A Corporate Guide for Protecting Intellectual Property

- Focus on Trade Secrets and Patents

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INTRODUCTION

The goal of this Guide is to provide a clear and basic understanding as to how to protect the *Intellectual Property* ("IP") that has been developed as a result of the resources that have been committed by a corporation and the hard work dedicated by its employees. This Guide will be useful to the Engineer, Scientist or other person involved in the research and innovation of technology, and who is interested in obtaining a better understanding of intellectual property and the benefits of taking the appropriate measures for its protection in both the United States and in foreign countries. The information will also be valuable to the entrepreneurial person (or group of people) doing start-up type development work, who desires a better understanding of the laws governing the protection of Intellectual Property and their corresponding procedures for protection. The issues that are presented are essential to any person in any type of business entity who plans to ultimately market and sell the product he or she is developing, or alternatively, who wishes to sell off its respective intellectual property. As such, the terms "engineer", "company" and "entity" will be used throughout this guide in the generic sense. The term engineer will encompass the researcher, scientist, or individual innovator as well as the engineer. The terms company or entity will be used interchangeably and will apply either to a large or small corporation, an individual, partnership or any other business entity, where development of a product or process is contemplated or already occurring in the U.S. It will be assumed that legal protection of IP is desired first and foremost in the U.S., but that protection in other countries that affect your company's markets will also be sought. It will also be assumed that all employees of your company have signed some form of Employee Agreement where ownership of any IP developed by the employee as a result of his or her employment will be assigned to the company.

The focus of this Guide will be on the two components of intellectual property most relevant to the protection of an innovation during the development stages of a

product or process: *Trade secrets and Patents*. A discussion of trade secrets and the methods for their protection will precede the discussion of whether to preserve these trade secrets as such, or whether to turn these trade secrets into patented ideas. The reader will understand how to determine whether a concept or innovation is potentially patentable, and will follow the process for turning this idea into a well-drafted, broadly claimed patent. Once a patent has been obtained, the reader will then explore the possibilities available to a patent owner when choosing to enforce his or her patent. And finally, a checklist is included containing issues that should be addressed when working with customers or suppliers when the disclosure or development of IP may occur. By considering these issues and following the guidelines presented in this Guide, one can be assured that his or her intellectual property protection is not jeopardized, and in fact is maximized.

By reading this Guide, you should gain an understanding of the following Intellectual Property related topics:

- The role of ***Patents*** and ***Intellectual Property*** (IP) at your company
- How to protect the company's ***Trade Secrets***: Actions to be taken and the appropriate agreements to be used; e.g. *Nondisclosure Agreements* when working with Consultants, Suppliers or Customers
- When a *Joint Development Agreement* (JDA) may be necessary with Suppliers, Consultants or Customers
- A successful *Corporate Patent Process* model
- Factors that influence patent application filing decisions
- How a patent application is drafted
- Differentiation between patent systems in the U.S. and foreign countries
- The options to a patent owner for pursuit against an infringer

• Tips for working with Customers or Suppliers while disclosure or development of IP may take place

Intellectual Property

Intellectual Property can be broadly defined as certain creations of the human mind that are given the legal aspects of a property right. The most basic source for its legal protection in the United States is the U.S. Constitution, where in Article I, Section 8 it states that " The Congress shall have the power...***to promote the progress of science and useful arts***, by securing for limited times to authors and inventors the exclusive right to their respective writing and discoveries" (emphasis added).

The four main legally protected categories of intellectual property **in** the U.S., each having its own set of governing laws, and most having their own agency of the U.S. government dedicated to their oversight are as follows:

Patents: A Grant by the government to an inventor to exclude others from making, using or selling the patented invention for a limited time. There are three different types of patents in the U.S.: 1) a *Utility Patent* on the functional aspects of products and processes; 2) a *Design Patent* on the ornamental design of useful objects; and 3) a *Plant Patent* on a new variety of living plant. Thus, patents protect the structures and methods that apply technological concepts to either technology, industrial design, or plant variety. In return for a limited-term exclusive right over the technology defined in the patent claims, the inventor discloses in the patent, information about the new technology of the invention. Once the patent expires, the public is entitled to make and use the invention and thus has a complete disclosure of how to do so. The patent system is designed to not only provide an economic incentive to inventors, but also to provide an incentive to investors to invest risk capital in inventive activity.

Governing Laws: Federal Law

U.S. Agency: U.S. Patent and Trademark Office

Trade Secrets: Business information that has value and is kept confidential by the company that owns the Trade Secrets. Such information is protected against those who obtain access through improper methods or by a breach of confidence. Generally, an alleged infringement of a trade secret involves two main issues: 1) whether there is valuable and secret business information; and 2) whether the accused infringer used improper means to obtain that information.

Governing Laws: All 50 states provide civil protection against trade secret misappropriation; Federal Law makes it a criminal act for trade secret theft under the U.S. Economic Espionage Act.

U.S. Agency: Only a U.S. Attorney can bring an action under the Federal Economic Espionage Act.

Trademarks: A word, design, slogan, picture or symbol used to identify and distinguish goods. Trademark law in its generic sense is used to indicate the whole field of protection of all forms of indications of origin, including marks used on goods, service marks, collective marks, certification marks, trade names, and trade dress. More specifically, trademark law is designed to prevent others from benefiting from the resources that an entity has invested in building up a reputation for itself and its products or services, and unfairly passing off a representation of that entities' marketing designs as their own.

Governing Laws: State and Federal Law

U.S. Agency: U.S. Patent and Trademark Office

Copyrights: Protection of an original work of authorship that is fixed in a tangible medium of expression. A federal right by every author of a work exists to exclude others from reproducing, adapting, distributing to the public, performing in public, or displaying in public the copyrighted work. As with patents, the right conferred on the owner is the right to exclude, not necessarily the right to use, as there may be underlying derivative work that the copyrighted work may be infringing.

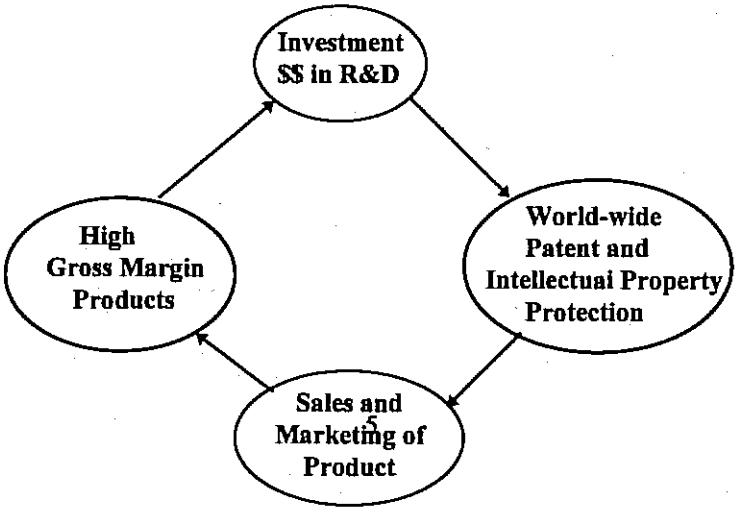
Governing Laws: Federal Law

U.S. Agency: U.S. Copyright Office

As mentioned above, the focus of this Guide will be in the areas of *Trade Secrets* and *Patents*. These areas are most relevant to the immediate and long-term protection of an innovation once the development of the product incorporating that innovation leads into the marketing and sales stages of the product cycle.

It is also important to note that IP that has value to a company has sources other than solely that company's own internal development programs. IP can be obtained from other sources, such as from a consultant, customer or supplier's preexisting intellectual property; or from joint development programs with a consultant, customer or supplier. Additionally, IP rights of your company should be maximized when engaged in a development program with a consultant, supplier, or customer, when that development program is either partially or wholly funded by your company. In each of these situations, your company is likely spending a large amount of its valuable resources, either by financing the development, or by providing personnel or equipment to fund the development. The vast amount of resources spent by your company for Research and Development is the main reason it is critical to ensure that the appropriate measures have been taken to protect the intellectual property that evolves from your internal development, and to ensure that the maximum benefit is being secured for your company when working with outside sources to acquire or develop intellectual property.

The following is a financial model of a high-tech company, which presumes that strong IP protection is an integral part of the long term profitability of each product.



To begin the education on how to maximize the benefits obtained from this model, we will start with a discussion on *Trade Secrets*; the options available to their owner, and the necessary precautions that should be taken to ensure their protection.

TRADE SECRETS - WHAT THEY ARE, AND HOW TO PROTECT THEM

Trade Secret Definitions

A discussion on trade secrets will begin with a few definitions of terms that are often used interchangeably, but that do have at least subtle distinctions.

The first definition is a ***trade secret***. A trade secret is information owned or in the possession of a company or individual, that is not generally known to the industry, and that gives that entity a commercial advantage. Trade secret information will cease to be considered a trade secret and will lose its legal status and respective protections if measures are not taken to keep the information accessible by people outside your company. The term *trade secret* is defined very broadly in the Economic Espionage Act, the federal legislation which makes it a criminal penalty for the theft of trade secrets, as follows: all forms and types of financial, business, scientific, technical, economic, or engineering information, including patterns, plans, compilations, program devices formulas, designs, prototypes, methods, techniques, processes, procedures, programs, or codes, whether tangible or intangible, and whether or how stored, complied, or memorialized physically, electronically, graphically, photographically, or in writing.

Confidential information is that trade secret information which is identified as such by the owner when disclosing the information to a third party under obligations of confidentiality. The confidential information is thereby protected from that third party's disclosure after having received it from the trade secret owner. Trade secret information that has not been designated as "Confidential Information" risks being lost to the entity

that gains access to the information, and also risks becoming public information. It is important to note that labeling trade secret information as "Confidential Information" is only one step in the process of adequately protecting one's trade secret, and is typically insufficient in itself. An agreement having confidentiality provisions, such as a *Nondisclosure Agreement* (NDA), should be signed by both the disclosing and receiving parties of the trade secret information. An NDA serves to legally obligate the entity receiving the trade secret information, to hold the information in confidence and prevent the disclosure of the information outside that entity. These acts in conjunction with each other are adequate legal protections by the trade secret owner to maintain the trade secret status of the information. This is also particularly important in the area of patent law, where information that has been made public by the party seeking to obtain a patent, may be barred from patent protection in the U.S. or in foreign countries. This area will be explored in more detail in the following section on *Patents*.

Finally, ***proprietary information*** is that information that is exclusively owned by an entity, which could in the form of a properly protected trade secret, or information that is covered by patent protection.

Options Available to a Trade Secret Owner

Much reference has been made in the above definitions to the need to keep trade secret information - that's right, *secret!* As mentioned above, a trade secret that is not properly protected by its owner, and which becomes accessible by third parties, will cease to remain a trade secret. Thus, at this point the processes for identifying and deciding whether a trade secret should be kept a trade secret, and the requirements for doing so, will be described in more detail.

There are two basic options available to a trade secret owner that will best ensure that the information remain proprietary to the entity. The first of these options is to protect the information and maintain the trade secret status of this information. The second option, for information that otherwise meets the requisite legal and practical qualifications, is to pursue patent protection on the trade secret information. This second option will be discussed later in this Guide in the following discussion on *Patents*.

Keeping the Trade Secret . . . SECRET!!

To assess whether the first of these two options may be more appropriate for your particular situation, let us first discuss the reasons one may wish to maintain the trade secret. One reason is that the concept or development may be difficult for a third party to detect or to reverse engineer. A few examples of trade secrets that fit this category is, a software implementation that is deeply embedded in a machine's operating system, or a hardware implementation in a product that is very difficult to determine by observing or operating the product, or even taking the product apart. An example of quite possibly the most famous of all trade secrets is the secret formula for **Coca-Cola®.** If it is highly unlikely that this feature will be detected once the product incorporating it is sold, and if the information is otherwise kept confidential by the trade secret owner, i.e. measures are taken so as to prevent disclosure of the idea outside the company, the costs of pursuing and maintaining patent protection may not be warranted. As you will observe later in this Guide, the costs required to obtain world-wide patent protection are not at all minor. A cost-benefit or risk analysis may determine that the feature simply may have insufficient value to justify these costs. Finally, there are minimum legal requirements to determine what qualifies for patent protection (also to be discussed in detail in the following *Patents* section of this Guide), all of which may not be met.

Contracts for Protecting Trade Secrets

Once it is determined that the information should be guarded as a trade secret, it is essential to understand the procedures for doing so in a manner that is least disruptive to the ongoing business of your company. The most essential rule for safeguarding one's trade secret is to not disclose the trade secret outside your company without a *contract* obligating the person or company receiving the trade secret information to hold the information in confidence. Examples of this type of contract are a Nondisclosure Agreement (NDA), or Joint Development (or Co-Development) Agreement (JDA) having confidentiality provisions. A purchase order agreement used when a customer places an order for a product may even be sufficient if the confidentiality provisions are written into the terms and conditions of the purchase order. However, it is often

necessary to disclose the information before the time of generating the purchase order, thereby rendering this type of agreement untimely and inadequate to protect the trade secret. For example, it is often necessary before a product has been finalized, to share the trade secret information with a potential customer to spark the customer's interest. Alternatively, an outside consultant or supplier, whose expertise or resources you may be seeking to build components of your product, may require knowledge of the trade secrets in order to build the components. In these cases, a basic NDA will likely suffice. Attached as Addendum A is a sample NDA agreement which restricts a third party's disclosure and use of confidential information that has been transmitted to that third party.

