

THE PATENT PROCESS

A Compendium of Information Regarding US Patents

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Editor's Notes

Information used in the following document was obtained via the Internet, and may contain minor errors and anomalies. Having said that, however, this document will provide the reader with an overview of the patent process, as well as a fairly detailed description of the requirements needed to prepare a Utility Patent and a Design Patent. Due to the nature of our business, I have left out the description of requirements for Plant Patents.

Questions, comments, and corrections can be directed to me, and I will attempt to resolve and answer all such inquiries in a timely manner. If you have a patentable idea/product and need assistance beyond the self-help information found in this document, you should contact a patent attorney for additional information and support. Please advise me if I have inadvertently included any unacknowledged copyrighted material.

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1.0 INTRODUCTION

1.1 WHAT IS A PATENTABLE INVENTION?

In order to be patentable, an invention must be "novel" and "useful" (35 U.S.C. Section 101).

"Novel" means that others must not have known the invention or placed the invention in public use in the United States before you invented it, and that others must not have already patented or described the invention in a printed publication anywhere in the world, more than one year prior to the filing of the patent application.

Also, the invention must not be "obvious." This means that any changes or modifications you make over any prior products or published designs must not have been obvious to a person having ordinary skill in the industry or trade, at the time of your invention.

"Useful" means simply that the invention has a useful purpose, actually works and is not frivolous or immoral.

How do patents differ from copyrights?

With the exception of innovative designs, patents are closely associated with things and processes which are useful in the real world. Almost at the opposite end of the spectrum, copyright applies to expressive arts such as novels, fine and graphic arts, music, phonograph records, photography, software, video, cinema and choreography. While it is possible to get a patent on technologies used in the arts, it is copyright that keeps one artist from stealing another artist's creative work.

An exception to the general rule that patents and copyrights don't overlap can be found in product designs. It is theoretically possible to get a design patent on the purely ornamental (non-functional) aspects of the product design and also claim a copyright in this same design. For example, the stylistic fins of a car's rear fenders may qualify for both a design patent (because they are strictly ornamental) and copyright (as to their expressive elements). In practice, however, to a particular product courts will usually extend one type of protection or the other -- not both.

1.2 THE PATENT PROCESS

Purpose of a Patent

Think of a patent as part of a bilateral agreement with the government, an agreement where both parties benefit if the terms are honored. If you do not honor the terms, this may result in a court declaring your patent invalid. Failing to disclose the "best mode" (the best configuration of your invention) at the time of the filing of your patent application is a violation of the terms of the agreement and, as such, places your patent in jeopardy.

Who may obtain a Patent?

The Patent Laws permit the Patent Office to award patents only to the true inventor or inventors. If you are an inventor, you cannot file a patent application as the inventor unless you are also the inventor or co-inventor of the invention (as the drafter of the patent application defined the invention it in at least one claim of the patent application). In addition, you cannot get a patent on a mere idea, concept, or suggestion. Therefore, even if you, as an inventor, provide the basic idea or identify the need which the invention is to fill, and subsequently fund the development of the invention by others, the Patent Laws do not entitle you to be named

as an inventor. You, the inventor, however, may retain full ownership of the patent rights, and thus benefit from the future income of the patent to the exclusion of the true inventors.

Bars to Obtaining Patent Protection

The following occurrences disqualify you from being able to receive a U.S. patent on your invention:

- 1) When anyone publicly uses the invention earlier than one year prior to your filing of a U.S. patent application;
- 2) When a foreign government grants you a foreign patent on an application covering the same invention which you filed more than one year prior to filing your U.S. patent application;
- 3) When anyone publishes any article anywhere in the world disclosing the features of the invention more than one year prior to filing your patent application;
- 4) When another publishes, patents, or invents the same invention prior to the earliest date on which you reduced your invention to practice (Note that if someone invents the invention before you, but later "abandons" the invention, you may still be entitled to a patent on the invention);
- 5) When you have abandoned the invention; and
- 6) When you did not yourself invent the subject matter for which you seek a patent.

Many foreign countries bar the issuance of a patent if anyone publicly used or disclosed the invention any length of time before the filing of a patent application in the foreign country. In other words, many foreign countries do not provide a one year grace period, as does the U.S. patent system. However, if you file for a U.S. patent before you do anything which might bar your obtaining a patent in foreign countries, then, under certain international treaties, foreign countries will consider your U.S. filing date as if it were your foreign filing date, thus allowing you to antedate activities which otherwise would constitute a bar [See the Paris Convention for the Protection of Industrial Property].

The Patent Search

You should search prior patents and publications at the earliest possible opportunity. Practitioners refer to this as a "novelty" search. The primary reason for this is to avoid the futility and cost of filing a patent application on an invention that someone else has already patented. In addition, a search decreases the chances that you will inadvertently infringe someone else's patent (note that a "novelty" search is not an infringement search—an infringement search is something completely different, costing anywhere from several hundred to tens of thousands of dollars). Still another reason for the search is to obtain information about the state of the art of the technical field of the invention, which you may use to improve the invention and increase its marketability (provided, of course, that you do not infringe someone else's patent)!

If you work for a company involved in an intensive research and development project, this search can save time and money by avoiding a wasted effort at "reinventing the wheel." There are countless examples of situations in which companies could have saved millions of dollars in unnecessary research and development costs, simply by taking advantage of one of the patent system's primary purposes, that of being a resource of relatively up-to-date technical knowledge.

In addition, you may be able to use some of the information in the prior art patents found during your patent search to help locate companies interested in licensing your patent. [The term "prior art" simply means the relevant technology as it existed apart from your invention, just prior to your filing for patent protection]. On the first page of the published patent, directly beneath the names of the inventors (See Appendix, exhibit A), the Patent Office prints the names and addresses of companies to whom inventors have licensed their patents.

You may elect to perform the preliminary patent search yourself, or, you may hire a patent practitioner or search professional to perform the search for you. Should you elect to attempt a search yourself, a system of patent depository libraries is available in many cities throughout the country. In the Houston area, there is only one such library—Fondren Library at Rice University. At these patent depository libraries, you may examine any issued U.S. patent. In addition, the Patent Office provides a database of patent summaries on the Internet. I suggest that you search the Internet summaries first, and then visit the local patent depository library where you can perform a more in-depth search.

