprecise case law, why the fixed drill pieces do not form a "new article" of the same patented combination.²⁵⁷

The framework would apply the same way in a suit involving a hypothetical consumer who used a 3D printer to make new pieces for a remote control. If the consumer used repair as an affirmative defense, the consumer could explain that he or she only made the replacements as necessary to prolong the remote control's life. The consumer could also demonstrate that the new plastic casing was shaped differently than the original, perhaps to

²⁵⁴ *Fuji Photo Film Co. v. Jazz Photo Corp.* (*Jazz 2005*), 394 F.3d 1368, 1373 (Fed. Cir. 2005) ("The burden of establishing an affirmative defense is on the party raising the defense." (quoting *Jazz Photo Corp. v. Int'l Trade Comm'n* (*Jazz 2001*), 264 F.3d 1094, 1102 (Fed. Cir. 2001) (internal quotation marks omitted))).

²⁵⁵ The doctrine of equivalents has implications in this burden-shifting scenario as well. See *supra* note 250.

²⁵⁶ See, e.g., *Aro I*, 365 U.S. at 346 (Brennan, J., concurring).

²⁵⁷ See, e.g., Julie E. Zink, *Shifting the Burden: Proving Infringement and Damages in Patent Cases Involving Inconsistent Manufacturing Techniques*, 2 HASTINGS SCI. & TECH. L.J. 81, 82-84 (2010) (stating that plaintiffs in patent infringement cases generally bear the burden of proof, but in certain situations involving repair-reconstruction the burden is placed on the accused infringer first).

fit with the contours of the consumer's hands. With either or both explanations from the defendant consumer, the burden would shift back to the plaintiff patent holder to prove that affixing new buttons, a new casing, and a new battery cover amounts to making a "new article" of the patented combination. In this way, the plaintiff has the heavier burden to demonstrate why the act of printing and affixing new pieces of a remote is comparable to retying a severed cotton bale tie. This heavier burden on the plaintiff provides more fairness, given that the plaintiff commenced the lawsuit.²⁵⁸

As it currently stands, the burden of proof with a repair defense is unjust, because it requires the defendant to parse through ambiguous case law and to submit substantial evidence proving his or her innocence. By redefining the way the burden of proof shifts, and assigning a heavier burden to the plaintiff, defendant consumers would receive more fairness in the litigation process.

C. *"Pandora's Flock" of Not-So Insignificant Standards: Justice Brennan's Aro I Approach*

Perhaps the best approach to the repair versus reconstruction dilemma lies within Justice Brennan's concurrence to the *Aro I* decision.²⁵⁹ As discussed above, Justice Brennan believed that when more than one unpatented part of an object is replaced at once, therefore falling outside the factual confines of *Aro I*, certain factors should be used as guidelines when deciding whether the whole object is in fact a "new article."²⁶⁰ The factors he proposed include the intent of the patent holder and user, and the life, importance, and cost of the part replaced in relation to the patented whole.²⁶¹ Courts have already used factors within his approach, without acknowledging it and perhaps without realizing it, to decide whether an object falls under permissible repair or infringing reconstruction.²⁶² Brennan's multifactor approach gives courts the flexibility they say is necessary, while also providing patent holders and consumers with a way to gauge a lawsuit's outcome.

²⁵⁸ See *id.* But see *Westinghouse Elec. & Mfg. Co. v. Wagner Elec. & Mfg. Co.*, 225 U.S. 604, 621-22 (1912) (justifying the burden of proof placed on a defendant in a patent apportionment case: "The rule of law and equity is strict and severe on such occasion[s] All the inconvenience of the confusion is thrown upon the party who produces it, and it is for him to distinguish his own property or lose it" (quoting *Hart v. Ten Eyck*, 2 Johns. Ch. 62, 108 (N.Y. Ch. 1816))).

²⁵⁹ See *Aro I*, 365 U.S. at 362-68 (Brennan, J., concurring).

²⁶⁰ *Id.* at 363-64.

²⁶¹ *Id.*

²⁶² See *supra* notes 120-125, 130138, 146149 and accompanying text; see also *Husky Injection Molding Sys. Ltd. v. R & D Tool & Eng'g Co.*, 291 F.3d 780, 786-87 (Fed. Cir. 2002) ("[T]here may be some concept of proportionality inherent in the distinction between repair and reconstruction.").

Justice Brennan's multifactor approach seems to have inspired decisions in *Monroe*, *High Voltage*, and *Sandvik*, even though the courts do not announce it or credit his concurrence. Recall that in *Monroe* the court ruled that a defendant committed reconstruction after he bought used shock absorbers as scrap, cut them, and affixed new seals to them for resale.²⁶³ The first reason for the court's decision was that "cutting and later rejoining the shock absorbers [was performed by the user] in a manner violative of and unintended by the shock absorbers' construction and design."²⁶⁴ Similarly, the intent of a patent holder and consumer was a factor in Justice Brennan's approach.²⁶⁵ Next, the *Monroe* court found that the seal usually "last[ed] the life of the shock absorber . . . and was not merely a temporary part."²⁶⁶ This element, the durability and life of the replaced part in relation to the whole, was another factor that Justice Brennan considered.²⁶⁷ Finally, the *Monroe* court reasoned that the shock absorbers permitted "no access to or severance of the working elements by any ordinary method of detachment."²⁶⁸ The extent to which something is severable or accessible is an element that can fit within either of Justice Brennan's factors of importance, or it can serve as a new factor that considers whether a piece is removable or easily detachable.²⁶⁹ Likewise, the decisions in *High Voltage* and *Sandvik* were based on the patent holder's intent, whether a part was spent before replacement, and a part's individual cost and temporary nature in relation to the patented whole—all factors within Justice Brennan's *Aro I* concurrence.²⁷⁰

Consider the remote control hypothetical once more. If a dog chewed the remote control's plastic casing and bit off the volume button, and the rest of the numbers on the buttons were completely worn off, but the remote could still function enough to change channels—could someone call it useless junk? Although it would not be as functional or aesthetically pleasing, it would still serve its basic purpose of changing television channels. In a patent infringement lawsuit resulting from 3D printed parts, courts would struggle using the abstract "useless junk" tests.²⁷¹

However, with Justice Brennan's factors, the determination would become more organized and predictable. First, the court would contemplate the parties' intent. To determine the patent holder's intent, the court would examine the remote control's construction, the way in which the individual pieces fit together, and whether the pieces are meant to be detachable or

²⁶³ See *supra* note 120-125 and accompanying text.