Once the appropriate agreement is signed by the proper authority at each company or entity, it is necessary to identify the trade secret information being transmitted that is to be treated as confidential information. This is done by marking "Company Confidential" (or more specifically by using the company's name, e.g. "ABC Inc. Confidential") on documents provided under the NDA that contain trade secret information. If the information is disclosed verbally to the recipient party, the disclosing party should identify the information as confidential at the time of disclosure. A memo should then be drafted and immediately sent to the recipient company. In this memo, the recipient is reminded that the information disclosed that was identified as confidential at the time of disclosure, falls under the restrictions of the NDA. Also include reference to the date of disclosure of the information, and the date that the NDA was signed.

It is important to note that marking "CONFIDENTIAL" on documents provided to outsiders is not sufficient in itself to fully protect the trade secret information. A Nondisclosure Agreement must already have been signed before documents properly marked as "CONFIDENTIAL" can be distributed. By making this routine a regular practice in your course of business, you will best safeguard the information that is most valuable to you, and is most important that it does not end up the hands of a current or future competitor. Additionally, separate bins should be readily available to all employees so that trade secret documents that are no longer needed are disposed of, and then handled and disposed of independent from the regular trash. This process is

important for two main reasons, one is to prevent high-tech junkies or other illegitimate people who may scour a company's trash bins from finding your trade secret jewels clearly spelled out for them (and it has been known to happen in the Silicon Valley), and second is to keep work areas as clean as possible, so that visitors to your facility will not set their eyes on anything other than what you desire that they see. Furthermore, it is important to escort and contain your visitors so that they do not view information that you may have received in confidence from another entity, e.g. a supplier developing a specialized part for you, such that an obligation of confidentiality you may have entered with that supplier regarding its trade secret information is not violated.

The main test for determining when it is necessary to take the prescribed precautions for protecting your company's information is to simply ask yourself: would it be detrimental for the company if this information were to end up in the hands of your competitors? If so, then the information is to be considered a trade secret, and the necessary precautions must be taken to keep it as such. Even if you or your company has a long-standing and trusting relation with a certain customer or supplier, getting an NDA signed is simply a way of putting the other company on notice that you consider certain information to be very important, and that it should not be used or disclosed when working with other companies or individuals (who may be present or future competitors with your company). Nonetheless, getting an NDA signed may be the legally required step to take if you should desire to pursue patent protection on a certain idea that you may need to disclose information about outside your company.

Nondisclosure Agreements in Detail

Up to this point, Nondisclosure Agreements have been referred to generally. Let us now explore this agreement and other related agreements in more detail, so that you may best determine which is the most appropriate to use in a particular situation, and then ensure its correct use.

A Nondisclosure Agreement is available in two different flavors. The first is a *Unilateral NDA*, which protects the disclosure of confidential information flowing in only one direction, e.g. you may need to give trade secret information to a customer or

supplier, but there is no need for you to receive any of the customer or supplier's trade secret information in return. This is the most preferable agreement to use, since receiving another company's confidential information may make it difficult for you to do work with alternate and competing customers or suppliers. One company's confidential information may closely conflict or overlap with another company's information, making it difficult to keep each company's information segregated. Complications of having one of the companies suspect that you have used their confidential information improperly, i.e. with the other company, may become a reality. However, if strict procedures have been put in place by management to carefully guard each company's information, and if the procedures are faithfully followed by all employees, the possibility of these occurrences are minimized. Addendum A is a sample Unilateral Nondisclosure Agreement.

If it is necessary that you receive another company's confidential information, however, a *Bilateral NDA* would be the appropriate agreement to use. A bilateral NDA governs the flow of confidential information going both ways. If it is necessary to use this agreement, try to define the category of information that you will be required to hold in confidence as narrowly as possible, so that you will not be overly restricted in your use and disclosure of information with other suppliers and customers. Conversely, when disclosing your trade secret information to another, define the information as broadly as possible, to ensure that the widest range of trade secret information be restricted from the receiving company's disclosure and use.

Although these agreements can be made available to employees in standard format for easy accessibility (see sample Unilateral agreements in Addendum A), it is important to involve the appropriate management (and legal, if possible) review in the following situations:

- If you propose a Unilateral NDA, but the other company insists on using a Bilateral NDA.
- If the other company proposes use of their own form which is different than your own company's standard form.

- If the other company proposes modifications to your company's standard form.
- Additionally, if the other company (or an employee in your own company) insists that an NDA already exists with that other company, insist on having a copy to review to ensure that the scope of information to be disclosed or received is appropriately described, and to ensure that the expiration date has not passed or is not imminent.

Once the appropriate agreement has been reviewed and signed by both companies, be sure to archive the agreements in an organized manner, so that other members of your company can be aware of the agreements that have been entered. Again, an organized procedure will help ensure that all confidentiality obligations to different companies are followed, and the risk of possible liability is minimized. Additionally, an agreement coordinator should be assigned to each agreement, so that there is always at least one person responsible for the flow of information pertaining to each situation. The person assigned should be the person who is closest to the project or communication of trade secret information that is taking place with that company.

As mentioned above, it is not sufficient to get an agreement signed with a company to which you are disclosing trade secret information. It is usually a requirement of a Nondisclosure Agreement (and it is always good business practice) to mark trade secret documents that you are showing to the other company with a legend such as "COMPANY CONFIDENTIAL". If the trade secret information is transmitted verbally during a presentation, the presentation slides should bear this legend. In addition, trade secret information that is communicated verbally should be identified as confidential information at the time of the discussion. Immediately following the discussion, the information should be summarized in a memo by the person who made the disclosure and then sent to the information recipient, thereby providing notice that you consider this information to be *Confidential Information* pursuant to the Nondisclosure Agreement that was signed by both companies.

Other Agreements Affecting Trade Secrets

Although a Nondisclosure Agreement is the basic contract for protecting a company's trade secret information, it may not be the most appropriate agreement to use in every situation where confidential information is being disclosed outside your company. For example, if you are disclosing information to a supplier or customer that you may be jointly working with to create a new product, or in the pursuit of further development of an innovation you may have already started, a *Joint Development (or Co-Development) Agreement* (JDA) may be the proper agreement to enter into with the other company. A Joint Development Agreement should contain provisions for the protection of each company's confidential information (as found in an NDA), but it will also contain provisions for the ownership of any intellectual property that may be developed as a result of the joint work. Certain restrictions on each company's use of any Intellectual Property developed as a result of the joint work can be negotiated and agreed upon before the collaboration begins. For example, if an engineer from your company comes up with a new idea together with an engineer from the supplier company, you may wish to divide the ownership of a future patent on that idea such that the supplier company could use the patented subject matter as they wish with the exception of selling products using that patented technology to your competitors. A justification for this restriction may be that the supplier would not have come up with the innovation had it not been for the supply of resources and seed information from your company. A diligent Intellectual Property or Licensing Attorney will try to get similarly favorable provisions for the other company, so it is worthwhile to pay close attention to the language contained in these types of agreements. It is advisable to have an attorney involved for all the non-standard agreements that your company enters. For all the resources your company is spending to acquire or develop new technologies, the extra resources for an attorney may be justified to ensure that you are getting the most *Intellectual Property Rights* for your buck!

If your company is involved in development of products that require evaluation by a customer before all testing can be completed and the product can be released, the appropriate agreement may be an *Evaluation Agreement* (for Alpha-site or Beta-site evaluation or testing by a customer) before the pre-released product is shipped to a

potential customer. This agreement should contain nondisclosure provisions to protect your company's trade secret information, as well as strict IP ownership provisions. Since the product is almost finalized, you should not have to give up too many IP ownership rights to a customer, who may be already gaining a commercial advantage by being the first of its competitors to evaluate a new technology. In this type of agreement, it may be easier to divide IP ownership within certain fields-of-use, since a company is usually not in direct competition with its customers. For example, it may be acceptable to both companies to allow ownership rights of jointly developed patented subject matter to be divided such that the customer can only use and sell the technology in their product field, e.g. laundry detergent; and your company can only use it within your own, e.g. washing machines.

Agreements such as JDAs and Evaluation Agreements are used when there is more activity between yours and another company than merely the disclosure of information, i.e. the development of new technologies may take place. The following are examples of situations where these types of agreements might be appropriate:

- If the co-development of a product or a process for using a product is desired with a customer or supplier; or
- If your company is supplying the resources to fund new development with a customer or supplier; e.g.
    - ⇒ if your company gives a discount on a product in exchange for a joint development program with that customer, or
    - ⇒ if your company provides employees to work at a customer site as dedicated support for a finite period of time.

In each of these situations, your company would likely have ample justification to request that an agreement be signed where ownership of resulting intellectual property be divided according to resources provided (and other relevant factors).

If it is unclear what rights can be pursued in a certain situation, consult an attorney, contract specialist, or businessperson who is experienced in such situations. It is important to provide sufficient time for the person drafting the agreement to prepare the

agreement with the most favorable provisions for your company. By not waiting until a late stage in the negotiation process to present the agreement, you will have more negotiating time and leverage. Certainly the JDA terms should be negotiated before or simultaneous with any commercial terms, so that each is given its proper attention. Additionally, it is very important to ensure that once the joint development begins with a consultant, customer or supplier, that your employees' work is well documented (dated and signed by the creator and by witnesses), so that there will not be an issue as to who may have been the original inventor of a particular development.

Another important area where it may be critical to show that a company's trade secrets have been protected by their owner, is when employees change jobs and move to different employers. If a company has not otherwise been careful to protect its trade secrets, it will be increasingly difficult to estop these employees from using that information at their new place of employment. Besides having procedures in place for marking, storing, and guarding trade secret information within a company as described above, other precautions that a company must take to protect their confidential trade secret information from traveling company to company by employees are in the form of employee agreements having strict confidentiality provisions, and entrance and exit interviews where the employees are reminded of their obligations to their previous and present employers.

Trade secret protection can last indefinitely, as long as the information is kept secret!

Legal Protection Against Trade Secret Theft

Recently Congress passed the Economic Espionage Act (EEA), effectively enhancing the level of trade secret protection that exists for U.S. companies. Prior law required tangible property, or use of mail, in order to prove criminal trade secret theft. Since the EEA came into effect in 1996, however, the theft of intangible property can be considered a criminal act regardless of the means of the theft. The owner of the trade secret is required to have taken reasonable measures to keep the information secret, and it is also required that the information derives economic value from not being generally

known to the public. The EEA makes it a crime to use or misappropriate that trade secret for the economic benefit of anyone but the owner, when the person using or misappropriating the information has intent or knowledge that the use will injure the owner. State law also exists for a company or person to pursue civil remedies for economic damages suffered as a result of trade secret misappropriation by another.

So trade secret thieves beware, but trade secret owners be careful!

PATENTS - A DIFFERENT AVENUE FOR PROTECTION OF TRADE SECRETS

The second option that may be available to a trade secret owner is to pursue and obtain a patent on the trade secret information, assuming all the legal and practical requirements for obtaining a patent are met. If all of the legal requirements are met, if the patentable feature is sufficiently valuable, and if the resources are available by your company, the protection afforded over a long term period by obtaining a patent can be much greater and much more practical than trade secret protection. One reason is that precautions are no longer required to maintain the secrecy of the patented information. The subject matter of a patent becomes public information once the patent is issued. A large burden of having to keep the trade secret confidential within a company is lifted by the patent process.

Legal protection that accompanies an issued patent is the right for the patent owner to exclude others from making, using, or selling the patented invention. In exchange, the public can then learn from the innovations of others since a patent describes the invention and is a public document. Thus the progress of science is promoted by the patent system. The rights of the patent holder are not indefinite, however, and in fact last 20 years from the date the patent application is filed with the U.S. Patent and Trademark Office ("PTO"). Therefore, a balancing of the advantages of trade secret protection over patent protection is warranted, since trade secret protection

could ultimately last forever as long as the proper precautions are taken to keep the information secret.

Patent Definitions

Let us begin this discussion on patents again with a few relevant definitions. For the purposes of this Guide, ***Product Differentiator*** is a term that establishes any feature of a company's product that is new, (not found on any competing products), and that provides an advantage over what has been done before. Once a product differentiator is identified, it can be recognized as a likely candidate for patent protection since its value may be significant to the company. ***Prior Art*** is a term commonly used in the patent process to define what already exists in a certain area of technology (or *field of art* as it is referred to in the patent process). Prior art may consist of issued patents, published foreign patent applications, trade articles or publications, product brochures or other marketing materials, or products pertaining to a particular field of art.

The two different types of patents that can be obtained are ***Pioneering Patents*** and ***Improvement Patents***. A *Pioneer* or *Blocking Patent* is a broad patent that is the first innovation in a certain field of art. A pioneer patent is desirable because any later innovation that improves upon, but uses the subject matter described and claimed in a pioneer patent, will most likely infringe the pioneer patent. This is the case even if the later development is patentable itself. In other words, a company that comes up with an improvement to a technology that is already patented, may infringe the existing patent. Rights must be obtained to that patent via a license in order to practice the company's own more narrow implementation (albeit an improvement) of the invention. A pioneer patent is usually very difficult for a competitor to design around and therefore is a very valuable patent to own.

An *Improvement Patent* is typically a more narrow innovation that is an enhancement to the pioneering innovation to which it pertains. The improvement patent is also valuable but may be easier for a competitor to design around.

To provide an example of the distinction between a pioneering patent and an improvement patent, the following is a claim from each of two separate patents. The first

patent is assigned to Bell Telephone Laboratories, Incorporated, and has already expired in 1967. The claim is to a basic transistor, and as you can see bolded are simply the basic elements of a transistor: a block of semiconductive material; an emitter electrode; a collector electrode; and a base electrode; with very few limitations defined other than the basic structure of these elements with respect to each other.