Even though I recommend that you hire a professional to perform the patent search, I also recommend that you do a patent "survey" search yourself. A survey search is a preliminary and inexpensive patent search, which you perform before your first meeting with a patent practitioner. If the results are in your favor, this will give you the confidence that your \$600 to \$1000 investment in a professional search and patentability opinion will be worthwhile. In addition, a survey search will help educate you about the state of the art in the field of your invention (more on this later).

Patent Pending

Manufacturers and marketers of products often use the terms "patent pending" and "patent applied for" to inform the public that an application for a patent on that product is on file in the Patent Office. [The law imposes a fine on those who use these terms falsely]. For the period of time during which your patent is pending, the Patent Office holds your patent application in strict secrecy. What may surprise you though is that having a patent pending provides no formal protection against infringement. Nevertheless, when a patent is pending, because the potential for its grant exists at the same time that the content of the application is held secret, this makes it more difficult for a competitor to effectively design around your patent. In some cases, the mere threat that your application may be granted may be sufficient to deter a would-be competitor from manufacturing the invention. If your patent issues and court rules that your competitor infringes your patent, he may have to completely shut down production of his product—a death sentence where his primary source of revenue is derived from manufacturing the infringing product.

The Special Problems of Joint Inventorship and Assignments

When assignments, employment agreements, joint inventors, or possible joint inventors are involved, you should bring this to your patent practitioner's attention immediately. If you omit an inventor that you should have recognized as a joint inventor, then the joint inventor or an infringer in a subsequent lawsuit can contest the validity of your patent application. If the protestor can prove bad faith in your omission, he could invalidate your patent.

Please understand that just because you should list someone else as a joint inventor in your patent application, this does not mean that the patent laws require that this person share in the future income from your patent. In fact, a joint inventor can contractually assign away all of his rights in the invention. However, if he retains any ownership interest at all, even as little as one percent, he has a right to protect that interest by entering into license agreements with manufacturers, or by exploiting the invention himself. In fact, unless otherwise stated in a contract, he may enter into such license agreements without your permission. However, if he does so, he must share with you any income or royalty he earns from any such license agreement.

If you have signed an employment agreement in which you pre-assigned to your employer all rights in job-related inventions, you may not have any rights in the invention at all. In such cases, you should first obtain a written waiver or release from your employer before you spend any money on a patent application.

Types of Patents

There are three different types of patents: **utility patents**, **design patents**, and **plant patents**.

The Patent Office grants **utility patents** to "anyone who invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof." The term "process" means a process or method; you may patent new industrial or technical processes or methods. The term "manufacture" refers to manufactured articles. "Composition of matter" relates to chemical compositions, and may include mixtures of ingredients as well as chemical compounds.

The Patent Office grants **design patents** to anyone who invents a new, original, and ornamental design for an article of manufacture. The patent laws protect the appearance of the article, not its function (for this reason, seek design patent protection only when the ornamental features of your invention are unique and commercially valuable).

The Patent Office grants **plant patents** to any person who has invented or discovered and asexually reproduced any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber-propagated plant or a plant found in an uncultivated state.

Design Patents vs. Utility Patents

Design patents, under certain circumstances, may be more effective than utility patents in protecting your intellectual property. Because the patent laws base design patent protection on the ornamental appearance of the invention, design patents are almost always easier to obtain than utility patents. Provided that the appearance of your "article of manufacture" is not solely dictated by its function, the patent laws consider that its appearance is ornamental and therefore patentable, provided also that the article of manufacture is useful, and the ornamental aspect is novel and not obvious to the designer of ordinary skill in the art. In addition, compared to utility patents, design patents are significantly less expensive to obtain and to maintain in force. The cost for filing a design patent application begins at about \$800. Unlike utility patents, the patent laws do not require you to pay maintenance fees.

The right to file and maintain an action for patent infringement is the essence of patent protection. With design patents, the criteria for judging infringement are more subjective than in utility patent cases. This uncertainty often favors the patent owner. In addition, the design patent holder may elect to recover total profits. The recovery of total profits is not available in a utility patent infringement case. The potential for such a recovery adds to the effectiveness of a design patent as a deterrent to infringement. For example, a court ordered Waring, the blender company, to pay Braun more than \$1,000,000 for its infringement of a Braun design patent for a tapered household blender design. *Braun v. Dynamics Corp of America*, 975 F.2d 815 (Fed. Cir 1992). On the other hand, because utility patent claims cover a wide variety of designs, regardless of the ornamental appearance of any particular design, utility patents are generally broader than design patents. Therefore, a utility patent is generally the most desirable type of patent.

Patent Protection in Foreign Countries

A U.S. patent gives you the right to sue anyone who makes, uses, or sells your invention within the United States, its territories, and possessions. If you desire protection in foreign countries, you must file patent applications in those countries. However, many foreign patent laws bar the grant of a patent if, before you filed in the foreign country, you displayed, sold to the public, or described your invention in a printed publication anywhere in the world. Therefore, early in the patent process, you should decide whether or not to seek foreign patent protection.

In addition, the exclusive right to exclude others from selling your invention, which your U.S. patent grants, can sometimes deter a potential overseas competitor from entering the overseas market. This indirect benefit of a U.S. patent depends on the economies of scale in the world market, and the relative proportion of the U.S. market. If the U.S. market for the invention is a substantial proportion of the world market for the invention, and if a potential competitor must make a significant investment in overhead and fixed costs in order to produce the product at a competitive price, the foreign demand alone may not be sufficient to justify the products overseas manufacture. Further, the sale of a product in the U.S., which an overseas manufacturer manufactured using a process covered by a U.S. patent, infringes the U.S. patent. [35 U.S.C. A7 271(g)]. This illustrates a special advantage of a process patent over other, more common, utility patents.

