

PATENT BASICS FOR PHYSICISTS

The careers of many physicists, particularly those engaged in applied or industrial research, depend on the practical applications of their work. As budgetary concerns grow, they are increasingly being asked to help expand their employers' sources of income. In many cases, the most direct link between an organization's scientific research, development and application efforts and its financial objectives is its portfolio of patents. And so it would not be unreasonable to say that the professional success of many physicists is greatly affected by the number and quality of the patents resulting from their efforts.

Through education and experience, physicists acquire the ability to solve physics-related problems, along with an extensive set of mathematical tools. The well-rounded physicist should also have some background knowledge of patents, including what sorts of things are patentable and how patents work, as well as recent legal trends that are affecting when and how an invention can be patented. To discount the patentability of one's work is to ignore the economic realities that are of increasing concern to the physicist. This article aims to provide a basic understanding of the patent issues relevant to physicists.

Each country has its own laws governing the patents it issues; our discussion deals only with the US. While the rights, responsibilities and features of the US patent system do not always agree with those of other countries, there are many similarities among the various systems.

Overview of the US patent system

The desirability of a national patent system in the US was expressed by the framers of the US Constitution: "The Congress shall have 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 writings and discoveries." With the Patent Act of 1790, Congress established the legislative framework for realizing that goal. In the two centuries since, the US patent system has evolved in response to developments in both science and society. There have been occasional major changes in the system due to an action of Congress or a landmark decision by the courts, and a plethora of nearly imperceptible changes each year in the form of Federal regulations and minor court decisions.

In the US patent system, "the progress of science and useful arts" is promoted

In an age when scientific knowledge is increasingly being treated as a form of property, a general understanding of patents is becoming a necessity for the physicist.

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by a mutually advantageous agreement between an inventor and the public, represented by the Federal government. Through this agreement, the inventor makes a full, complete and understandable public disclosure of an invention, in exchange for which he or she is permitted—for a certain period of time—to exercise a

kind of monopoly over the invention by having the right to exclude others from making, using, selling or offering to sell the invention in the US, and from importing the invention into the US. In effect, this limited-duration monopoly encourages inventors to disclose their inventions rather than keeping them secret. The public disclosure takes the form of a patent issued by the US Patent and Trademark Office (USPTO). After the inventor's limited-duration monopoly has expired, anyone is free to use the invention without restriction.

What can be patented

US patent laws specify three types of patents: utility patents, which protect the mechanical, electrical, chemical and/or functional aspects of an invention; design patents, which cover the visual or ornamental appearance of an item; and plant patents, which cover new varieties of plants. Since the vast majority of patents awarded to physics-related inventions are utility patents, we will focus on those.

Within utility patents, there are four categories of inventions that Congress has deemed appropriate for protection: new and useful machines, processes, articles of manufacture and compositions of matter. The machines category is self-explanatory. The processes category includes computer software as well as chemical and mechanical processes. The articles-of-manufacture category includes useful articles and products, typically without moving parts; diffraction gratings would fall into this category. Patentable compositions of matter—for example, semiconductors—must not be naturally occurring and must provide at least one new property that is materially different from the properties of the elements that form the substance.

In general, a patentable invention must not be obvious in view of previous developments in the field. Thus, patents are not issued for trivial developments or for newly discovered laws of nature, naturally occurring compositions, scientific principles or mathematical relationships. Most patents now in