U.S. Patent #: 2,524,035
Assigned to: Bell Telephone Laboratories, Incorporated
Granted: October 3, 1950

1. A circuit element which comprises
a **block of semiconductive material** of which the body is of one conductivity type and a thin surface layer is of the opposite conductivity type,
an **emitter electrode** making contact with said layer,
a **collector electrode** making contact with said layer disposed to collect current spreading from said emitter electrode, and
a **base electrode** making contact with the body of the block.

Next is an example of a claim of what is arguably an improvement patent to the above patent to Bell Telephone Labs, and was only recently issued (August 1996) to National Semiconductor Corporation. As you can see from the highlighted portions, most of the same basic elements are claimed: and emitter; a collector; and a base; however, in particular the base element has many more limitations (as underlined) defining its structure, presumably to improve the performance of the base, and of the entire transistor.

U.S. Patent #: 5,548,158

Assigned to: National Semiconductor Corporation

Granted: August 20, 1996

1. A bipolar transistor comprising:

an **emitter** situated in a semiconductor body and extending to an upper surface of the semiconductor body;

a **collector** situated in the semiconductor body and comprising a main collector region; and

a **base** situated in the semiconductor body between the emitter and the collector, the base comprising (a) a main intrinsic portion located below the emitter and above the main collector region and (b) a pair of encroaching base portions that are continuous with the main intrinsic base portion, have a lighter doping than the main intrinsic base portion, extend deeper into the semiconductor body than the main intrinsic base portion, extend below corresponding parts of the main intrinsic base portion, extend laterally outward beyond the emitter, and are laterally separated from each other below the main intrinsic base portion by a minimum spacing S_{min} which is less than three times the minimum distance T_{min} by which the main intrinsic base portion vertically separates the emitter and the main collector region.

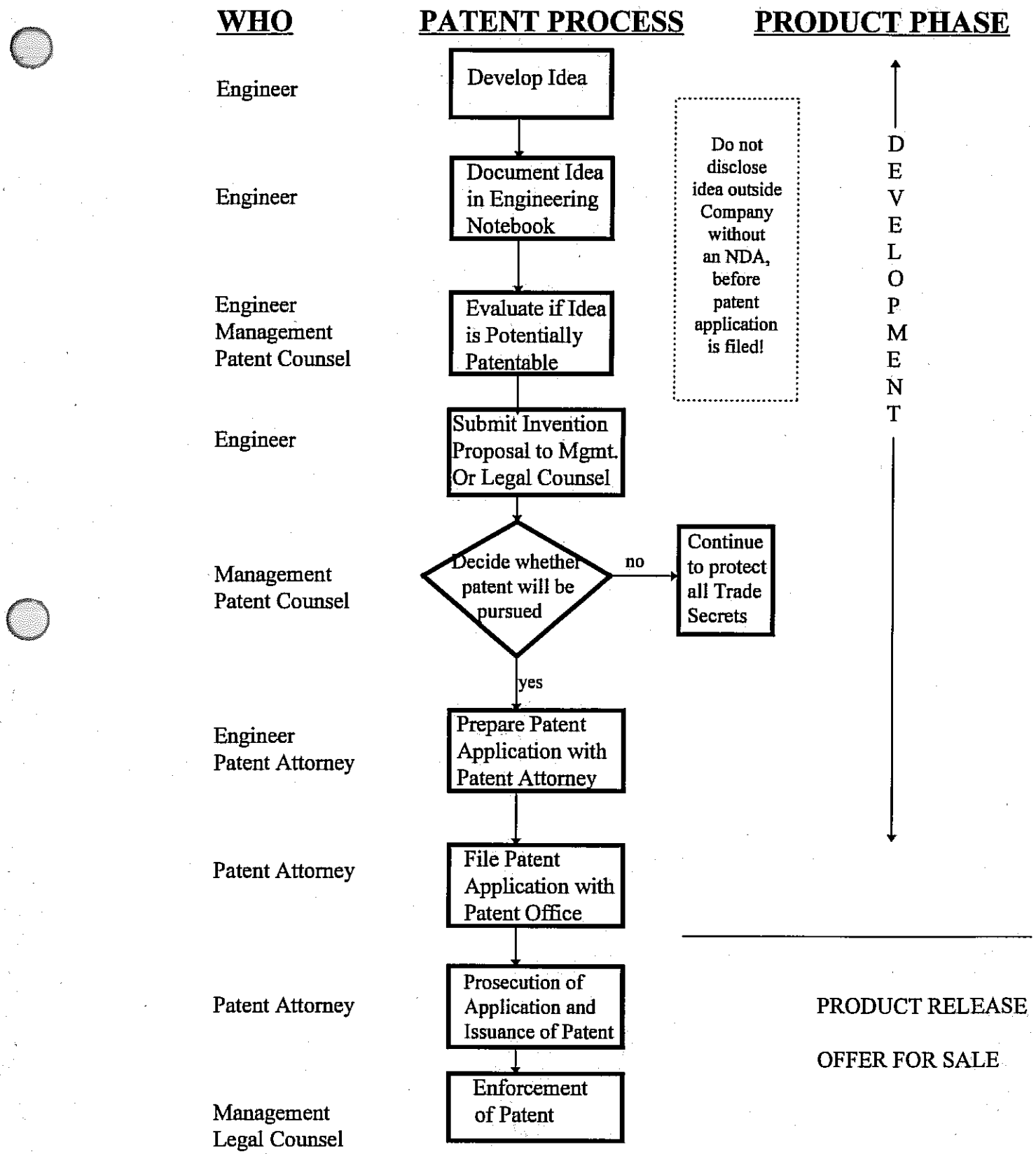
Arguably, the National Semiconductor patent shown above would infringe on the Bell Telephone patent. Assume for the sake of this example that the National Semiconductor patent does infringe and that the Bell Telephone patent had not expired, National Semiconductor would not be able to use their own patented innovation without first obtaining rights, i.e. obtaining a license, to use the Bell Telephone patented technology. National Semiconductor would have the right to exclude others from making, using, or selling their specific patented innovation, however, could not use their own patented technology unless a license to use the Bell Telephone patent were obtained. Now imagine a third company that enters the picture and wants to license the rights to

make, use and sell the National Semiconductor patented technology. Not only would this third company have to obtain a license to the National Semiconductor patent, but would also need a license to the Bell Telephone patent.

How To Get a Patent

The process for obtaining a patent is not without effort and resources. A company must be diligent to protect its intellectual property by patents, and therefore a properly established process should be set by management so that in the fervor and chaos of getting a product to market in time, a very critical step in the process of preserving a company's R& D investment is not missed.

The following is a very basic flowchart outlining the steps that must be taken to ensure that patent protection will not be lost. Shown next to each step is the person whose responsibility it is to ensure its successful completion. Also shown next to each step is its corresponding phase of the product development cycle.


WHO
PATENT PROCESS
PRODUCT PHASE
Engineer
Develop Idea
Engineer
Document Idea in Engineering Notebook
Engineer
Management
Patent Counsel
Evaluate if Idea is Potentially Patentable
Engineer
Submit Invention Proposal to Mgmt. Or Legal Counsel
Management
Patent Counsel
Decide whether patent will be pursued
no
Continue to protect all Trade Secrets
yes
Engineer
Patent Attorney
Prepare Patent Application with Patent Attorney
Patent Attorney
File Patent Application with Patent Office
Patent Attorney
Prosecution of Application and Issuance of Patent
Management
Legal Counsel
Enforcement of Patent
Do not disclose idea outside Company without an NDA, before patent application is filed!
DEVELOPMENT
PRODUCT RELEASE
OFFER FOR SALE

Develop and Document the Idea

The first step of this flowchart: ***Develop the Idea***, is beyond the scope of discussion of this Guide. It is assumed that established practices for development and innovation exist within your company. You will notice that many of the steps of the *Patent Process* flowchart coincide with the development phase of the product cycle, and that the patent application is filed before the product is released. This is not a mere coincidence, but rather a legal requirement for filing patent applications overseas. The patent application should be filed in the U.S. as early as practically possible so that maximum world-wide protection can be ensured.

The next step in the flowchart is to ***Document the Idea in an Engineering Notebook***. New ideas and developments, and their supporting test results, processes and designs should be documented by the engineer in an Engineering, Laboratory, or other type of (preferably bound) notebook. Additionally, important computer information relevant to the innovation should be printed and included in the notebook in chronological order.

There are several very important reasons for the engineer to document information pertaining to his or her developments and innovations. First, this information may be needed during the prosecution of the U.S. patent to prove the date of invention. The U.S. awards a patent to the first person (or group of people) to have invented the innovation. This is in contrast to foreign countries where the patent is awarded to the first inventor to file his or her patent application with the patent office of that country. Thus, in the U.S., the Patent and Trademark Office ("PTO") may require that an inventor submit documentation or other evidence that would prove the prior invention date if there is another application or patent that includes overlapping subject matter. Having to prove the actual date of invention may also take place when enforcing the patent in court against a company believed to be infringing your patent. The party accused of infringement may bring newly discovered prior art to the court's attention in an attempt to invalidate your company's patent. You would then be required to prove a prior date of

invention by presenting notes that the inventor diligently made in his or her notebook at the time of the invention.

The next step on the flowchart is to ***Evaluate if the Idea is Potentially Patentable***. It is cautioned that this step should be performed by the engineer at only a basic level, however, and the more detailed analysis done by the company's management and their Patent Attorney. For the engineer, he or she should be able to recognize when the basic test of a Product Differentiator has been met, i.e. when a new development or feature has not been done before in the prior art, which provides an advantage over what has been done before. Additionally, innovations that do not end up being incorporated into a product, but that are valuable and that may be useful to block competitors from a certain area of technology, should also be considered by the engineer as potential candidates for patent protection by a company.

If the development meets these basic criteria, the Engineer should proceed to the next step and ***Submit an Invention Proposal*** to the company's Law Department, or if none, to the Senior Management or otherwise designated personnel. A standard form should be available for the convenience of the engineer to write down the details of his or her innovation, i.e. in between the busy and demanding schedules of today's engineering environment. The absence of a standard form or procedure for submitting an employee's ideas may have the detrimental effect of foregone IP protection for that idea, if greater attention is being paid to more immediate business needs such as getting the product out the door when promised. However, short-term requirements are only a part of the equation for a successful business - long term strategies include the protection of intellectual property by patents.

The Invention Proposal should contain enough detail about the innovation to enable the manager and/or attorney to evaluate it and ***Decide Whether a Patent will be Pursued***. Included with the information disclosed by the inventor should be past or upcoming disclosure information about the innovative feature, and sale information regarding the product incorporating the innovation, so that the appropriate timing for patent filing can be assessed. Very important emphasis must be placed on the need for a certain amount of evaluation time by management, preparation time by the Patent

Attorney, and time for the engineer to review and assist in the formation of a technically accurate and legally correct patent application. In other words, *do not wait until a product is about to ship before the patent application is considered!*

Additionally, the engineer should name any and all people who are considered to be the true inventors of the development. An inventor (or joint inventors, if more than one) is he or she who has contributed to the inventive concept or discovery. It is important to note that inventorship is a legal, and not a political determination. An employee may feel pressure to add their manager or other more senior ranking person to the list of inventors, despite the manager or superior's limited contributions to the actual innovation of the product. If working with a customer in a co-development situation, there may also exist pressure to name the customer as an inventor. However, it is important to note that this practice is not only legally improper since if discovered when attempting to later enforce the patent in court the patent may be invalidated, it could also have negative business consequences to your company. For example, naming a customer as a joint inventor as a favor to that customer would in effect give that customer a license to use that technology with any company it desires, including any of your competitors. However, if the patent only (and rightfully) names your company's employees, the customer would then be able to obtain that technology from your company.

In order to name joint inventors on a patent, it is not necessary that each person has physically worked together with the other inventors, or even has worked on the invention at the same time. There is a requirement, however, that each inventor must have contributed to the subject matter of one of more claims of the patent. For example, a first inventor may come up with an idea and then proceed to write a memo describing the idea. A second person, reading the memo at a later time and at a different facility of the same company, adds an idea to the original concept, making the concept even more novel and its features more advantageous. Since the Patent Attorney is able to write separate claims describing each person's contribution to the invention, these two people would therefore truly be joint inventors.

The Invention Proposal that has been submitted by the engineer is reviewed by management and legal counsel to determine whether the *legal requirements for*

patentability have been met, and if so whether the company's *practical requirements* for pursuing a patent on the particular subject matter will be met. Generally, the legal requirements are that the invention is new, useful, and nonobvious to a person of ordinary skill in the field to which the invention pertains, and that it falls within one of the legally defined categories of patentable subject matter. Each of these legal elements of patentability has its own set of rules, which will now be explored in more detail.

Legal Requirements for Patentability

Patentable Subject Matter

First, the categories of patentable subject matter will be discussed, which are broken down into the following five categories: 1) machine; 2) process; 3) article of manufacture; 4) composition of matter; and 5) improvements to any of the categories 1) through 4). Essentially, everything that is tangible, and some things that are intangible, such as a computer software program, falls into at least one of these categories.

Examples of the five categories of patentable subject matter are as follows. The category of ***machine*** is easiest to envision, and could include products such as an improved vacuum chamber used for the deposition of metal onto a silicon substrate, or a new washing machine that dries and folds clothes after they are cleaned. Examples of patentable ***processes*** are a new method for depositing the metal onto a silicon wafer in a vacuum chamber; or a computer program that enables a new way of controlling a washing machine so that after clothes are washed, they are automatically dried and folded. A patentable ***article of manufacture*** example could be a new clamp ring for holding down the silicon wafer while metal is being deposited on a silicon substrate inside a vacuum chamber. Finally, examples of patentable ***compositions of matter*** include a mixture of semiconductive materials that have been found to improve the electromagnetic resistance in a computer chip, or a chemical mixture that has been found to improve the immunity systems of AIDS patients.