2.0 A Guide to Filing a *Utility Patent* Application

U.S. Patent and Trademark Office (as of 10-17-00)

- 2.1 Introduction
- 2.2 Nonprovisional Utility Patent Application Requirements
- 2.3 Utility Patent Application Transmittal Form Or Transmittal Letter
- 2.4 Fee Transmittal Form And Appropriate Fee
- 2.5 Specification
 - 2.5.1 Title Of Invention
 - 2.5.2 Cross-Reference To Related Applications
 - 2.5.3 Statement Regarding Federally Sponsored Research Or Development
 - 2.5.4 Reference To A Microfiche Appendix
 - 2.5.5 Background Of The Invention
 - 2.5.6 Brief Summary Of The Invention
 - 2.5.7 Brief Description Of The Several Views Of The Drawing
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- 2.9 Obtaining A Receipt For Documents Mailed To The Pto
- 2.10 Drawing Requirements
- 2.11 Identification Of Drawings
- 2.12 Graphic Forms In Drawings
- 2.13 Paper
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 - 2.14.1 Exploded Views
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 - 2.14.3 Sectional Views
 - 2.14.4 Alternate Position
 - 2.14.5 Modified Forms
- 2.15 Arrangement Of Views
- 2.16 View For The Official Gazette
- 2.17 Scale
- 2.18 Character Of Lines, Numbers, And Letters
- 2.19 Shading
- 2.20 Symbols
- 2.21 Legends
- 2.22 Numbers, Letters, And Reference Characters
- 2.23 Lead Lines And Arrows
- 2.24 Copyright Or Mask Work Notice
- 2.25 Numbering Of Sheets Of Drawings And Views
- 2.26 Security Markings
- 2.27 Corrections
- 2.28 Holes

2.1 INTRODUCTION

The U.S. Patent and Trademark Office (PTO) is the government agency responsible for examining patent applications and issuing patents. A patent is a type of property right. It gives the patent holder the right, for a limited time, to exclude others from making, using, or selling the subject matter that is within the scope of protection granted by the patent. The PTO determines whether a patent should be granted in a particular case. However, it is up to the patent holder to enforce his or her own rights if the PTO does grant a patent.

The purpose of this guide is to provide you with basic information about filing a utility patent application. A patent application is a complex legal document, best prepared by one trained to prepare such documents. Thus, after reviewing this guide, you may wish to consult with a patent attorney or agent. Additional information is available:

- by calling the PTO's General Information Services at +1-800-PTO-9199 or +1-703-308-4357,
- from the PTO's Web site at www.uspto.gov, and
- at your nearest Patent and Trademark Depository Library (PTDL).

There are various types of patents—utility, design, and plant. There are also two types of utility patent application—provisional and nonprovisional. Each year the PTO receives approximately 200,000 patent applications. Most of these are for nonprovisional utility patents.

This guide contains information to assist you in filing your nonprovisional utility patent application. It discusses the required parts of the utility patent application and includes samples of some of the forms you may use. This information is generally derived from the Patent Act, found at Title 35 of the *United States Code* (U.S.C.), and Title 37 of the *Code of Federal Regulations* (CFR). These materials are available at PTDLs and at most law libraries.

If you have questions about:

- other types of patent applications,
- locating a patent attorney or agent,
- obtaining the most up-to-date *Fee Schedule*, or
- obtaining copies of other PTO publications,

please contact General Information Services, the PTO Web's site, or a PTDL.

2.2 NONPROVISIONAL UTILITY PATENT APPLICATION REQUIREMENTS

A nonprovisional utility patent application must be in the English language or be accompanied by a verified translation in the English language and a fee set forth in 37 CFR §1.17(k) [Non-English Specification Fee Code 139].

All papers which are to become part of the permanent records of the PTO must be typewritten or produced by a mechanical (or computer) printer. The text must be in permanent black ink or its equivalent; on but one side of the paper; in portrait orientation; on white paper that is all of the same size, flexible, strong, smooth, nonshiny, durable, and without holes. The paper size must be either:

- 21.6 cm. by 27.9 cm. (8½ by 11 inches), or
- 21.0 cm. by 29.7 cm. (DIN size A4).

There must be a left margin of at least 2.5 cm. (1 inch) and top, right, and bottom margins of at least 2.0 cm. (¾ inch). Drawing page requirements are discussed separately below.

A nonprovisional utility patent application must include a specification, including a claim or claims; drawings, when necessary; an oath or declaration; and the prescribed filing fee. A complete nonprovisional utility patent application should contain the elements listed below, arranged in the order shown.

- Utility Patent Application Transmittal Form or Transmittal Letter
- Fee Transmittal Form and Appropriate Fee
- Specification
- Drawings (when necessary)
- Oath or Declaration
- Sequence Listing (when necessary)

These elements are further described as follows:

2.3 Utility Patent Application Transmittal Form or Transmittal Letter

A Utility Patent Application Transmittal form (Form PTO/SB/05) or a transmittal letter should be filed with every patent application to instruct the PTO on the services desired in the processing of the application. It identifies the name of the applicant, the type of application, the title of the invention, the contents of the application, and any accompanying enclosures. (Form PTO/SB/21 is to be used for all correspondence after initial filing.)

2.4 Fee Transmittal Form and Appropriate Fee

The Fee Transmittal form (Form PTO/SB/17) should be used to calculate the prescribed fee and indicate the method of payment.

Fees for a patent application should be submitted with the application and must be made payable to the "Commissioner of Patents and Trademarks." If an application is filed without the basic filing fee, the applicant will be notified and will be required to submit the filing fee along with a surcharge within the time period set in the notice. Fees are subject to change and the applicant should consult the current *Fee Schedule* before filing.

Please note that two sets of fees exist, one for small entities and one for other than small entities. If you qualify as a small entity for patent fee purposes, you must file the appropriate small entity statement (Form PTO/SB/09, PTO/SB/10, PTO/SB/11, or PTO/SB/12) to claim your entitlement to reduced fees.

2.5 Specification

The specification is a written description of the invention and of the manner and process of making and using the same. The specification must be in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which the invention pertains to make and use the same.

Computer program listings, when required to be submitted as part of the specification, must be direct printouts (not copies) from the computer's printer with dark, solid black letters not less than 0.21 cm. (0.08 inch) high (elite type), on white, unshaded and unlined paper; and the sheets should be submitted in a protective cover.