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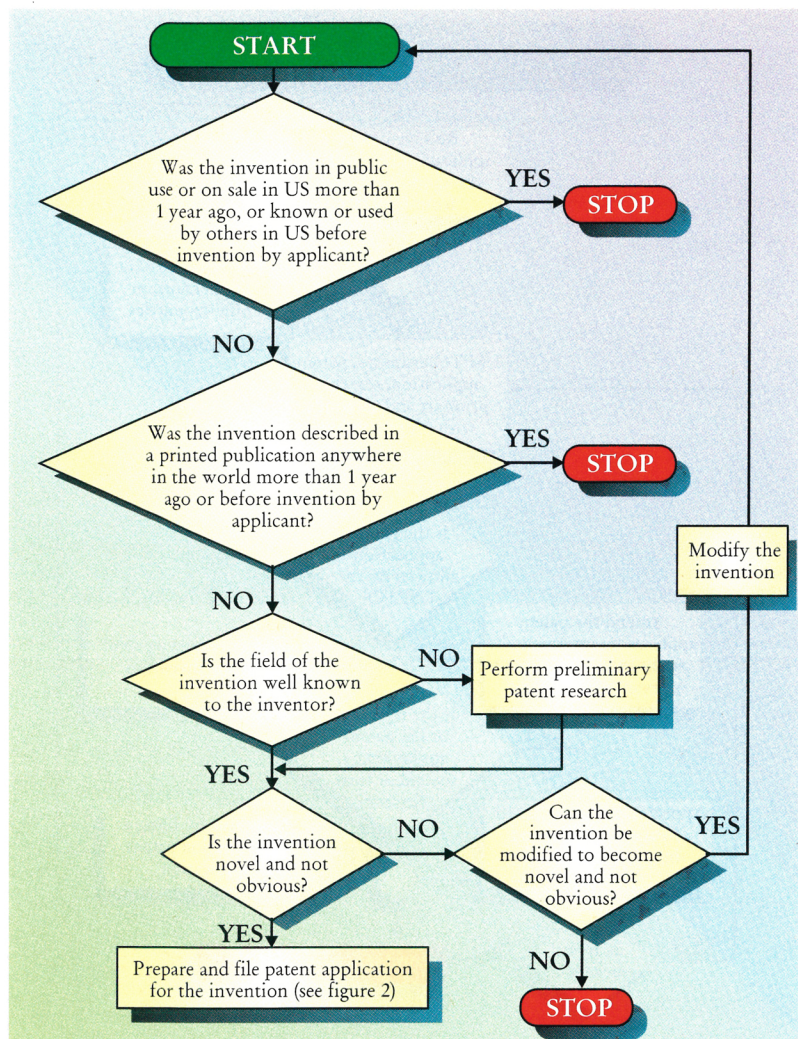


FIGURE 1. IS THE INVENTION PATENTABLE? Prior to filing a patent application with the US Patent and Trade Office, an inventor should make sure that the idea meets certain basic criteria, as outlined here.

revised guidelines for patent examiners who are studying applications related to software. In a statement announcing the new guidelines, Bruce Lehman, commissioner of patents and trademarks, said they would be the "first step in our effort to make the patent system more responsive to software innovation."

The patent application

The process of obtaining US patent protection for an invention involves numerous steps. Figure 1 offers a basic checklist for the patent seeker to determine whether his or her invention is patentable. Figure 2 shows some fairly typical steps after an application has been filed.

A patent attorney may assist in the initial process of evaluating an invention's patentability, and is also usually employed to prepare, file and "prosecute" a patent application on behalf of the inventor.

In figure 1 the threshold determination of whether an invention has been in public use or on sale prior to the patent application applies to activities within the US only. Similarly, if an invention is already "known or used by others" in the US, patent protection will be unavailable. Perhaps of more interest to the physics community is the requirement that the invention must not have been described in a printed publication anywhere in the world more than one year before the patent application is filed. Thus, one should note carefully the publication date of research that includes potentially patentable subject matter in any journal or conference proceeding, however obscure.

Like scientific papers, patent applications are written in a specialized format. Each application includes an abstract, a section describing the field of the invention and a review of prior developments in the field. These portions are followed by a summary of the invention and a detailed description of the preferred embodiments of the invention. The application concludes with a set of claims, designed to stake out the boundaries of the invention. The claims constitute the most important part of the

force are directed toward the improvement, perhaps only slight, of more basic existing products and processes. Considerable effort goes into the legally acceptable and financially prudent practice of "designing around" patented products. By analyzing a patent, one may discover a way to obtain the result of the patented invention without infringing on the patent. A product or process made by designing around a patent may itself be eligible for patent protection.

Computer software is one example of how the US patent system has been changing. Although considered a process invention, and therefore patentable, software has typically been protected by copyrights rather than patents in the US. But recent court decisions seem to indicate that patenting may soon become the preferred mode of protecting certain types of software. Specifically, although some aspects of software are clearly protected by copyright, the trend of court decisions is that copyright protection does not automatically extend to everything contained in or associated with software. (In general, original creative works of fiction that can be expressed in infinite variation, such as novels, plays and motion pictures, are given broad copyright protection, while functional or factual works having only a narrow range of possible expression have more limited copyright protection.) In recognition of these recent decisions, the USPTO has issued

FIGURE 2. PATENT PROSECUTION, as shown here, takes place after a patent application has been filed with the US Patent and Trade Office; it usually involves several rounds of review by the USPTO and revisions by the patent seeker.