Finally, many innovations are actually ***improvements*** to known devices or processes. For example, National Semiconductor Corporation believed at the time of

filing and prosecuting the patent application for U.S. patent number 5,548,158 (as discussed on pages 18-19) that the transistor described in that patent had features that were an improvement to the transistors that were known in the prior art. Thus the subject matter of the improvement may itself be patentable, however before using or selling the improvement invention, it should be considered whether the improvement infringes any other more pioneering patents. If so, the inventor of the improvement should first obtain rights to the more pioneering patent before the use or sale of the improvement invention. A license to the pioneering patent could be pursued, so that the risk of patent infringement would not later be an issue. As you can now envision, most things fit into one or more categories of patentable subject matter. However, a few examples of non-patentable subject matter are: the source code for software, and purely mathematical algorithms or scientific formulae.

Now that the categories of patentable subject matter have been identified, the remaining legal requirements for patentability will be explored: that the subject matter has *Novelty*; *Utility*; and that it is *Non-obvious*. To paraphrase this with less legalese - the innovation must be new, useful and not obvious to a person working in that field of technology.

Utility

To be patentable, an invention must have *utility* in the sense that it can operate to perform some *useful* function for society that is not clearly illegal. It is understood that individual inventors or smaller business entities are often at a financial disadvantage to larger entities, and often do not have the resources to actually build and test all of their inventions. Thus, the inherency of the utility requirement that the invention must be operable, is actually a presumption and not a prerequisite for applying for a patent. Therefore, unless the written description in the patent specification causes reason for a person skilled in the art to question the truth of the statement of utility, the utility requirement of the innovation will not be challenged.

Novelty

The Novelty requirement is also simply satisfied, if it is believed by the inventor that the subject matter has not been done before by others. Novelty is present if every element of the claimed invention is not disclosed in a single piece of prior art.

The *utility* and *novelty* requirements will easily be satisfied if the model of *Product Differentiators*, defined in the *Patent Definitions* section above, is used to determine potentially patentable subject matter. A product differentiator is each new and advantageous feature of a product that distinguishes that product over competing products. A product differentiator therefore meets each of the requirements of Novelty and Utility by default, if a new advantage is provided in a certain field of technology that has never been done before.

Timing Requirements for Filing

Relevant to this discussion are the rules surrounding disclosure of the invention before the patent application is filed, and distinctions between the U.S. and foreign patent filing systems. In foreign countries other than the U.S., a system of *Absolute Novelty* controls, where a patent application must be filed in any one of the foreign countries you intend to pursue a patent before there is any public disclosure of the subject matter. If such disclosure takes place before a patent application is filed, whether it is by marketing or discussing the invention outside your company, or selling a product which incorporates the invention, the applicant will be barred from filing any patent applications overseas. If disclosure of the invention is absolutely necessary (on a limited and controlled basis) before a patent application is filed, e.g. a supplier must be told about the invention in order to accurately produce components that will go into the final product, a Nondisclosure Agreement must be signed with that supplier in order to preserve foreign filing rights.

In the U.S., however, a grace period of one year to file the patent application is given, after a disclosure of the invention has been made or after a sale or an offer for sale of a product incorporating the invention has been made. This grace period is a definite convenience in the U.S., as patent filing is easily overlooked when diligently trying to timely bring a product to market at the time it was promised. However, it should not be

relied on as general practice, since many companies have global markets, and should consider patents in foreign countries where their product is sold and where their competitors have markets. Thus, if an open disclosure is made regarding the invention (without an NDA) in the U.S. before a patent application is filed, e.g. the product incorporating the invention and that is soon to be released is discussed at a trade show to a potential customer or set of customers, that company would then be prevented from filing a patent application in any foreign countries on all inventions embodied in that product. However, the company would have one year from the date the first disclosure was made, to file the patent application in the U.S.

Priority of Invention - Who gets the patent!

The concept of *Priority of Invention,* i.e. who should be granted ultimate patent rights to an invention, is also relevant to this discussion, as there are differences between who is granted priority of invention in the United States, than that of most foreign countries. For example, in the U.S., the person with priority of invention is the first person to invent the patentable concept. Hence, the U.S. has a *First-to-Invent* patent system. In the event that someone files a patent first, but is believed to have actually invented the concept after another person, an *Interference Proceeding* with the U.S. Patent and Trademark Office is required to sort the facts and determine which person will be granted priority of invention. Each party would be required to submit information pertaining to the invention, particularly pertaining to the activities surrounding the date of the conception of the invention. It is important that the inventor seeking patent protection in the U.S. keep dated notes corroborating the developments leading to the conception of the invention, and regarding continued developments pertaining to that invention. The most important notes should be accompanied by witness signatures that are also dated.

In foreign countries, however, the first to file the patent application, regardless of whether they actually invented the concept first, will be granted priority of invention, and may ultimately be granted the patent for their innovation (*First-to-File* patent systems). This distinction makes it very important to be extremely diligent in getting the patent application filed if there are plans to file an application in the U.S. and also in foreign

countries, so that costly Interference Proceedings can be avoided in the U.S., and so that loss of patent rights altogether can be avoided in foreign countries.

It would be very burdensome to attempt to get all patent applications filed in all countries where patent protection is desired before any disclosure or sale of the product. Those who have gone through the process of filing a patent application in the U.S. will agree that it is difficult and time consuming to get the U.S. application filed, before even considering having to deal with foreign patent associates, translation issues, or country specific rules, which are all issues that accompany the foreign filing process. Thus, it is the rule among countries that are members of the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations, that once a patent application is filed in a single country, then one year is allowed to complete the filing process in the remainder of countries where it is also intended that a patent application will be filed.

As you are most likely surmising at this point, there are many legal issues that accompany the process for obtaining a patent. However, you may have gleaned a common theme from the above discussion - that *good business practices of incorporating the patent process as an integral part of product development, (not waiting until the product incorporating the invention is about to be shipped), will ensure optimal ultimate world-wide patent protection!*

NonObviousness

The final legal requirement for patentability is that the invention be nonobvious to a person with ordinary skill in the related technology to which the invention pertains. Although this requirement may be the most difficult to ascertain, certain factors can be considered when determining whether an innovation is obvious or not. For example, if the innovation provides advantages or improvements over the prior art, or if an average engineer might be surprised at the result of the invention, and if the prior art only discusses different problems, purposes and/or results than are contemplated by the innovation, the innovation may pass this hurdle and may be sufficiently nonobvious to qualify for patent protection. Other criteria for determining nonobviousness is if the

invention satisfies a long felt but unsatisfied need, or if an unexpected result is achieved. This determination is based on what should have been obvious at the time the innovation was made. It is not made in retrospect at a later time when making a patent filing decision, nor after the patent application has been filed, nor when the patent is challenged in a court of law.

An important consideration in determining whether an invention is nonobvious, is that the engineer is most likely to harshly judge the value of an innovation. Having been working quite closely with a particular development, that engineer may undermine the significance of a particular feature of a product. However, those members of the company who can see the importance of that feature more objectively, i.e. as a product differentiator, may best be able to determine whether that feature may be patentable. My point is that if the engineer has any doubt as to whether a certain development is obvious or not, err on the side of not, and get management or legal involved to help make the ultimate determination.

Practical Requirements for Patentability

If all the legal requirements for patentability are believed to have been met, the manager should then evaluate the *practical requirements for patentability* of the invention. Management should continually be checking to ensure that all Product Differentiators have been considered for patent protection. Since these are the features that distinguish your company's products from the competition, particular attention should be given to protecting these developments. Assuming that most or all of the Product Differentiators will be covered by one or more patent applications, a decision must then be made whether to file only in the U.S., or whether to also file in one or more foreign countries. To make these decisions, management should be aware of the *costs* of pursuing patent protection, both in the U.S. and abroad. An analysis should then be performed balancing the present and future potential *value* of a particular technology for which the patent is being pursued, and the countries where *your company markets* its products, and well as those countries where your *competition markets* its products. If a certain technology or innovation is relatively immature in its development cycle at the

time a patent application is sought, or if resource limitations require, the final decisions as to what other countries to file for patent protection can be delayed up to one year from the date of filing the U.S. application.

Costs

Pursuing high quality patent protection on a global basis is not an inexpensive venture. Certainly there exists ways to reduce costs, however the following gives an example of the average costs for pursuing patent protection in several major countries. The costs given are an approximation, and are inclusive of costs for Patent Attorney services, patent office fees, and maintenance fees to keep an issued patent active throughout the term of the patent. In the United States this amount is $20,000; Europe (for six countries) - $75,000; Japan - $60,000; Korea - $28,000; Taiwan - $9,000. It is simple to calculate that the sum total for pursuing patent protection in all of these countries approaches $200,000 over the duration of the protection afforded by the governments of each of these countries - not an insignificant cost for any type of business.

Value of Technology

It is not always the case that the subject matter described in each patent pursued and obtained actually gets incorporated into the final product that is sold to a customer. However, there is much value in obtaining a portfolio of patents that may serve to block competitors from a larger range of technology than may be possible from a single patent.

The following is a checklist of questions and factors to consider that can be used to help determine whether the resources required would be justified to obtain patent protection in the U.S. and/or foreign countries.

- Is the technology currently being used by your company, and if not, is it likely that it will be used by your company in the future?
- Is the technology currently being used by your company's competitors, and if not, is it likely that it will be used by your competitors in the future?

- Is it a mainstream technology to your company?
- If not, will there be another division in your company that will find this invention useful?
- Are there alternate means of protection, e.g., trade secret?
- Is protection in the U.S. sufficient, and if not, in which foreign countries is protection deemed essential?

Your Company's Markets

- Patent protection is needed in countries where your company (presently and in the future) manufactures, distributes, and sells products markets.
- To ensure early and broad rights to make, use and sell our products wherever you want.

Your Competitor's Markets

- Patent protection should also be pursued in countries where your competitors manufacture, distribute, sell or use their competing (infringing) products.
- Obtaining an injunction in these countries would prevent your competitors who manufacture in the U.S. from distributing, manufacturing, and selling infringing products there.

Work with Patent Attorney to Prepare Patent Application

Once the decision is made to file a patent application, a Patent Attorney will then be assigned to prepare a patent application. The company may be large enough to have in-house intellectual property counsel, to either prepare the patent application, or assign the responsibility to an outside Patent Attorney and then oversee the quality of the work. The Patent Attorney who will perform the patent application preparation should have sufficient technical experience and aptitude to quickly learn the technology relevant to the invention. However, the Patent Attorney cannot do the work alone, since they are not the

originator of the idea. Since the inventor is the one who is most intimate with the details of the invention and with what is being done by the competition, he or she will play an integral role in the preparation of the application. Consequently, the Patent Attorney should give the inventor a proposed deadline for completing the work, which may be required due to the activities of your business entity, e.g. a product announcement may be forthcoming, and therefore the patent application should be filed before such occurrence. The Patent Attorney should be required to reasonably meet this deadline, assuming that excessive or unreasonable time commitments are not imposed. However, the Patent Attorney may not be able to adequately do so without the inventor's active participation. A Patent Attorney - Inventor relationship is an important one, and if it is felt that the Patent Attorney is not understanding the details of the invention in a reasonable amount of time or effort, management should have the opportunity to recommend that a different attorney handle the work.

Prior to the initial meeting between the inventors and the Patent Attorney, however, as much of the following materials should be collected and forwarded to the Patent Attorney as the inventors have access to or knowledge of, so that these materials can be read and understood ahead of time. Thus, the time spent when the actual meeting occurs can be used to fill in the gaps, rather than having to start from scratch.

Technical information regarding the invention - which can be in the form of lab notebook entries, notes, materials from internal presentations, and other memoranda that describe the invention and the work leading up to it, and results obtained from using the invention.

Drawings - relating to embodiments already designed and/or tested, and planned embodiments.

Background information useful in providing a context for the invention - which includes patents, publications, and relevant portions of textbooks that the Patent Attorney can review to better understand the terminology which pertains to the invention and its field of technology.

Prior Art - that relates to each novel feature of the invention. Prior art is important since it helps the Patent Attorney distinguish the invention from that which

already exists. In addition to assisting the Patent Attorney prepare the patent application, this information is legally required by each inventor. Each inventor has a duty to disclose all information that is *material* to the examination of the application. Information that is material includes all information where there is a substantial likelihood that a reasonable Patent Office Examiner would consider the information to be important in deciding whether or not to issue the application as a patent. If there is any question as to whether information is material, it should be brought to the attention of the Patent Attorney to help decide that issue. There is no legal requirement that the inventors investigate the prior art to find references of which they are not presently aware, however, the duty to disclose material information is a continuing duty, which lasts until the time that the patent issues.

Disclosure of the invention - which may already exist in the form of an Invention Proposal. The disclosure must contain any information relating to any disclosure or publication concerning the invention that was made or will be made, and should include dates and copies of any Nondisclosure Agreements entered into that pertain to information about the invention.

During the meeting with the Patent Attorney, the inventors should be prepared to identify each feature or design element of the invention. This is important since the attorney may not initially recognize that each of these features exists. In addition, the inventors should describe whatever they are aware about other companies' products that relate to the invention. This information may be useful to the Patent Attorney when drafting the claims of the patent application. The legally required level of detail to describe the invention in the patent application must satisfy each of the following two criteria:

1) The invention and the manner and process of making and using it must be described in such full, clear, concise, and exact terms that an engineer having ordinary skill in your area of technology could make and use the invention without undue experimentation. Thus it is not necessary to describe implementation details that would be readily available to an engineer of ordinary skill. However, if the invention uses a

component that is not commercially available and whose design would not be obvious to an engineer of ordinary skill, the design of that component must be described.