The pages of the specification (but not the transmittal letter sheets or other forms), including claims and abstract, should be numbered consecutively, starting with 1. The page numbers should be centrally located preferably below the text. The lines of the specification must be 1.5 or double spaced (lines of text not comprising the specification need not be 1.5 or double spaced). It is desirable to include an indentation at the beginning of each new paragraph.

It is preferable to use all of the section headings described below to represent the parts of the specification. Section headings should be in upper case without underlining or bold type. If the section contains no text, the phrase "Not Applicable" should follow the section heading.

2.5.1 Title of Invention

The title of the invention (or an introductory portion stating the name, citizenship, residence of each applicant, and the title of the invention) should appear as the heading on the first page of the specification. The title should be brief but technically accurate and descriptive. It is preferred that the title not exceed 280 typewritten spaces.

2.5.2 Cross-Reference to related Applications

Any nonprovisional utility patent application claiming the benefit of one or more prior filed copending nonprovisional applications (or international applications designating the United States of America) must contain in the first sentence of the specification following the title, a reference to each such prior application, identifying it by the application number (consisting of the series code and serial number) or international application number and international filing date, and indicating the relationship of the applications. Cross-references to other related patent applications may be made when appropriate.

2.5.3 Statement regarding Federally Sponsored research or Development

The application should contain a statement as to rights to inventions made under federally sponsored research and development (if any).

2.5.4 Reference to a Microfiche Appendix

If a computer program listing printout is required and is 11 or more pages long, you must submit such listing in the form of microfiche, which will not be part of the printed patent. The total number of microfiche and total number of frames should be specified.

2.5.5 BACKGROUND OF THE INVENTION

This section should include a statement of the field of endeavor to which the invention pertains. This section may also include a paraphrasing of the applicable U.S. patent *Classification Definitions* or the subject matter of the claimed invention. In the past, this part of this section may have been titled "Field of Invention" or "Technical Field."

This section should also contain a description of information known to you, including references to specific documents, which are related to your invention. It should contain, if applicable, references to specific problems involved in the prior art (or state of technology) which are solved by your invention. In the past, this section may have been titled "Description of the Related Art" or "Description of Prior Art."

2.5.6 Brief Summary of the Invention

This section should present the substance or general idea of the claimed invention in summarized form. The summary may point out the advantages of the invention and how it solves previously existing problems, preferably those problems identified in the BACKGROUND OF THE INVENTION. A statement of the object of the invention may also be included.

2.5.7 Brief Description of the Several Views of the Drawing

Where there are drawings, you must include a listing of all figures by number and with corresponding statements explaining what each figure depicts.

2.5.8 Detailed Description of the Invention

In this section, the invention must be explained along with the process of making and using the invention in full, clear, concise, and exact terms. This section should distinguish the invention from other inventions and from what is old; and describe completely the process, machine, manufacture, composition of matter, or improvement invented. In the case of an improvement, the description should be confined to the specific improvement and to the parts which necessarily cooperate with it or which are necessary to completely understand the invention.

It is required that the description be sufficient so that any person of ordinary skill in the pertinent art, science, or area could make and use the invention without extensive experimentation. The best mode contemplated by you of carrying out your invention must be set forth in the description. Each element in the drawings should be mentioned in the description. This section has often, in the past, been titled "Description of the Preferred Embodiment."

2.5.9 Claim or Claims

The claim or claims must particularly point out and distinctly claim the subject matter which you regard as the invention. The claims define the scope of the protection of the patent. Whether a patent will be granted is determined, in large measure, by the choice of wording of the claims.

A nonprovisional application for a utility patent must contain at least one claim. The claim or claims section must begin on a separate sheet. If there are several claims, they shall be numbered consecutively in Arabic numerals, with the least restrictive claim presented as claim number 1.

The claims section must begin with a statement such as "What I claim as my invention is: . . ." or "I (We) claim: . . ." followed by the recitation of the particular matter which you regard as your invention.

One or more claims may be presented in dependent form, referring back to and further limiting another claim or claims in the same application. All dependent claims should be grouped together with the claim or claims to which they refer to the extent practicable. Any dependent claim which refers to more than one other claim ("a multiple dependent claim") shall refer to such other claims in the alternative only. Each claim should be a single sentence, and where a claim sets forth a number of elements or steps, each element or step of the claim should be separated by a line indentation.

The fee required to be submitted with a nonprovisional utility patent application is, in part, determined by the number of claims, independent claims, and dependent claims.

2.5.10 Abstract of the Disclosure

The purpose of the abstract is to enable the PTO and the public to determine quickly the nature of the technical disclosures of your invention. The abstract points out what is new in the art to which your invention pertains; however, it will not be used for interpreting the scope of the claim(s). It should be in narrative form and generally limited to a single paragraph, and it must begin on a separate page.

2.6 Drawings (when necessary)

A patent application is required to contain drawings if drawings are necessary for the understanding of the subject matter sought to be patented. The drawings must show every feature of the invention as specified in the claims. Omission of drawings may cause an application to be considered incomplete. Please see the detailed discussion of drawing requirements.

2.7 Oath Or Declaration

The oath or declaration (Forms PTO/SB/01, PTO/SB/02A, PTO/SB/02B, and PTO/SB/02C) must identify the application with which it is associated, and must give the name, city and either state or country of residence, country of citizenship, and post office address of each inventor. It must state whether the inventor is a sole or joint inventor of the invention claimed.

Additionally, designation of a correspondence address is needed on the oath or declaration. Providing a correspondence address will help to ensure prompt delivery of all notices, official letters, and other communications.

The oath or declaration must be signed by all of the actual inventors. An oath may be administered by any person within the United States, or by a diplomatic or consular officer of a foreign country, who is authorized by the United States to administer oaths. A declaration does not require any witness or person to administer or verify its signing. Thus, use of a declaration is preferable.