²⁶⁴ *Monroe Auto Equip. Co. v. Precision Rebuilders, Inc.*, 229 F. Supp. 347, 352 (D. Kan. 1964).

²⁶⁵ *Aro I*, 365 U.S. at 363-64 (Brennan, J., concurring).

²⁶⁶ *Monroe*, 229 F. Supp. at 352.

²⁶⁷ *Aro I*, 365 U.S. at 363-64 (Brennan, J., concurring).

²⁶⁸ *Monroe*, 229 F. Supp. at 352.

²⁶⁹ See *Aro I*, 365 U.S. at 363-64 (Brennan, J., concurring).

²⁷⁰ See *supra* notes 112, 130-138, 146-149 and accompanying text.

²⁷¹ See *Monroe*, 229 F. Supp. at 352-53.

replaced. The consumer's intent can be found through evidence of CAD file downloading and the consumer's own testimony. Second, the court would look to the life and durability of the pieces in relation to the whole remote control. Since the casing, buttons, and battery cover typically last the entire life of the remote control, and they are not perishable or dispensable, the court would probably find that this factor cuts against the consumer, as the court did in *Monroe*. Third, the court would determine the importance of the three pieces in relation to the whole remote control. Since the pieces are significant to a remote's operation, this factor would likely work against the consumer as well. Finally, the court would consider the cost of the three pieces compared to a new, comparable remote control. Since the cost for a remote control can fall within a wide range of prices, this segment of the analysis would depend on which type of remote control the consumer fixed.²⁷² If the cost of replacement parts was significantly lower than buying a new remote control, it would appear more like the consumer preserved the remote control's life instead of recreating the whole.²⁷³

The standards outlined by Justice Brennan in *Aro I* are more helpful than the abstract test of whether an object has been converted from "useless junk" into a second creation. Litigation outcomes will be more predictable if these factors are used and announced by the Supreme Court. The factors provide a clear checklist of reasons a court could arrive at its decision. These standards also comport with *Cotton-Tie* and *Aro I*, since they are a more articulated version of the "new article" analysis that took place in both cases. Justice Brennan's criticized or overlooked set of "insignificant" standards could be the most significant, most consistent, and fairest way of deciphering between repair and reconstruction after all.

CONCLUSION

Three-dimensional printing is amazing technology that is quickly becoming mainstream. With a layering process that disperses material and fuses it together, the process allows a home user to produce a wide-ranging selection of tangible, 3D objects from scratch. In barely more than a decade, the cost of 3D printers has dramatically dropped, making them affordable for the home tinkerer to purchase. The technology advances each day, and the prices continue to plummet. Soon, having a 3D printer in the home will be commonplace, and consumers will be able to print their own replacement parts to fix or enhance nearly any object.

²⁷² BEST BUY, <http://www.bestbuy.com> (search "remote controls") (last visited May 22, 2013) (showing remote control costs ranging from an estimated \$6.99 to over \$500).

²⁷³ See *Heyer v. Duplicator Mfg. Co.*, 263 U.S. 100, 102 (1923) ("The machine is costly, the bands are a cheap and common article of commerce.").

Like the printing press, 3D printers have the potential to cause quite a stir from both business and legal standpoints. When consumers are able to further the useful life of an object with 3D printing, they will stop buying certain objects from retail stores. Some patent holders will start to attribute lost revenues to the 3D printing revolution, and they will view 3D printing replacement parts as theft. As a result, they will either try to tighten the restrictions on the products they sell, or they will initiate litigation against the consumers who are fixing products with multiple 3D printed replacement parts.

Current patent law holds that a consumer has a legal right to repair a patented combination, but not the right to reconstruct it. But what do repair and reconstruction actually mean? The Supreme Court has said that repair means preserving an object's useful life, whereas reconstruction occurs when a consumer makes a second creation of the patented product. This legal distinction becomes more complex and context dependent when a consumer replaces several parts to an object at one time, which will become very common in the wake of 3D printing.

The Supreme Court has declined to create an all-encompassing test to determine the difference between permissible repair and infringing reconstruction, and as a result lower courts have applied the law inconsistently and erratically. If patent holders commence lawsuits against consumers who use 3D printing for multiple replacement parts, the consumers will have no certainty that their actions are legal, and they will be left guessing about the possible outcomes of litigation. Consumers need and deserve a defined standard or set of standards to determine whether their actions are permissible repair or infringing reconstruction.

Any of the three methods proposed in this Comment—an “all or nothing” standard, a redefined burden-shifting analysis, or a multifactor approach—would help lessen the ambiguities in the current repair-reconstruction legal doctrine. At the very least, any of the methods would provide accused consumers with a more reasonable litigation process and would allow consumers to better predict the lawfulness of their 3D printing activities. Consumers would then be able to fully embrace 3D printing technology, and patent holders would be able to develop and license products with clear expectations. As 3D printing technology advances, the legal standards distinguishing item repair and reconstruction must do the same.