2) The best way it is known to make and use the invention at the time the patent application is filed must be described, including preferred values for all important parameters. As a result, the Patent Attorney should be given a copy of the latest design specification, if any, that incorporates the invention.

After the meeting, and after the Patent Attorney has had sufficient time to prepare a draft, the inventors will be requested to review that draft. Remember that this is *the inventor's* patent application, both in fact and in law, so it is important that the inventors *ask* if something has been written that is not understood. Don't assume that it is just *legalese*!

Sections of the Patent Application

A patent application has several different sections, each containing information with a different purpose than the others. The following text will identify each section, and describe its purpose, as well as the information required by the inventors. A checklist is included for the inventors to review to determine whether the section is accurate and complete. You may refer to the patent attached to this text as Addendum B as a sample to review its structure as you read about each of the following sections.

Abstract of the Disclosure

This section is a brief statement of the invention.

Background of the Invention

This section typically describes the prior art, and highlights either the problems of the prior art that are solved by the invention, or the needs that are identified in the prior art that are fulfilled by the invention.

Checklist:

- Are the disadvantages of the prior art which are overcome by the invention clearly discussed?

- Are the problems that the invention overcomes clearly discussed?

Summary of the Invention

This section summarizes the broadest aspect of the invention, and typically points out how the invention solves the problems or fulfills the needs described in the *Background of the Invention* section.

Checklist:

- Are the broadest concepts of the invention identified?
- Are the advantages of the invention clearly stated?

Brief Description of the Drawings

This section is a list of the figures of the patent with an accompanying brief description of each figure.

Checklist:

- Are the essential elements or process steps clearly illustrated?
- Would a figure illustrating the prior art help distinguish the invention from the prior art?

Detailed Description

This section describes the invention, the preferred embodiments of the invention, and all variations and alternative forms of the invention. The description of variations and alternatives helps to support broad claims, will ensure that the patent will cover modifications made by other companies in an attempt to avoid the patent, and will prevent other companies from patenting one of these modifications.

Checklist:

- Is the description technically correct? Is every element of the invention described clearly, completely, and unambiguously?

- For each part/material/quantity/step, does it explain how or what it could be? Does is explain the reason for a preferred choice?
- Is each "number" (e.g. 20kV, 10 mm, 10 MHz, 400 sccm) relevant to the invention, i.e. is this number necessary to include? Can it be expressed as a range of values instead? If so, is the range specified and is there an explanation as to why the range is advantageous? Is there an explanation of why a "chosen" number is better?
- Will the numbers, dimensions, values work in scale up or down, e.g. to produce the same product in different sizes? If not, can the description be written in a way which does?
- Is the "best mode" described? Are the latest embodiments disclosed?
- If you were telling someone how to build the invention, what else do you think they should know or think about?
- Are parts, components and steps that are not conventional or "off the shelf" clearly specified?
- Are terms used consistently? Are the meanings of key terms well known or clearly defined?

The above sections collectively comprise what is referred to as the *specification* of the patent or patent application.

Claims

The claims are clearly the most important part of a patent, since they define exactly what the patent covers. The claims can be analogized to a deed of property, which defines the boundaries of a parcel of property. The claims are consecutively numbered. There are two types of claims: independent and dependent. An independent claim is self-contained and does not reference any other claim. A dependent claim refers back to a previous claim and incorporates all of the limitations of all claims to which it refers.

Checklist:

- Review each of the independent claims. Delete any unnecessary limitations. An independent claim should have only one limitation which distinguishes it from the

prior art. If there are have multiple distinctions, there should be an independent claim for each.

- Simplicity is best; legalese is not necessary in the claims.
- Is everything claimed also mentioned in the specification? There must be a clear antecedent basis for everything that is found in the claims.
- Is every claimed structural feature shown in a drawing or otherwise described in the specification?
- Is each of the patentable aspects of the invention covered by an independent claim which describes this aspect broadly, i.e. without any details that are not needed to distinguish the invention from the prior art?
- Are the advantages of the invention reflected in a corresponding independent claim?
- For process inventions, can the process also be expressed in terms of a product, or an apparatus which is capable of performing the process?

Final Review of Patent Application Before Filing with Patent and Trademark Office

Now that you have gone through the complex process of the preparation of a patent application, it is time to file the application with the PTO. Aside from the legal obligations associated with providing the information in the patent application as set forth in each of the above sections' descriptions and checklists, each inventor must sign an Oath and Declaration. The Oath is a legal document that is signed under penalty of perjury. By signing the Oath, each person listed as an inventor declares that they are the original and first inventor(s) of the invention; that the contents of the patent application have been read and understood; and that all material prior art has been disclosed to the PTO. A finding that one or more of these conditions was not true at the time the inventors signed the Oath may result in a finding of invalidity of the patent, wherein the patent would no longer be enforceable. If the patent were to be later litigated in court during a patent enforcement action against an infringer, not only might the patent be found invalid, but the patent holder might have to fight allegations of inequitable conduct, as well as claims of antitrust and unfair competition.

A reminder to the reader at this point that all of the above steps in the patent process, including the filing of the patent application with the PTO, should occur before a sale of the product is made, or a disclosure of the subject matter (unless an NDA has been signed), to ensure maximum patent protection.

Prosecution of Patent Application and Issuance of Patent

The Patent Attorney will then embark on the process of prosecuting the patent application with the Patent and Trademark Office. Typically, the PTO will respond to the initial receipt of the patent application after six to twelve months by issuing a notice of rejection. Not to despair in most cases, however. The Patent Attorney will review the prior art presented by the PTO Examiner with the rejection, and with the inventor's assistance in identifying the distinctions of the invention over that prior art, will submit a response to the rejection. The response should respectfully establish the position as to why the Examiner may have erred in the rejection, and should include an articulation of the patentable distinctions of the invention over the prior art. This response may also include amendments to the claims as originally filed, that serve to more clearly distinguish the invention over the cited prior art. This process of correspondence back and forth between the Patent Attorney and the PTO Examiner may last in duration anywhere from six months to three years, and may require an appeal of the Examiner's final decision if it is not to the accord of the Patent Attorney and inventor. Hopefully the hard work and patience of your company's inventors will eventually be rewarded by the issuance of a broad and well-written patent.

Management and Legal Counsel Determines When Enforcement of Patent is Appropriate

A patent gives the owner the right to prevent others from making, using or selling the claimed invention. These rights can be exercised in several ways, which can be summarized most basically as being either through litigation, or through grant of a license.

Litigation may be viewed as the most aggressive manner of exercising patent rights. You may pursue an injunction such that the accused entity would be required to cease making, using or selling the patented invention. In conjunction, an award of past damages could be pursued against the accused infringer for past infringing sales of the products or services incorporating the patented invention since the time the accused was put on notice of the infringement. Litigation sometimes concludes with a finding of infringement and a permanent injunction restricting the defendant from any future use or sales of their infringing product. Alternatively, the damages phase of the trial could end prematurely with a settlement between the parties which would allow the infringer to continue sales of the infringing product, however, with a payment of ongoing royalties from those sales to the patent owner.

In certain circumstances, it may not be as important to the patent owner that the infringer cease use of the invention as it is important for the patent owner to recognize revenue from the infringer's use or sales of the patented invention. In this case, expensive litigation can be avoided if a license to the patent can be negotiated between the patent owner and the alleged infringer for an agreed upon amount of royalties. These royalties can take the form of a single lump sum payment or they can be paid as a running royalty based on the number of units sold or amount of revenues received.

And finally, the patents can be used as a bargaining chip to obtain access to technology of others, particularly competitors, through the vehicle of cross-licensing. In essence, you would agree not to sue the infringing company for their use of your company's patented invention by granting that company a license for that use, in exchange for a license to some or all of their own patented technology.

There are of course many different forms of licenses and cross-licenses, the negotiation for which is not fully contemplated in this text. However, in general terms, some of the different options for licensing could be in the form of:

- a non-exclusive license, where not only does the patent owner retain access to the patented invention, but may also pursue non-exclusive licenses with one or more additional companies;

- an exclusive license, where even the patent owner gives up the right to use the patented technology;
- a payment of money accompanying one side of a cross-license but not the other, where the value of the patented technologies exchanged are unequal.

Various factors must be considered before deciding whether to enforce a particular patent. Management should involve legal counsel when considering commencing a patent enforcement litigation against another company, to assess the probability of success, and the risk of a counterattack should that company have patents of their own that may end up being asserted against your company. A critical step to take before any legal action is asserted is to compare the claims of the patent to the potentially infringing product or process. Looking at the broadest independent claims and the potentially infringing device, it must be determined whether every one of the claimed elements is contained in the device. It is at this point in the patent process where it becomes very clear how crucial it is to have reviewed the scope of the claims during prosecution of the patent, to make sure that they do not contain any unnecessary limitations, i.e. that they are as broadly defined over the prior art as possible. Every unnecessary element in the claims makes it one step easier for a competitor to avoid the boundaries of your patent and thus avoid infringement. If the patent process has been followed with precision and dedication, however, and it is found that every element of at least one of the claims of your company's patent is found in the accused product, then there is infringement.

Once a patent enforcement action is commenced, it is likely that the defendant will assert at least two defenses against the patent owner: 1) that their device does not infringe the patent; and 2) that even if it is found to infringe, that the patent is invalid. Thus, a thorough review of the U.S. prosecution history of the patent to be asserted, and the prosecution of any foreign counterparts to the patent would be beneficial, to ensure that all known issues which might arise and be asserted by the defendant in an invalidity defense have been considered in advance.

CHECKLIST FOR WORKING WITH CUSTOMERS AND SUPPLIERS - While Maximizing Your Company's IP Rights

Now that you have learned much of the basic information regarding the protection of your company's proprietary information, either through trade secret protection or by patent protection, the following information regarding how to apply that knowledge with your work with your customers or suppliers is provided to you in checklist form. It is often necessary to work with a customer, potential customer, or supplier before your product is released. In the course of that work, you will likely be tempted to make a disclosure of information that includes your company's trade secret information. It may also be likely that you will develop some new ideas with that customer or supplier. These, however, can be delicate situations, and you will no doubt find it helpful to have entered into the appropriate agreements in advance, rather than have to battle sticky issues of IP ownership afterward.

During Preliminary Discussions with a Customer or Supplier

- Determine whether trade secret information needs to or will be disclosed.
- If so, protect trade secret information by GETTING A *NONDISCLOSURE AGREEMENT* SIGNED FIRST!
- An NDA should be executed before any disclosure of confidential information.
- A different type of Agreement may be appropriate to sign, as long as there are confidentiality provisions to protect your trade secret information.
- Only enter Bilateral Nondisclosure Agreements when absolutely necessary to receive the other company's confidential information.

Situations Where IP May Be Developed with Customer or Supplier

- The following are situations where development may occur with your Customer or Supplier:
    - ⇒ Creation of hardware components for use in your company's equipment;

⇒ Co-development of software for use in your company's equipment;

⇒ Development of new processes for use in your company's equipment.

- In these situations, get an NDA signed before the initial discussions begin.
- Discuss with Management or Legal Counsel to determine whether a Joint Development Agreement is appropriate .
- JDAs ensure your company maximum rights to any IP that is developed.
- Make sure JDA is completely negotiated and signed before any development occurs.

Once Disclosure of Trade Secret Information and/or Development with Customer or Supplier Begins

- Document all discussions where ideas, designs or new parameters are discussed
- Mark "*your company's name* CONFIDENTIAL" on documents, whiteboards (before printing), etc. when working together with a customer or supplier.
- List originators of new ideas only (not all people in the room).
- Limit customer or supplier access in your facility so that confidentiality obligations with other customers or suppliers is respected.
- Inform Management or Legal Counsel immediately if your company develops potentially patentable IP to avoid later conflict with the customer or supplier.
- All documentation containing trade secret information that is transmitted during collaboration should be marked " CONFIDENTIAL".
- All trade secret information that is verbally disclosed to the customer or supplier should be summarized in a memo and provided to the other company within one month of disclosure, alerting that company of the information's trade secret nature.

Hopefully you have gained insight into the many considerations that factor into maximizing your company's Intellectual Property rights. *It is your responsibility to develop, acquire, capture and protect Intellectual Property - and it is your company's biggest asset (next to you) - so handle it with extreme care!*

ADDENDUM A
NONDISCLOSURE AGREEMENT

ABC, Inc., having its principal offices in Wilmington, Delaware ("ABC") and _____, having its principal offices in _____ ("Recipient"), hereby agree as follows:

I. IDENTIFICATION OF CONFIDENTIAL INFORMATION

A. ABC may disclose to Recipient the following types of information: _____
_____.

B. The foregoing information shall be deemed "Confidential Information" if:

(1) in the case of a written disclosure, ABC affixes to the document an appropriate legend, such as "Confidential", and

(2) in the case of an oral or visual disclosure, ABC makes a contemporaneous oral statement or delivers to Recipient a written statement within thirty (30) days to the effect that such disclosure is proprietary, confidential or the like.

C. "Confidential Information" shall not include information which: (1) becomes a matter of public knowledge through no fault of Recipient, (2) is rightfully received by Recipient from a third party without restriction on disclosure, (3) is independently developed by Recipient without the use of ABC's Confidential Information, (4) is in the possession of Recipient prior to its disclosure by ABC, or (5) is disclosed pursuant to a valid order of a court or authorized government agency provided that Recipient has given ABC an opportunity to defend, limit or protect such disclosure.