The oath or declaration must be in a language which you understand. If you comprehend the English language, you should preferably use an English language oath or declaration. If you cannot comprehend English, any oath or declaration must be in a language which you can comprehend and shall state that you understand the content of any documents to which the oath or declaration relates. If the oath or declaration used is in a language other than English, the oath or declaration must either be (1) accompanied by a verified English translation, or (2) in a form provided or approved by the Patent and Trademark Office.

If the person making the oath or declaration is not the inventor, the oath or declaration shall state the relationship of that person to the inventor, upon information and belief, the facts which the inventor would have been required to state, and the circumstances which render the inventor unable to sign, namely death, insanity or legal incapacity or unavailability/refusal to sign. (See 37 CFR §§1.42, 1.43, and 1.47)

2.8 Sequence Listing (when necessary)

This section, for the disclosure of a nucleotide and/or amino acid sequence, should contain a listing of the sequence complying with 37 CFR §1.821 through 37 CFR §1.825.

2.9 Obtaining a Receipt for Documents mailed to the PTO

A receipt for documents mailed to the PTO can be obtained by attaching a stamped, self-addressed postcard to the first page of the documents. The postcard should contain a detailed list that identifies each type of document and the number of pages of each document. Upon receipt at PTO, the detailed list on the postcard will be compared to the actual contents of the delivery. Any discrepancies between the detailed list and the actual contents will be noted on the postcard. The postcard will be initialed and date stamped by the person at PTO who received the delivery. The postcard will be returned by mail to the addressee whose name appears on the postcard.

The returned postcard serves as evidence of receipt in the PTO of all items listed on the postcard, unless otherwise noted by PTO on the postcard. That is, if the postcard receipt has been annotated to indicate that a particular paper was not received, the postcard receipt will not serve as evidence of receipt of that paper in the PTO. Likewise, the postcard receipt will not serve as evidence of receipt of papers which are not adequately itemized.

When preparing the detailed list of documents identified on the postcard, it is important to include the following identifying information:

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- the application number (if known)
- the filing date of the application (if known)
- the title of the invention
- the name of the inventor or inventors

The postcard should also include a detailed list of every document type and the number of pages of each document that are included in the delivery. If the postcard is submitted with a patent application, the detailed listing should include the following items:

- the title and number of pages of each PTO form
- the number of pages of specification (excluding claims)
- the number of claims and the number of claims pages
- the number of figures of drawing and the number of sheets of drawing
- whether oath or declaration statement is included
- the type and number of other documents that are included
- the amount of payment and the method of payment (i.e., check, money order, deposit account)

It is important that the postcard itemize each component of the application. For example, a general statement such as "complete application" or "patent application" or "drawings" will not show that each of the required components of an application was included if one of the items is later found to be missing by PTO.

When the self-addressed postcard is submitted with a utility patent application, the PTO will stamp the postcard being returned to the addressee with both the receipt date and the application number before placing it in the outgoing mail.

Upon receipt of the returned postcard, the addressee should promptly review the postcard to ensure that all documents and all pages were received by PTO.

2.10 Drawing Requirements

Information on drawing requirements is based substantially on Title 37, Code of Federal Regulations, (CFR) §1.84. There are two acceptable categories for presenting drawings in utility patent applications: black ink (black and white) and color.

Black and white drawings are normally required. India ink, or its equivalent that secures black solid lines, must be used for drawings. Drawings made by computer printer must be originals, not photocopies.

On rare occasions, color drawings may be necessary as the only practical medium by which the subject matter sought to be patented in a utility patent application is disclosed. The PTO will accept color drawings in utility patent applications and statutory invention registrations only after granting a petition explaining why the color drawings are necessary. Any such petition must include the following:

- the appropriate fee set forth in 37 CFR §1.17(i) [or Patent Petition Fee Code 122];
- three (3) sets of color drawings; and
- the following language as the first paragraph in that portion of the specification relating to the BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING. If the language is not in the specification, a proposed amendment to insert the language must accompany the petition.

"The file of this patent contains at least one drawing executed in color. Copies of this patent with color drawing(s) will be provided by the Patent and Trademark Office upon request and payment of the necessary fee."

Photographs are not ordinarily permitted in utility patent applications. However, the PTO will accept black and white photographs in utility patent applications only in applications in which the invention is not capable of being illustrated in an ink drawing or where the invention is shown more clearly in a photograph. For example, photographs or photomicrographs of electrophoresis gels, blots (e.g., immunological, western, Southern, and northern), autoradiographs, cell cultures (stained and unstained), histological tissue cross sections (stained and unstained), animals, plants, in vivo imaging, thin layer chromatography plates, crystalline structures, and ornamental effects continue to be acceptable. Only one set of black and white photographs is required. Furthermore, no additional processing fee is required.

Photographs must either be developed on double weight photographic paper or be permanently mounted on Bristol board. The photographs must be of sufficient quality so that all details in the drawing are reproducible in the printed patent.

Color photographs will be accepted in utility patent applications if the conditions for accepting color drawings have been satisfied.

2.11 Identification of Drawings

Identifying indicia, if provided, should include the application number or the title of the invention, your name, docket number (if any), and the name and telephone number of a person to call if the PTO is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawings a minimum distance of 1.5 cm. ($\frac{5}{8}$ inch) down from the top of the page. In addition, a reference to the application number (or, if an application number has not been assigned, your name) may be included in the left hand corner of the drawing sheet, provided that reference appears within 1.5 cm. ($\frac{5}{8}$ inch) from the top of the sheet.

2.12 Graphic Forms in Drawings

Chemical or mathematical formulas, tables, computer program listings, and waveforms may be submitted as drawings and are subject to the same requirements as drawings. Each chemical or mathematical formula must be labeled as a separate figure, using brackets when necessary, to show that information is properly integrated. Each group of waveforms must be presented as a single figure, using a common vertical axis with time extending along the horizontal axis. Each individual waveform discussed in the specification must be identified with a separate letter designation adjacent to the vertical axis. These may be placed in a landscape orientation if they cannot be presented satisfactorily in a portrait orientation. Typewritten characters used in such formulas and tables must be chosen from a block (nonscript) type font or lettering style having capital letters which are at least 0.21 cm. (0.08 inch) high (elite type). A space at least 0.64 cm. ($\frac{1}{4}$ inch) high should be provided between complex formulas or tables and the text.