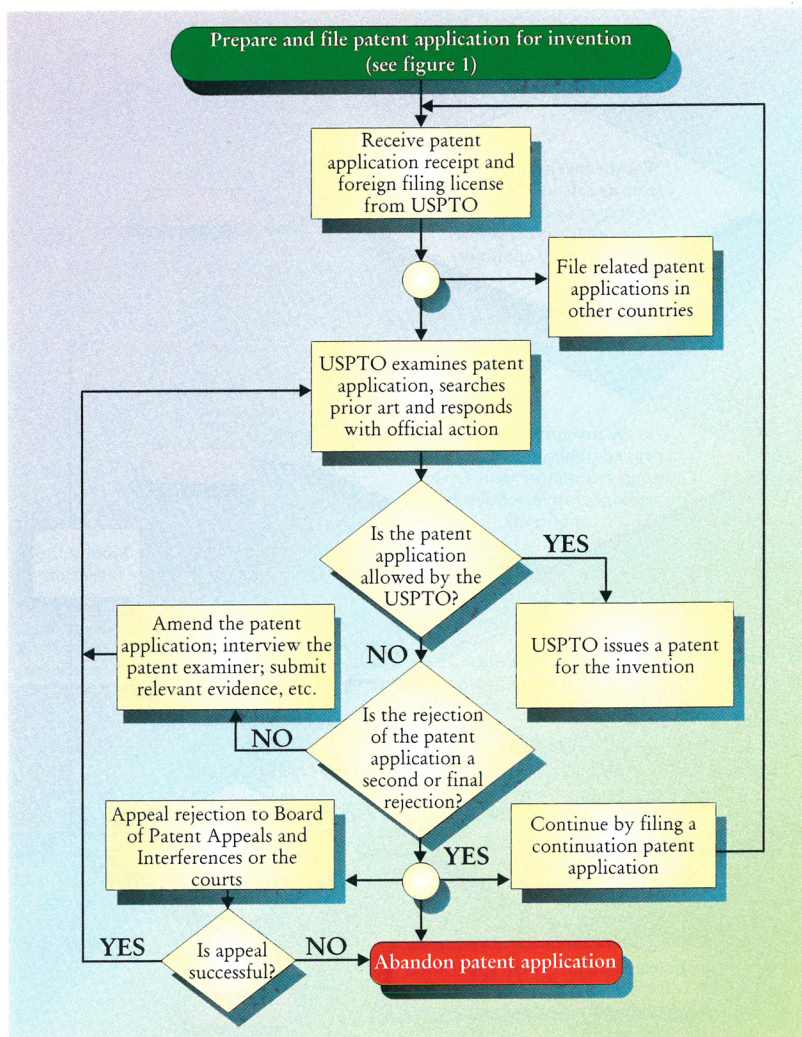
application; among other uses, they may be cited in patent-infringement litigation. The language and form of patent claims, which have changed little in the past 50 or even 100 years, are exemplified in figures 3 and 4, which were taken from US patents issued to Albert Einstein and Leo Szilard in 1930 and to John Bardeen and William Brattain in 1950, respectively.

It is important that a patent application disclose the best mode for producing the invention, describe all embodiments of the invention and claim the invention as broadly as is justified. In general, a patent that discloses an invention broadly but claims it too narrowly will prevent other parties from obtaining patent protection for the unclaimed portion—but it may also prevent the inventor from later broadening his or her claims. When a patent both discloses and claims an invention too narrowly, other parties may obtain a patent for a similar invention that was not disclosed or claimed in the original patent. But if a patent application claims an invention too broadly, the USPTO will reject it.

The USPTO's examination of a patent application to determine whether the invention qualifies for patent protection (in a process known as patent prosecution) includes a word-by-word analysis of the application and a careful review of any drawings included with it. The goal of the examination is to ascertain whether the invention has the utility, novelty and lack of obviousness required by Federal law, whether the application makes a full, clear, concise and exact written description of the invention, and whether the application clearly states the subject matter of the invention. Ideally, a patent should allow a person of ordinary skill in the field of the invention to understand and reproduce the invention.

The USPTO does not accept most patent applications after the first examination; some type of amendment of the application will generally need to be made. For example, the patent seeker may be instructed by the patent examiner to narrow the scope of claims that are too broad. The revised patent application may then be resubmitted. Successive rounds of review by the USPTO and responses by the applicant culminate with the USPTO either issuing a patent or making a final rejection of the patent application.