II. USE OF CONFIDENTIAL INFORMATION

Recipient shall use the Confidential Information only for the purpose of (1) determining whether to enter into a transaction with ABC, (2) purchasing and using products and services supplied by ABC, or (3) providing products and services to ABC.

III. RESPONSIBILITIES OF RECIPIENT

A. Recipient agrees (1) not to disclose Confidential Information to any third party and (2) to protect the Confidential Information with at least the degree of care with which it protects its own Confidential information, but in no case with less than a reasonable degree of care.

B. Within thirty (30) days of a written request by ABC, Recipient shall (1) destroy or return to ABC all documents received from ABC which contain Confidential Information, all documents it may have created which reveal any Confidential Information, and all copies of the foregoing (except for one copy which may be kept by the legal department for archival purposes only), and (2) deliver to ABC a certificate stating that Recipient has complied with such requests.

C. Recipient agrees not to disclose to ABC any information that Recipient or any third party regards as proprietary or confidential. ABC may use without restriction any and all information disclosed to it by Recipient.

D. The Nondisclosure Agreement ("NDA") Coordinator for ABC shall be_____.

E. The NDA Coordinator for Recipient shall be _____.

IV. DISCLOSURE PERIOD AND CONFIDENTIALITY PERIOD

A. The period during which ABC may disclose Confidential Information under this Agreement shall begin on the date of the first disclosure of Confidential Information (which may be prior to the date of this Agreement) and shall end on _____ (if no date is specified, the period shall end three (3) years from the date this Agreement was signed. Either party may terminate the Agreement by giving the other party ten (10) days written notice.

B. The obligations set forth in Articles II and III shall (1) terminate five (5) years from the initial date of disclosure of the particular item of Confidential Information and (2) survive the termination or expiration of this Agreement.

ABC, Inc.

_____
(Name of Recipient Company)

By: _____ _____ By: _____ _____
(Signature) (Date) (Signature) (Date)

_____ _____ _____ _____
(Printed Name) (Title) (Printed Name) (Title)

ABC Division or Product Group:_____ Please circle one: Customer Supplier Consultant

US005547417A

United States Patent [19]

Breivogel et al.

[11] **Patent Number: 5,547,417**

[45] **Date of Patent: Aug. 20, 1996**

[54] **METHOD AND APPARATUS FOR CONDITIONING A SEMICONDUCTOR POLISHING PAD**

[75] Inventors: **Joseph R. Breivogel**, Aloha; **Matthew J. Price**; **Christopher E. Barns**, both of Portland, all of Oreg.

[73] Assignee: **Intel Corporation**, Santa Clara, Calif.

[21] Appl. No.: **210,957**

[22] Filed: **Mar. 21, 1994**

[51] **Int. Cl.**[6] **B24B 53/00**

[52] **U.S. Cl.** **451/58**; 451/443

[58] **Field of Search** 451/56, 285, 286, 451/287, 289, 443, 444

[56] **References Cited**

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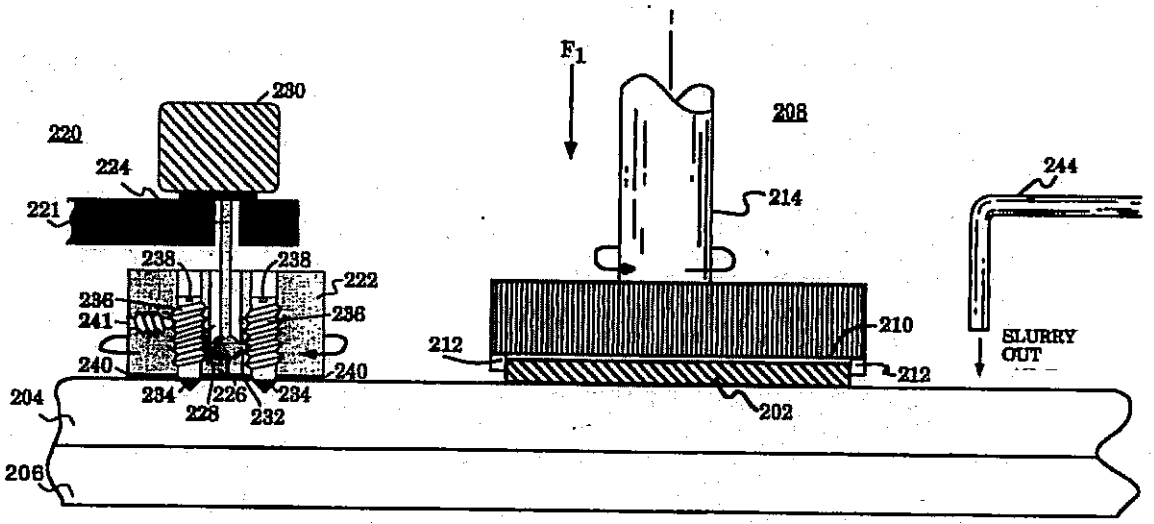
Primary Examiner—Maurina T. Rachuba
Attorney, Agent, or Firm—Blakely, Sokoloff, Taylor & Zafman

[57] **ABSTRACT**

A method of polishing a thin film formed on a semiconductor substrate. In a method of the present invention a polishing pad is rotated. A substrate is pressed against the rotating polishing pad so that the thin film to be polished is placed in direct contact with the polishing pad. During polishing, the polishing pad is continually conditioned by forming a plurality of grooves into the polishing pad. The grooves are formed by a conditioning block having a substantially planar bottom surface with a plurality of groove generating points extending from the substantially planar surface of the conditioning block. The grooves are generated by sweeping and rotating the conditioning block between an outer radius and an inner radius of the polishing pad.