2.13 Paper

Drawings submitted to the PTO must be made on paper which is flexible, strong, white, smooth, nonshiny, and durable. All sheets must be free from cracks, creases, and folds. Only one side of the sheet shall be used for the drawing. Each sheet must be reasonably free from erasures and must be free from alterations, overwritings, and interlineations. Photographs must either be developed on double weight photographic paper or be permanently mounted on Bristol board.

All drawings sheets in an application must be the same size. One of the shorter sides of the sheet is regarded as its top. The size of the sheets on which drawings are made must be:

- 21.6 cm. by 27.9 cm. ($8\frac{1}{2}$ by 11 inches), or

- 21.0 cm. by 29.7 cm. (DIN size A4).

The sheets must not contain frames around the sight (the usable surface), but should have scan target points (cross hairs) printed on two catercorner margin corners. The following margins are required:

- On 21.6 cm. by 27.9 cm. ($8\frac{1}{2}$ by 11 inch) drawing sheets, each sheet must include a top margin of at least 2.5 cm. (1 inch), a left side margin of at least 2.5 cm. (1 inch), a right side margin of at least 1.5 cm. ($\frac{5}{8}$ inch), and a bottom margin of at least 1.0 cm. ($\frac{3}{8}$ inch) from the edges, thereby leaving a sight no greater than 17.6 cm. by 24.4 cm. ($6\frac{15}{16}$ by $9\frac{5}{8}$ inches).
- On 21.0 cm. by 29.7 cm. (DIN size A4) drawing sheets, each sheet must include a top margin of at least 2.5 cm. (1 inch), a left side margin of at least 2.5 cm. (1 inch), a right side margin of at least 1.5 cm ($\frac{5}{8}$ inch), and a bottom margin of at least 1.0 cm. ($\frac{3}{8}$ inch) from the edges, thereby leaving a sight no greater than 17.0 cm. by 26.2 cm.

2.14 Views

The drawing must contain as many views as necessary to show the invention. The views may be plan, elevation, section, or perspective views. Detail views of portions of elements, on a larger scale if necessary, may also be used. All views of the drawing must be grouped together and arranged on the sheet(s) without wasting space, preferably in an upright position, clearly separated from one another, and must not be included in the sheets containing the specifications, claims, or abstract. Views must not be connected by projection lines and must not contain center lines. Waveforms of electrical signals may be connected by dashed lines to show the relative timing of the waveforms.

2.14.1 Exploded Views

Exploded views, with the separated parts embraced by a bracket, to show the relationship or order of assembly of various parts are permissible. When an exploded view is shown in a figure which is on the same sheet as another figure, the exploded view should be placed in brackets.

2.14.2 Partial Views

When necessary, a view of a large machine or device in its entirety may be broken into partial views on a single sheet, or extended over several sheets if there is no loss in facility of understanding the view. Partial views drawn on separate sheets must always be capable of being linked edge to edge so that no partial view contains parts of another partial view. A smaller scale view should be included showing the whole formed by the partial views and indicating the positions of the parts shown. When a portion of a view is enlarged for magnification purposes, the view and the enlarged view must each be labeled as separate views.

Where views on two or more sheets form, in effect, a single complete view, the views on the several sheets must be so arranged that the complete figure can be assembled without concealing any part of any of the views appearing on the various sheets.

A very long view may be divided into several parts placed one above the other on a single sheet. However, the relationship between the different parts must be clear and unambiguous.

2.14.3 Sectional Views

The plane upon which a sectional view is taken should be indicated on the view from which the section is cut by a broken line. The ends of the broken line should be designated by Arabic or Roman numerals corresponding to the view number of the sectional view, and should have arrows to indicate the direction of sight. Hatching must be used to indicate section portions of an object, and must be made by regularly spaced oblique parallel lines spaced sufficiently apart to enable the lines to be distinguished without difficulty. Hatching should not

impede the clear reading of the reference characters and lead lines. If it is not possible to place reference characters outside the hatched area, the hatching may be broken off wherever reference characters are inserted. Hatching must be at a substantial angle to the surrounding axes or principal lines, preferably 45°.

A cross section must be set out and drawn to show all of the materials as they are shown in the view from which the cross section was taken. The parts in cross section must show proper material(s) by hatching with regularly spaced parallel oblique strokes; the space between strokes being chosen on the basis of the total area to be hatched. The various parts of a cross section of the same item should be hatched in the same manner and should accurately and graphically indicate the nature of the material(s) illustrated in cross section.

The hatching of juxtaposed different elements must be angled in a different way. In the case of large areas, hatching may be confined to an edging drawn around the entire inside of the outline of the area to be hatched. Different types of hatching should have different conventional meanings as regards the nature of a material seen in cross section.

2.14.4 Alternative Position

A moved position may be shown by a broken line superimposed upon a suitable view if this can be done without crowding; otherwise, a separate view must be used for this purpose. Alternate Position

2.14.5 Modified Forms

Modified forms of construction must be shown in separate views.

2.15 Arrangement of Views

One view must not be placed upon another or within the outline of another. All views on the same sheet should stand in the same direction and, if possible, stand so that they can be read with the sheet held in an upright position. If views wider than the width of the sheet are necessary for the clearest illustration of the invention, the sheet may be turned on its side so that the top of the sheet is on the right-hand side, with the appropriate top margin used as the heading space. Words must appear in a horizontal, left-to-right fashion when the page is either upright or turned so that the top becomes the right side, except for graphs utilizing standard scientific convention to denote the axis of abscissas (of X) and the axis of ordinates (of Y).

2.16 View for the Official Gazette

One of the views should be suitable for publication in the *Official Gazette* as the illustration of the invention.

2.17 Scale

The scale to which a drawing is made must be large enough to show the mechanism without crowding when the drawing is reduced in size to two-thirds in reproduction. Views of portions of the mechanism on a larger scale should be used when necessary to show details clearly. Two or more sheets may be used if one does not give sufficient room. The number of sheets should be kept to a minimum.