If the application is successful, patent protection begins when the patent is granted and ends 20 years after the filing date of the patent application. At that point, the invention becomes available for anyone to use with



no further restriction. The 20-year term reflects a fairly recent change in US patent law; previously, the term of protection was 17 years (starting on the date the patent was granted). Most patents are prosecuted in less than three years, and so the recent change, on average, extends the term of patent protection.

In the event of a final rejection, as shown in figure 2, the applicant has three choices: stopping prosecution of the patent application, which results in the application being abandoned; continuing prosecution by filing a so-called continuation patent application for the invention; or appealing the final rejection to the Board of Patent Appeals and Interferences (a branch of the USPTO) or to the courts. A specially staffed Federal appellate court, the Court of Appeals for the Federal Circuit, is responsible for hearing such appeals.

Issues affecting patent filing

An important element of the US patent system is what is known as the first-to-invent paradigm, under which legal priority is given to the inventor who first conceived the idea leading to the invention, continuously and diligently worked on the invention until it was reduced to practice and then filed a patent application within the time prescribed by law. A second inventor of the same invention who reduced to practice before the first inventor did but cannot trace back a continuous period of diligent

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FIGURE 4. A "CIRCUIT ELEMENT" invented by John Bardeen and Walter Brattain received US Patent No. 2 542 035 in 1950. As described in Claim 1, the device "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".

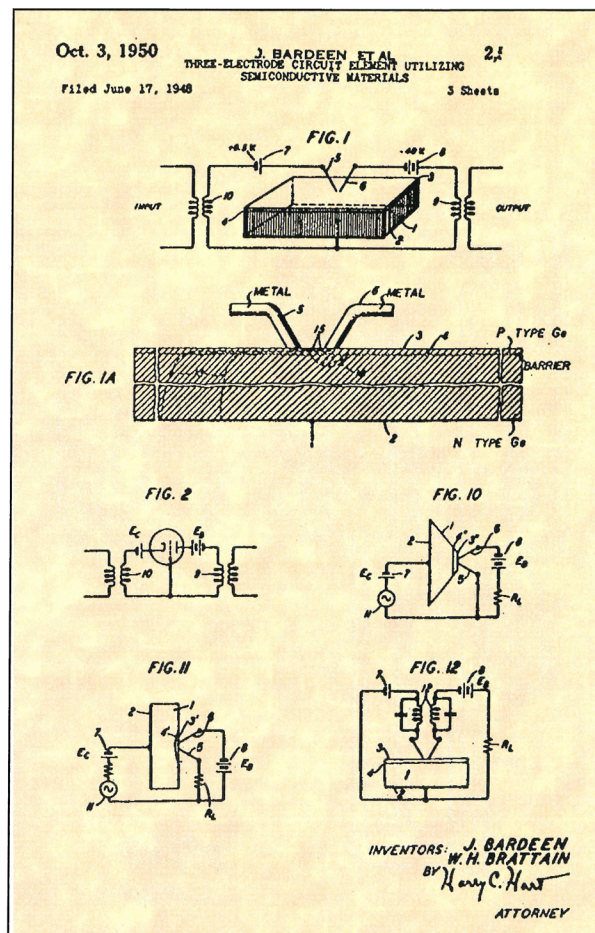
\$770 for a utility patent application). Median costs for typical patent-prosecution activities include about \$235 for the preparation of an information disclosure statement, \$1000 for an amendment to a patent application and \$1600 to \$2000 for a relatively complex amendment. Finally, when a patent application is approved, an issue fee must be paid to the USPTO before the patent is granted. Currently, the issue fee is \$1290. (Filing and issue fees for independent inventors, small businesses and nonprofit organizations are reduced by 50%.) Thus, the total cost of obtaining a typical US patent can amount to \$10 000 or more.

Another important potential cost may occur if one person infringes on the patent rights of another. Infringement occurs when a patented item is made, used, sold or offered for sale within the US, or is imported into the US, without the authority of the patent owner. In the majority of patent-infringement lawsuits, the amount at risk¹ is between \$1 million and \$10 million. Willful infringers risk fines of treble damages, and in some cases, attorneys fees—which can easily be two or three orders of magnitude greater than the original cost of obtaining the patent. Clearly, anyone who infringes a patent may face economic consequences ranging from the merely substantial to the truly catastrophic. So, before undertaking any type of activity that may cause patent infringement, one should carefully analyze existing patents and other relevant information. To assist in this process, an experienced patent attorney can perform what is known as an infringement search.