19 Claims, 5 Drawing Sheets



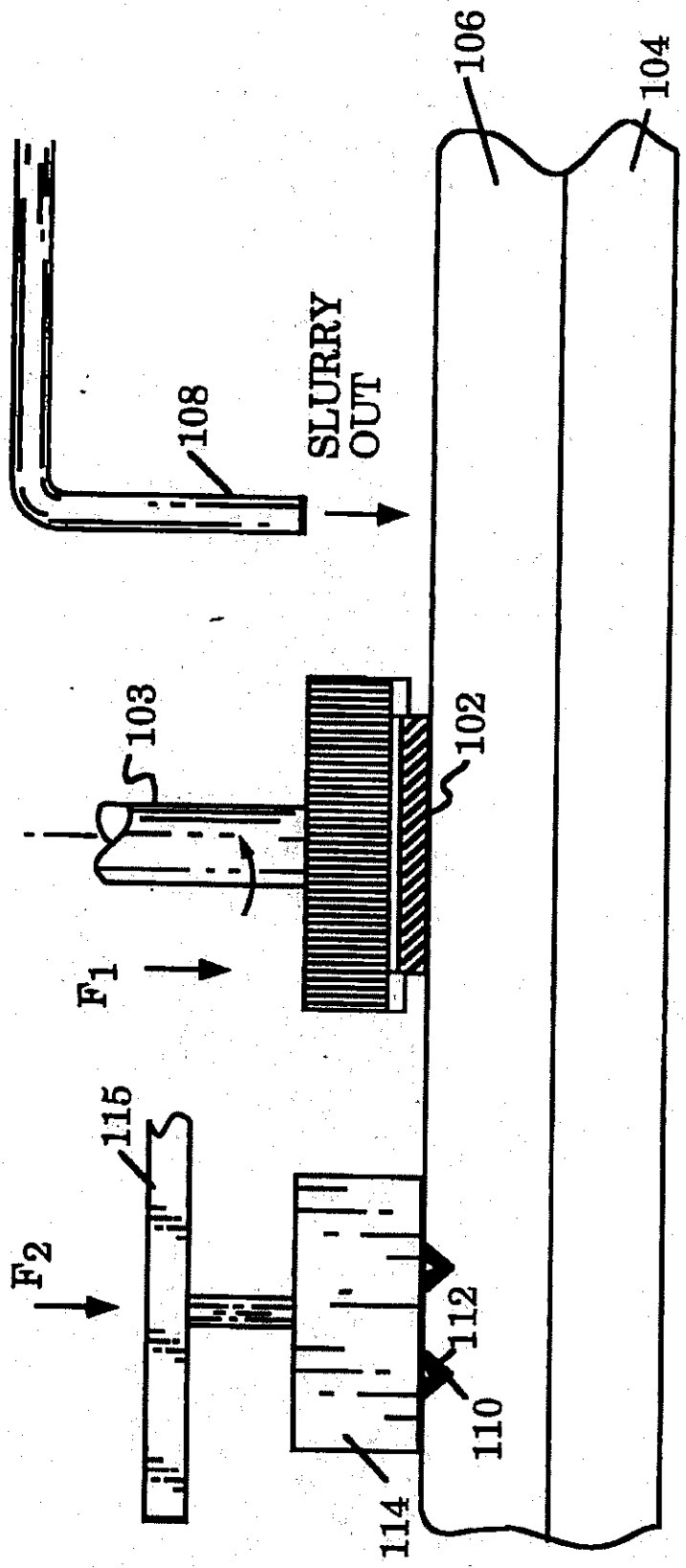


Figure 1a

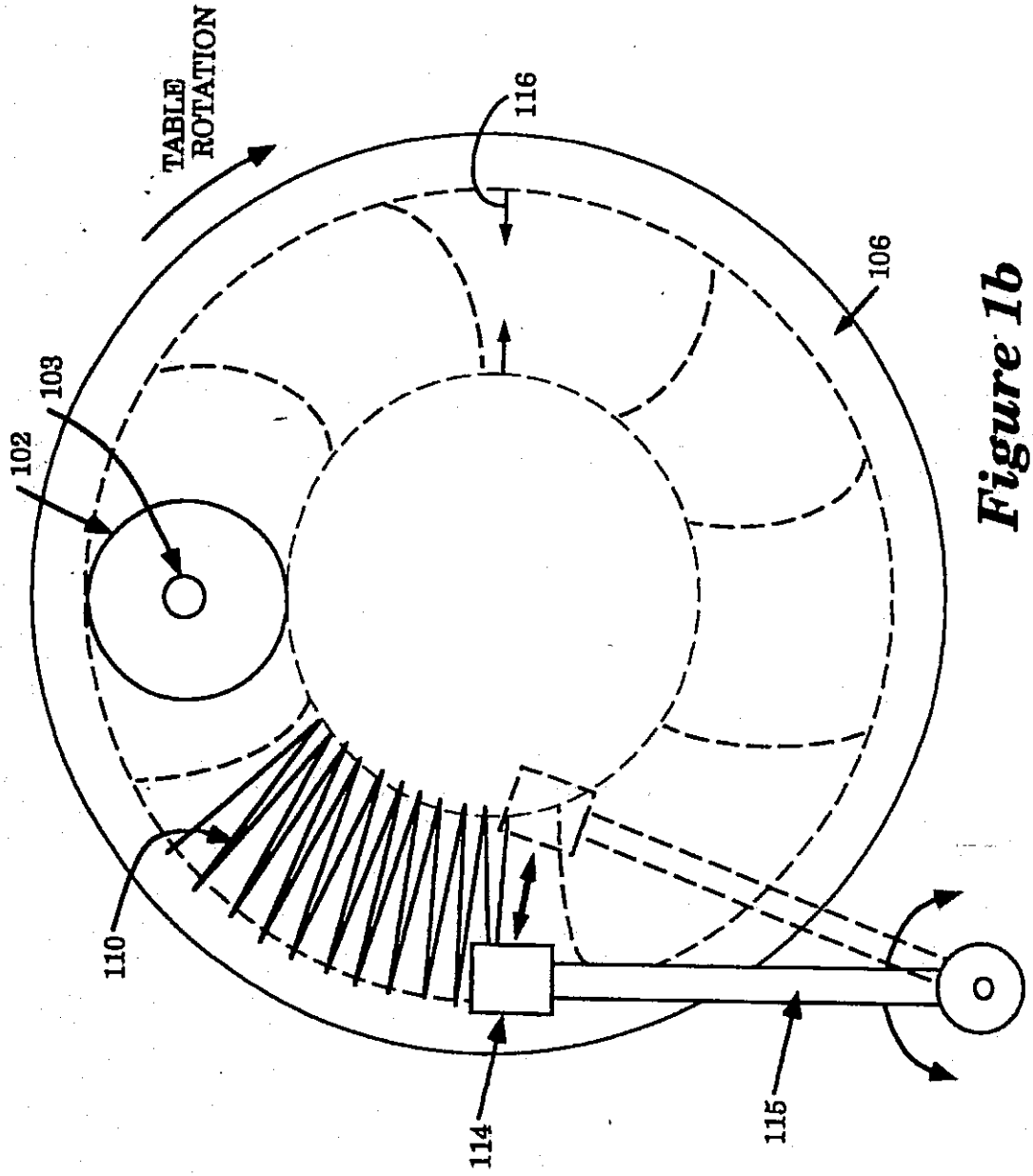


Figure 1b

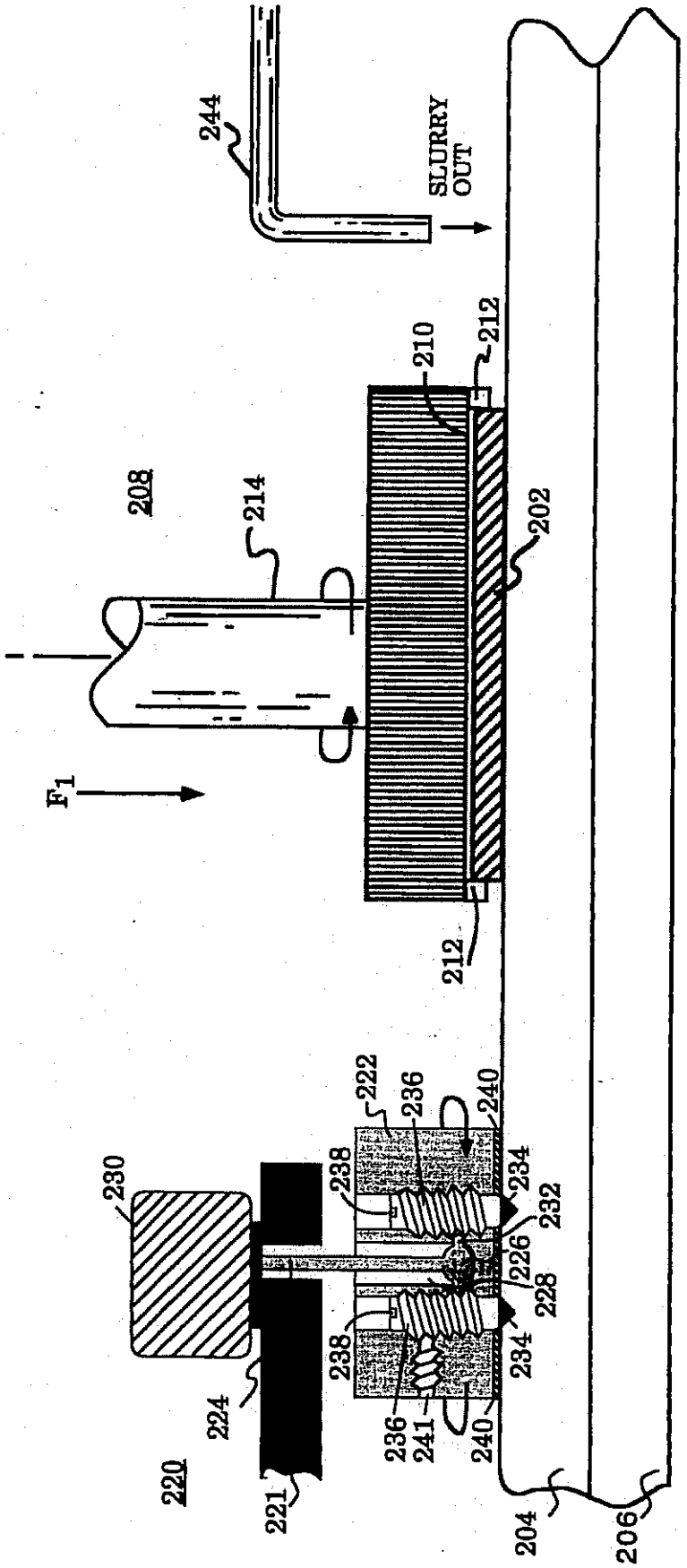

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Figure 2a

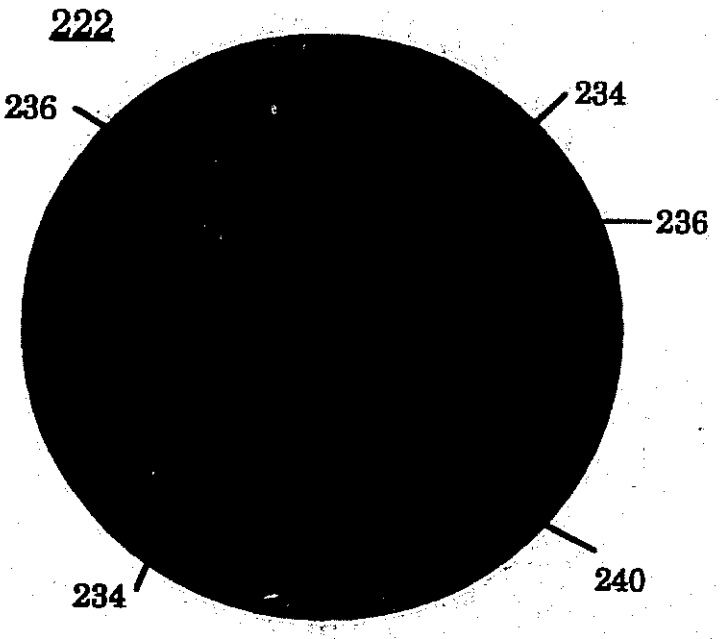

Figure 2b

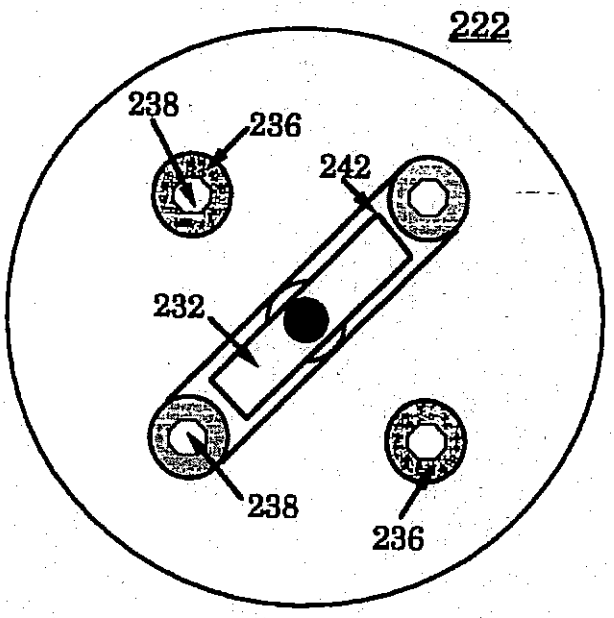

Figure 2c

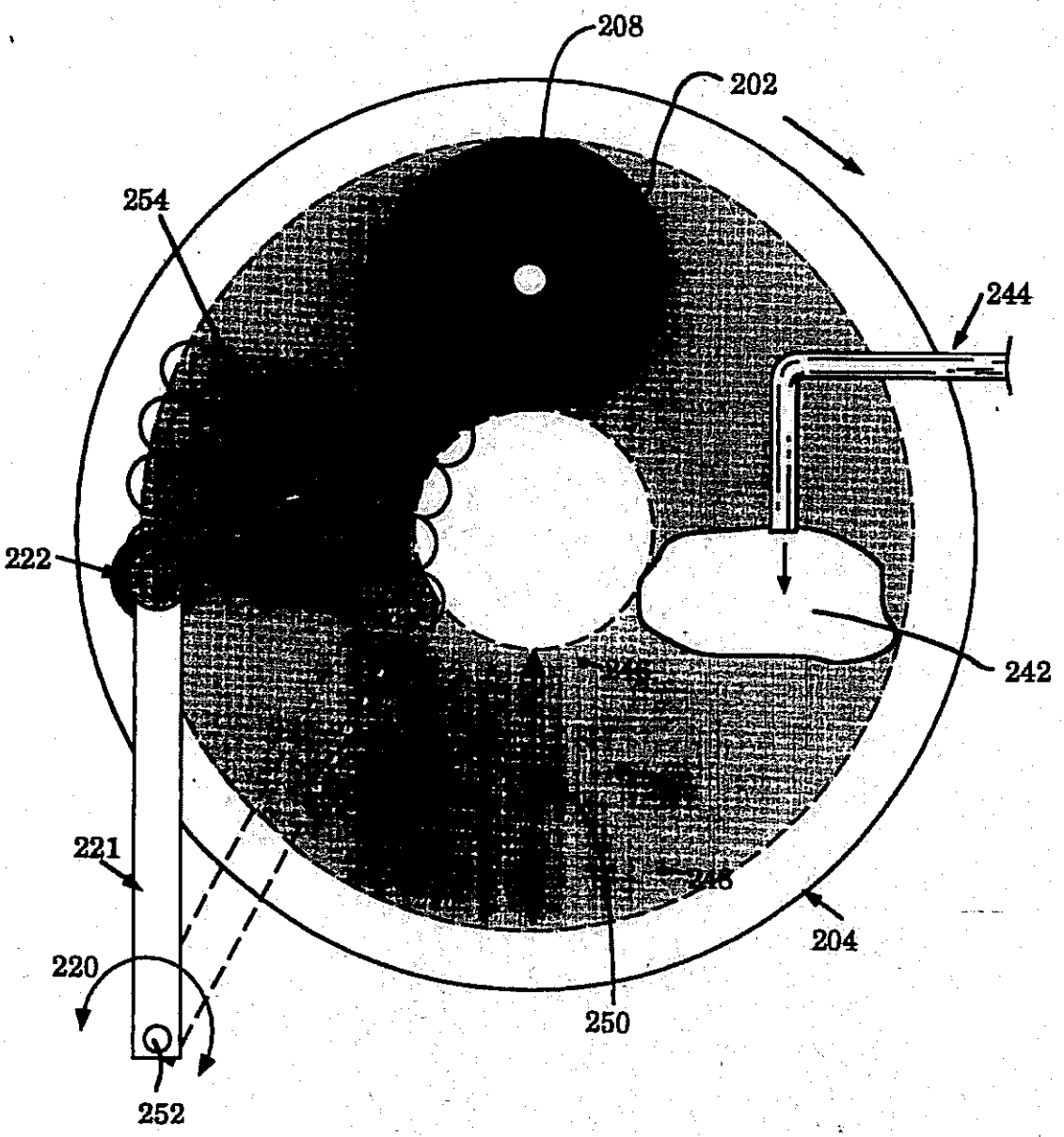

Figure 2d

METHOD AND APPARATUS FOR CONDITIONING A SEMICONDUCTOR POLISHING PAD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of semiconductor processing; and more specifically to the field of conditioning methods and apparatuses for polishing pads used in the planarization of thin films formed on a semiconductor substrate.

2. Discussion of Related Art

Integrated circuits (ICs) manufactured today generally rely upon an elaborate system of metallization interconnects to couple various devices which have been fabricated in the semiconductor substrate. The technology for forming these metallized interconnects is extremely sophisticated and well understood by practitioners in the art. Commonly, aluminum or some other metal is deposited and then patterned to form interconnection paths along the surface of the silicon substrate. In most processes a dielectric or insulated layer is then deposited over the first metal (metal 1) layer; via openings are etched through the dielectric layer and the second metallization layer is deposited. The second metal layer covers the dielectric layer and fills the via openings thereby making an electrical contact down to the metal 1 layer. The purpose of this dielectric layer, of course, is to act as an insulator between metal 1 and metal 2 interconnections. Most often the intermetal dielectric layer comprises a chemical vapor deposition (CVD) of silicon dioxide which is normally formed to a thickness of approximately one micron. (Conventionally, the underlying metal 1 interconnections are also formed to a thickness of approximately one micron.) The silicon dioxide layer covers the metal 1 interconnections conformably such that the upper surface of the silicon dioxide layer is characterized by a series of non-planar steps which correspond in height and width to the underlying metal 1 layers.

These step height variations in the upper surface of the interlayer dielectric have several undesirable features. First, non-planar dielectric surfaces interfere with the optical resolution of subsequent photolithography processing steps. This make it extremely difficult to print high resolution lines. A second problem involves a step coverage of metal 2 (second metal) layer over the interlayer dielectric. If the step height is too large there is a serious danger that open circuits will be formed in metal 2 layer.

To combat these problems, various techniques have been developed in an attempt to planarize the upper surface of the interlayer dielectric (ILD). One approach, shown in FIGS. 1*a* and 1*b*, employs an abrasive polishing to remove the protruding steps along the upper surface of the dielectric. According to this method a silicon substrate or wafer **102** is forced faced down by quill **103** on a table **104** covered with flat pad **106** which has been coated with an abrasive material (slurry) **108**. Both wafer **102** and table **104** are rotated relative to each other under pressure to remove the protruding portions. The abrasive polishing process continues in this manner until the upper surface of the dielectric layer is largely flattened.

Polishing pads **106** of the type used for wafer planarization suffer from a reduction in polishing rate and uniformity due to a loss in sufficient surface roughness. One method of countering the smoothing of polishing pad **106** and achieving and maintaining high and stable polishing rates is pad

conditioning. Pad conditioning is the technique whereby the pad surface is put into a proper state for polishing work. This normally entails forming a plurality of microgrooves in the upper polishing pad surface prior to polishing. The microgrooves help to facilitate the polishing process by providing point contacts and by aiding in slurry delivery to the pad/substrate interface. These initially provided grooves, however, become worn or smooth over time necessitating the continual generation of grooves in polishing pad **106** during polishing.

In one conditioning method, shown in FIGS. 1*a* and 1*b* and described in U.S. Pat. No. 5,216,843 which is assigned to the present assignee, a multitude of fine microgrooves **110** are formed in the surface of polishing pad **106** with a diamond pointed **112** conditioning block **114**. Microgrooves **110** are formed during the polishing process by pivoting diamond conditioning block **114** back and forth across the area **116** of pad **106** which contacts substrate **102**. The sweep rate of diamond conditioning block **114** can be varied to condition some parts of the polishing pad **106** more than others (i.e., nonuniformly condition polishing pad **106**). Nonuniform conditioning allows those areas of polishing pad **106** which become smoothed to be conditioned more so that the overall roughness of polish pad **106** is uniformly maintained. It is to be appreciated that the polishing rate in this polishing process is proportional to the roughness of the polishing pad (i.e., the amount of conditioning received by the polishing pad). Nonuniform conditioning can improve polish uniformity across the surface of a substrate by maintaining a consistant roughness across the polishing pad.