When approved by the examiner, the scale of the drawing may be graphically represented. Indications such as "actual size" or "scale $\frac{1}{2}$ " are not permitted on the drawings since these lose their meaning with reproduction in a different format.

Elements of the same view must be in proportion to each other, unless a difference in proportion is indispensable for the clarity of the view. Instead of showing elements in different proportion, a supplementary view may be added giving a larger-scale illustration of the element of the initial view. The

enlarged element shown in the second view should be surrounded by a finely drawn or "dot-dash" circle in the first view indicating its location without obscuring the view.

2.18 Character of Lines, Numbers, and Letters

All drawings must be made by a process which will give them satisfactory reproduction characteristics. Every line, number, and letter must be durable, clean, black (except for color drawings), sufficiently dense and dark, and uniformly thick and well-defined. The weight of all lines and letters must be heavy enough to permit adequate reproduction. This requirement applies to all lines however fine, to shading, and to lines representing cut surfaces in sectional views. Lines and strokes of different thicknesses may be used in the same drawing where different thicknesses have a different meaning.

2.19 Shading

The use of shading in views is encouraged if it aids in understanding the invention and if it does not reduce legibility. Shading is used to indicate the surface or shape of spherical, cylindrical, and conical elements of an object. Flat parts may also be lightly shaded. Such shading is preferred in the case of parts shown in perspective, but not for cross sections. See discussion of sectional views above. Spaced lines for shading are preferred. These lines must be thin, as few in number as practicable, and they must contrast with the rest of the drawings. As a substitute for shading, heavy lines on the shade side of objects can be used except where they superimpose on each other or obscure reference characters. Light should come from the upper left corner at an angle of 45°. Surface delineations should preferably be shown by proper shading. Solid black shading areas are not permitted, except when used to represent bar graphs or color.

2.20 Symbols

Graphical drawing symbols may be used for conventional elements when appropriate. The elements for which such symbols and labeled representations are used must be adequately identified in the specification. Known devices should be illustrated by symbols which have a universally recognized conventional meaning and are generally accepted in the art. Other symbols which are not universally recognized may be used, subject to approval by the PTO, if they are not likely to be confused with existing conventional symbols, and if they are readily identifiable.

2.21 Legends

Suitable descriptive legends may be used, or may be required by the examiner, where necessary for understanding of the drawing, subject to approval by the PTO. They should contain as few words as possible.

2.22 Numbers, Letters, and Reference Characters

The English alphabet must be used for letters, except where another alphabet is customarily used, such as the Greek alphabet to indicate angles, wavelengths, and mathematical formulas.

Reference characters (numerals are preferred), sheet numbers, and view numbers must be plain and legible, and must not be used in association with brackets or inverted commas, or enclosed within outlines (encircled). They must be oriented in the same direction as the view so as to avoid having to rotate the sheet. Reference characters should be arranged to follow the profile of the object depicted.

Numbers, letters, and reference characters must measure at least 0.32 cm. ($\frac{1}{8}$ inch) in height. They should not be placed in the drawing so as to interfere with its comprehension. Therefore, they should not cross or mingle with the lines. They should not be placed upon hatched or shaded surfaces. When necessary, such as indicating a surface or cross section, a reference character may be underlined and a blank space may be left in the hatching or shading where the character occurs so that it appears distinct.

The same part of an invention appearing in more than one view of the drawing must always be designated by the same reference character, and the same reference character must never be used to designate different parts.

Reference characters not mentioned in the description shall not appear in the drawings. Reference characters mentioned in the description must appear in the drawings.

2.23 Lead Lines and Arrows

Lead lines are those lines between the reference characters and the details to which they refer. Such lines may be straight or curved and should be as short as possible. They must originate in the immediate proximity of the reference character and extend to the feature indicated. Lead lines must not cross each other. Lead lines are required for each reference character except for those which indicate the surface or cross section on which they are placed. Such a reference character must be underlined to make it clear that a lead line has not been left out by mistake. Lead lines must be executed in the same way as lines in the drawing.

Arrows may be used at the ends of lines, provided that their meaning is clear, as follows:

- on a lead line, a freestanding arrow to indicate the entire section towards which it points;
- on a lead line, an arrow touching a line to indicate the surface shown by the line looking along the direction of the arrow; or
- to show the direction of movement.

2.24 Copyright or Mask Work Notice

A copyright or mask work notice may appear in the drawing, but must be placed within the sight of the drawing immediately below the figure representing the copyright or mask work material and be limited to letters having a print size of 0.32 cm. to 0.64 cm. ($\frac{1}{8}$ to $\frac{1}{4}$ inches) high. The content of the notice must be limited to only those elements provided for by law. For example, "©1983 John Doe" (17 U.S.C. 401) and "*M* John Doe" (17 U.S.C. 909) would be properly limited and, under current statutes, legally sufficient notices of copyright and mask work, respectively. Inclusion of a copyright or mask work notice will be permitted only if the authorization language set forth in 37 CFR §1.71(e) is included at the beginning (preferably as the first paragraph) of the specification.

2.25 Numbering of Sheets of Drawings and Views

The sheets of drawings should be numbered in consecutive Arabic numerals, starting with 1, within the sight (the usable surface). These numbers, if present, must be placed in the middle of the top of the sheet, but not in the margin. The numbers can be placed on the right-hand side if the drawing extends too close to the middle of the top edge of the usable surface. The drawing sheet numbering must be clear and larger than the numbers used as reference characters to avoid confusion. The number of each sheet should be shown by two Arabic numerals placed on either side of an oblique line, with the first being the sheet number and the second being the total number of sheets of drawings, with no other marking.

The different views must be numbered in consecutive Arabic numerals, starting with 1, independent of the numbering of the sheets and, if possible, in the order in which they appear on the drawing sheet(s). Partial views intended to form one complete view, on one or several sheets, must be identified by the same number followed by a capital letter. View numbers must be preceded by the abbreviation **FIG.** Where only a single view is used in an application to illustrate the claimed invention, it must not be numbered and the abbreviation **FIG.** must not appear.

Numbers and letters identifying the views must be simple and clear and must not be used in association with brackets, circles, or inverted commas. The view numbers must be larger than the numbers used for reference characters.