Of what value is a patent? This can vary widely, depending on how the patent is used and who owns it. For example, an inventor who is employed by an institution usually does not retain the patent rights to his or her invention—the institution does. And so the financial rewards for the inventor may range from a nominal sum when the patent is granted to a portion of the income generated by the patent paid over the life of the patent.

The owner of a patent may choose to license its use to others and then collect royalties, which vary in size from field to field and are, in general, inversely related to predicted sales. Patents for such items as semiconductor chips may command royalties of around 1% of the sales price; patents in a few other fields can command royalties of up to 15%. Sometimes, two patent owners exchange licenses for their patents in a practice known as cross-licensing. That is one way for a company to gain access to important technology developed by outsiders that is essential to a particular project. A patent thus may be economically valuable to an organization primarily as an addition to a library of patents that can be licensed.

A patent may also be held for defensive purposes, to prevent others from using a particular technology. Such a strategy may be adopted, for instance, when a particular goal may be reached through any number of competing technologies, and when, to justify the cost of bringing just one of the technologies to market, it's necessary to garner



a large share of the potential market. In such a scenario, a company may wish to inhibit development of competing technologies by acquiring the patent rights to most or all of those technologies.

Beyond the direct, immediate benefits afforded by patent protection, the long-term gains it brings to an organization will help the entity to survive and perhaps flourish. Therefore, an organization that employs clever, inventive people will be able to continue to support more theoretical and basic research, where patentable inventions are necessarily infrequent.

Recent and future changes

The US patent system is undergoing several major changes. Of particular interest to the physics community is the recent creation of the "provisional" patent application. Other changes concern new guidelines for patent protection of computer software (discussed earlier) and the publication of patent applications that are pending.

On 8 June 1995, the US established a "domestic priority system" for patents, under which one may file a provisional patent application to quickly and inexpensively establish an early effective filing date. An early filing date has the obvious advantage of establishing when an invention was reduced to practice (although the inventor may be able to prove that an invention was in fact reduced to practice before the filing date). A provisional application automatically expires one year after filing—but that time provides an opportunity to further develop the invention and explore licensing possibilities.

The new type of application consists of a full written description of the invention, including the best mode for making and using the invention, plus any drawings; the filing fee is \$150. The USPTO does not examine provisional patent applications for content, so almost any written document that complies with a few formal requirements will be accepted. Only if a regular patent application is subsequently filed and a question of priority arises will the content be analyzed.

Provisional patent applications are expected to be widely used by university and college researchers, who could, for example, file slightly modified versions of their scientific papers. Although it might be tempting, in view of the low cost, for an institution to implement a policy of regularly submitting scientific papers as provisional patent applications before their publication, each provisional application should still be reviewed to ensure that it discloses everything that might go into the subsequent regular patent application.

Among the changes to the US patent system being considered is the publication of pending patent applications. At present, patent applications filed with the USPTO are held in strict secrecy during the entire examination process. Although the mean time of such patent prosecution is around 19.5 months, it sometimes takes much longer, especially in areas such as computer technology and biotechnology. In some instances, inventors intentionally prolong the patent prosecution to preserve their invention in secrecy while maintaining priority over other inventors.

The practice of keeping patent applications confidential is almost unique to the US. In most countries, a patent application is routinely published after a specified interval has elapsed (typically 18 months). The US may soon adopt the practice also; Congress is now considering legislation² that would mandate the publication of US patent applications 18 months after filing.

As the above changes illustrate, the US patent system continues to evolve. And yet, for the would-be inventor who is developing a potentially patentable idea, the basic challenge remains the same: the goal of eventual commercial success. Although elegance and simplicity may be the physicist's paradigms of choice, market factors such as cost, ease of manufacture, durability and repairability also have to be considered when attempting to bring an invention to market. In doing so, physicists may find themselves working on unfamiliar, seemingly intractable issues that are quite remote from science.

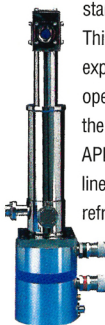
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2. HR 400.

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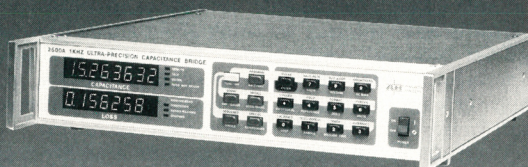
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