A problem with conditioning polishing pad **106** with the technique shown in FIG. 1*a* and 1*b*, is that although nonuniform conditioning can be achieved with this technique it has been found that its effectiveness is limited. Since conditioning block **114** is rigidly connected to conditioning arm **115**, microgroove formation depends on the relative motion of polishing pad **106** and diamond conditioning block **114**. In order to increase conditioning of one part of polishing pad **106**, the other parts of polishing pad **106** must receive less conditioning. It is to be appreciated that polish rate is proportional to the amount of pad conditioning. In order to nonuniformly condition polishing pad **106** and still maintain a manufacturably acceptable polish rate, it would be necessary to increase the oscillation frequency of diamond conditioning block **114**. There is, however, a practical limit (approximately two cycles per second) to oscillation frequency, due to mechanical inertia. Thus, because diamond conditioning block **114** is rigidly attached to conditioning arm **115**, nonuniform conditioning of polishing pad **106** can not be obtained without decreasing the overall polish rate. A low polish rate decreases wafer throughput and increases fabrication costs.

Another method for conditioning a polishing pad uses a large diameter diamond particle covered disk (typically about six inches in diameter). In this method the large disk is pressed against the polishing pad and rotated while the polishing pad rotates. One problem with this technique for conditioning a polishing pad is that nonuniform polishing cannot be obtained. Another problem with this technique is the large diameter disk which is used. A large diameter disk has been found unsuitable due to a combination of insufficient surface flatness as well as its inability to track surface variations across the polishing track left in the polishing pad. Such a conditioner tends to gouge portions of the polishing pad while not sufficiently conditioning other portions. Additionally, the grit size and spacing are also difficult to control which has a direct effect on the process and its repeatability

disk to disk. Still further, this type of conditioning apparatus easily loses diamond particles which become embedded in the polishing pad and later scratch wafers or substrates. Thus, conditioning with a large diameter rotating disk has been found unsuitable for ultra-large scale integrated circuit (ULSI) manufacturing processes.

Thus, what is required is an improved method and apparatus for conditioning a polishing pad used in semiconductor manufacturing wherein a polishing pad can be nonuniformly conditioned without decreasing the overall polish rate.

SUMMARY OF THE INVENTION

A method and apparatus for polishing a thin film formed on a semiconductor substrate is described. In the method of the present invention a polishing pad is rotated. A wafer is pressed against the rotating polishing pad so that the thin film to be polished is placed in direct contact with the polishing pad. During polishing, the polishing pad is continually conditioned by forming a plurality of grooves into the polishing pad. The grooves are formed by rotating a conditioning block at a rate of between 200–2000 rotations per minute while moving the rotating conditioning block between an outer radius and an inner radius of the polishing pad at a rate of between one to fifteen cycles per minute. In a preferred embodiment of the present invention the conditioning block is swept at a constant rate between the outer and inner radii of the polishing pad while the rotation rate is varied for different radii of the polishing pad. The conditioning block can be rotated fastest while at the middle radii so that the middle radii receives the most conditioning. Alternatively, the rotation rate of the conditioning block can be held constant while the sweep rate is varied for different radii of the polishing pad. A plurality of discrete point contacts, such as diamond tipped threaded shanks extending from the substantially planar bottom surface of the conditioning block, generate the grooves in the polishing pad as the conditioning block is rotated and swept across the polishing pad surface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1*a* is an illustration of a cross-sectional view of a polishing apparatus which includes an earlier polishing pad conditioning assembly.

FIG. 1*b* is an illustration of an overhead view of the polishing apparatus shown in FIG. 1*a*.

FIG. 2*a* is an illustration of a cross-sectional view of a polishing apparatus of the present invention which includes a novel pad conditioning assembly.

FIG. 2*b* is an illustration of a bottom view of a conditioning block of the pad conditioning assembly of the present invention.

FIG. 2*c* is an illustration of a top view of a conditioning block used in the pad conditioning assembly of the present invention.

FIG. 2*d* is an illustration of an overhead view of the polishing apparatus shown in FIG. 2*a*.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

An improved method and apparatus for polishing a thin film formed on a semiconductor substrate is described. In the following description numerous specific details are set forth such as specific equipment, materials, and process parameters, etc., in order to provide a thorough understanding of the present invention. It will obvious, however, to one skilled in the art that the present invention may be practiced with these specific details. In other instances, well-known semiconductor equipment and processes have not been described in particular detail in order to avoid unnecessarily obscuring the present invention.

With reference to FIG. 2*a*, a side view of a polishing apparatus including a pad conditioning assembly of the present invention is illustrated. The polishing apparatus is used to planarize a thin film layer formed over a semiconductor substrate. The thin film is typically an interlayer dielectric (ILD) formed between two metallization layers of a semiconductor integrated circuit. The thin film, however, need not necessarily be an ILD, but can be any one of a number of thin films used in a semiconductor circuit manufacturing, such as but not limited to: metal layers, organic layers, and even the semiconductor material itself. In fact, the pad conditioning technique of the present invention can be generally applied to any polishing process which uses similar equipment where polishing pad smoothing causes the polishing rate to decline or to become unstable. For example, the present invention may be useful in the manufacturing of metal blocks, plastics and glass plates.

During planarization, a silicon substrate or wafer **202** is placed face down on the upper surface of a polishing pad **204** which is fixedly attached to the upper surface of table **206**. In this manner, the thin film to be polished is placed in direct contact with the upper surface of polishing pad **204**. According to the present invention, pad **204** comprises a relatively hard polyurethane or similar material capable of transporting abrasive particular matter such as silica particles. In the currently preferred embodiment of the present invention, an initially non-perforated pad manufactured by Rodel, Inc. known by the name "IC1000" is employed. It is to be appreciated that similar pads having similar characteristics may be used in accordance with the invented method and apparatus. Generally, a plurality of preformed circular grooves (not shown) are generated in polishing pad **204** prior to any polishing. Preformed grooves help facilitate the polishing process by providing a plurality of point contacts between the substrate and the polishing pad and by delivering slurry to the pad/substrate interface.

A carrier **208**, also known as a "quill", or similar means, is used to apply a downward pressure F1 against the backside of substrate (or wafer) **202**. The backside of substrate **202** is held in contact with the bottom carrier **208** by a vacuum or by simply wet surface tension. Preferably, an insert pad **210** cushions substrate **202** from carrier **208**. An ordinary retaining ring **212** is employed to prevent substrate **202** from slipping laterally from beneath carrier **208** during polishing. The applied pressure F1 is typically on the order of four to nine pounds per square inch and is applied by means of shaft **214** attached to back side of carrier **208**. The applied pressure F1 is used to facilitate the abrasive polishing of the upper surface of the thin film. Shaft **214** may also rotate to impart rotational movement to substrate **202**. This greatly enhances the polishing process. It is to be appreciated that other carriers such the improved carriers described in co-pending U.S. patent application Ser. No. 08/103,918, filed Aug. 6, 1993 and assigned to the present assignee, may be used if desired.

The polishing apparatus of the present invention includes a novel pad conditioning assembly **220**. Pad conditioning assembly **220** is used to generate a plurality of grooves into the top surface of polishing pad **204** during polishing. The grooves help to facilitate the polishing process by continually providing a plurality of point contacts between the

substrate and polishing pad, as well as helping to channel slurry to the pad/substrate interface. Although polishing pad **204** is initially provided with a plurality of grooves, the effectiveness of these grooves reduces over time. It is, therefore, recommended to continually generate micro-grooves in polishing pad **204** during polishing. By continually generating grooves into polishing pad **204** during polishing, the present invention improves polish rate uniformity across a substrate and from substrate to substrate. The pad conditioning technique of the present invention makes the planarization process of the present invention extremely uniform, reliable, and ultra-large scale integrated circuit (ULSI) manufacturable.

A preferred embodiment of pad conditioning assembly **220** is shown in FIG. **2***a*. A stainless steel rotatable conditioning block **222** is coupled by a "ball and socket" joint to shaft **224**. A ball **226** is rigidly connected to one end of shaft **224**. Ball **226** fits securely inside of socket **228** formed in rotatable conditioning block **222**. The "ball and socket" joint allows conditioning block **222** to move freely in the vertical direction during polishing so that the planar bottom surface of conditioning block **222** remains in uniform contact with polishing pad **204** even when undulations are present in pad **204**. The end of drive shaft **224** opposite to ball **226** is coupled to a well-known variable speed electric drive motor **230**, such as a Micro Mo Brushless DC - Servomotor (2444SBL1). Electric motor **230** is capable of rotating shaft **224** and conditioning block **222** at rates between 200–2000 rotations per minute. A drive pin **232** rigidly connected to the equator of ball **232** transfers the torque of shaft **224** to conditioning block **222**. The combination of a "ball and socket" joint and a drive pin **232** allows conditioning block **222** to move freely with undulations in pad **204** while being rotated by drive motor **230**.

Conditioning block **222** contains four stainless steel diamond-tipped **234** threaded shanks **236** which provide discreet points for generating grooves into polishing pad **204**. The diamond tips **234** extend a distance of approximately 30–50 microns from the substantially planar bottom surface of conditioning block **222**. Grade A or AA diamond tips **234** without flaws or major cracks, grounded into a cone having a 90° angle, can be attached to stainless steel threaded shanks **236**. The threaded shanks **236** have Hex driver sockets **238** on the top surface so that the distance at which diamond tips **234** extend from conditioning block **222** can be easily varied. The threads on shanks **236** help to securely fasten shanks **236** to conditioning block **222**. The stainless steel threaded shanks are approximately 0.5 inches in length and have a diameter of approximately ⅛ of an inch. It is to be appreciated that other means besides diamond tip threaded shanks **236** can be used to generate grooves into polishing pad **204**. Cross locks of nylon tipped set screws **241** can be used to prevent diamond tipped shanks **236** from shifting adjustment during usage. Additionally, a wear resistant surface plate **240**, of for example silicon-carbide, is preferably attached to the bottom surface of conditioning block **222**. Wear resistant surface plate **240** prevents conditioning block **222** from becoming worn during polishing so that the bottom surface of conditioning block **222** remains substantially planar for long periods of time.

FIG. **2***b* shows a bottom view of conditioning block **222**. The four diamond tipped threaded shanks **236** in a preferred embodiment of the present invention are positioned at the indices of a square having between 0.25 to 1 inch sides. It is to be appreciated that alternative placements can be used, if desired. Conditioning block **222** in a preferred embodiment of the present invention is an approximately 0.50 to 2 inch diameter cylindrical stainless steel block. Use of a small diameter block allows conditioning block **222** to better track the contours of polishing pad **204**. Additionally, with a small diameter block it is simpler to provide a substantially planar bottom surface.

FIG. **2***c* shows a top view of conditioning block **222**. Hex driver sockets **238** of threaded shanks **236** are readily accessible to allow for easy length adjustment and replacement of diamond tipped threaded shanks **236**. Conditioning block **222** has a drive slot **242** in which drive pin **232** is situated. In order to rotate conditioning block **222**, torque is delivered by drive pin **232** to the sidewalls of drive slot **242**.

In reference to FIG. **2***d*, during polishing a substrate (or wafer) **202** is placed face down on polishing pad **204** so that the material to be polished on substrate **202** is placed in direct contact with the upper surface of polishing pad **204**. In a preferred method of the present invention substrate **202** is pressed face down against polishing pad **204** at a pressure of between four and nine pounds per square inch by carrier **208**. Additionally, during polishing carrier **208** is rotated at a rate of between 20–90 rpms to help enhance the polishing process. In the currently preferred embodiment of the present invention, table **206** and polishing pad **204** rotate at a rate of approximately 10–70 rpms. As table **206** and polishing pad **204** are rotated, a silica-based solution **242** (frequently referred to as "slurry") is deposited or pumped through a pipe **244** onto the upper surface of polishing pad **204**. Currently a slurry known as SC3010, which is manufactured by Cabot, Inc. is preferably used for polishing SiO_2 insulating layers. During the polishing process, slurry particles become embedded in the upper surface of polishing pad **204**. The relative rotational movement of carrier **208** and table **206** facilitate the polishing of the thin film. Abrasive polishing continues in this manner until a highly planar upper surface is produced and the desired thickness reached.

According to a preferred embodiment of the present invention, polishing pad **204** is continually conditioned by pad conditioning assembly **220** during polishing. According to the present invention, conditioning block **222** is rotated while it is moved back and forth between an inner radius **246** and an outer radius **248** of polishing pad **204**, wherein the conditioned area includes at least polish track **250** created by the substrate **202** being polished. Conditioning block **222** is moved or swept back and forth across polishing track **250** at a rate of between one to fifteen cycles per minute. Conditioning block **222** can be moved across polishing pad **204** by coupling the end of conditioning arm **221** opposite conditioning block **222** to a variable speed oscillating motor located at pivot point **252**. A variable speed motor allows conditioning block **222** to be swept across different radii of polishing pad **204** at different rates. It is to be appreciated that other means, such as a reciprocating mechanism, can be used to move conditioning block **222** between the inner and outer radii of polishing pad **204**. It is important to note that the rotation rate of polishing pad **204** and the sweep rate of conditioning block **222** should not be the same, or multiples thereof, so that all portions of polishing pad **204** receive some conditioning.

As conditioning block **222** is rotated and moved back and forth across polishing pad **204**, the diamond tipped threaded shanks **234** condition polishing pad **204** by forming grooves **254** in polishing pad **204**. Grooves **254**, in a preferred embodiment of the present invention, are formed at an approximate depth of between 30–50 microns. The depth of grooves **254** is set by the distance at which diamond tipped threaded shanks **234** extend from conditioning block **222** (or wear resistant plate **240** if used). The weight of conditioning