2.26 Security Markings

Authorized security markings may be placed on the drawings provided they are outside the sight, preferably centered in the top margin.

2.27 Corrections

Any corrections on drawings submitted to the PTO must be durable and permanent.

2.28 Holes

No holes should be made by the applicant in the drawing sheets.

3.0 A Guide to Filing A Design Patent Application

U.S. Patent and Trademark Office (as of 10-17-00)

- 3.1 Definition of a Design**
- 3.2 Types of Designs and Modified Forms**
- 3.3 Difference Between Design and Utility Patents**
- 3.4 Improper Subject Matter for Design Patents**
- 3.5 Invention Development Organizations**
- 3.6 Elements of a Design Patent Application**
- 3.7 The Preamble**
- 3.8 The Title**
- 3.9 The Figure Descriptions**
- 3.10 A Single Claim**
- 3.11 Drawings or Photographs**
- 3.12 The Views**
- 3.13 Surface Shading and Drafting Symbols**
- 3.14 Broken Lines**
- 3.15 Photographs**
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- 3.17 Disclosure Examples**
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- 3.19 Drawing Examples**
- 3.20 Symbols for Draftsmen**
- 3.21 Patent Laws That Apply to Design Patent Applications**
- 3.22 Rules That Apply to the Drawings of a Design Patent Application**
- 3.23 Sample Specification**

3.1 Definition of a Design

A design consists of the visual ornamental characteristics embodied in, or applied to, an article of manufacture. Since a design is manifested in appearance, the subject matter of a design patent application may relate to the configuration or shape of an article, to the surface ornamentation applied to an article, or to the combination of configuration and surface ornamentation. A design for surface ornamentation is inseparable from the article to which it is applied and cannot exist alone. It must be a definite pattern of surface ornamentation, applied to an article of manufacture.

The Patent Law provides for the granting of design patents to any person who has invented any new, original and ornamental design for an article of manufacture. A design patent protects only the appearance of the article and not its structural or utilitarian features. The principal statutes (United States Code) governing design patents are:

35 U.S.C. 171

35 U.S.C. 173

35 U.S.C. 102

35 U.S.C. 103

35 U.S.C. 112

35 U.S.C. 132

The rules (Code of Federal Regulations) pertaining to the drawing disclosure of a design patent application are:

37 CFR § 1.84

37 CFR § 1.152

37 CFR § 1.121

The following additional rules have been referred to in this guide:

37 CFR § 1.3

37 CFR § 1.63

37 CFR § 1.153

A copy of these laws and rules are included in the Appendix of this guide.

The practice and procedures relating to design patent applications are set forth in chapter 1500 of the Manual of Examining Procedure (MPEP). Inquiries relating to the sale of the MPEP should be directed to the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402. Telephone: +1-202-512-1800.

3.2 Types of Designs and Modified Forms

An ornamental design may be embodied in an entire article or only a portion of an article, or may be ornamentation applied to an article. If a design is directed to just surface ornamentation, it must be shown applied to an article in the drawings, and the article must be shown in broken lines, as it forms no part of the claimed design.

A design patent application may only have a single claim. 37 CFR § 1.153. Designs that are independent and distinct must be filed in separate applications since they cannot be supported by a single claim. Designs are independent if there is no apparent relationship between two or more articles. For example, a pair of

eyeglasses and a door handle are independent articles and must be claimed in separate applications. Designs are considered distinct if they have different shapes and appearances even though they are related articles. For example, two vases having different surface ornamentation creating distinct appearances must be claimed in separate applications. However, modified forms, or embodiments of a single design concept may be filed in one application. For example, vases with only minimal configuration differences may be considered a single design concept and both embodiments may be included in a single application. An example of modified forms appears in Appendix II.

3.3 The Difference Between Design and Utility Patents

In general terms, a "utility patent" protects the way an article is used and works (35 U.S.C. 101), while a "design patent" protects the way an article looks (35 U.S.C. 171). Both design and utility patents may be obtained on an article if invention resides both in its utility and ornamental appearance. While utility and design patents afford legally separate protection, the utility and ornamentality of an article are not easily separable. Articles of manufacture may possess both functional and ornamental characteristics.

3.4 Improper Subject Matter for Design Patents

A design for an article of manufacture that is dictated primarily by the function of the article lacks ornamentality and is not proper statutory subject matter under 35 U.S.C. 171. Similarly, a design for an article of manufacture that is hidden in its end use and whose ornamental appearance is of no commercial concern prior to reaching its end use, lacks ornamentality and is not proper statutory subject matter under 35 U.S.C. 171. In addition, 35 U.S.C. 171 requires that a design to be patentable must be "original". Clearly a design which simulates a well-known, or naturally occurring object or person is not original as required by the statute. Furthermore, subject matter that could be considered offensive to any race, religion, sex, ethnic group, or nationality is not proper subject matter for a Design Patent Application (35 U.S.C. 171 and 37 CFR § 1.3).

3.5 Invention Development Organizations

Invention Development Organizations (IDO) are private and public consulting and marketing businesses that exist to help inventors bring their inventions to market, or to otherwise profit from their ideas. While many of these organizations are legitimate, some are not. Be wary of any IDO that is willing to promote your invention or product without making a detailed inquiry into the merits of your idea and giving you a full range of options which may or may not include the pursuit of patent protection. Some IDOs will automatically recommend that you pursue patent protection for your idea with little regard for the value of any patent that may ultimately issue. For example, an IDO may recommend that you add ornamentation to your product in order to render it eligible for a design patent, but not really explain to you the purpose or effect of such a change. Because design patents protect only the appearance of an article of manufacture, it is possible that minimal differences between similar designs can render each patentable. Therefore, even though you may ultimately receive a design patent for your product, the protection afforded by such a patent may be somewhat limited. Finally, you should also be aware of the broad distinction between utility and design patents, and realize that a design patent may not give you the protection desired.

3.6 Elements of a Design Patent Application

The elements of a design patent application should include the following:

- (1) Preamble, stating name of the applicant, title of the design, and a brief description of the nature and intended use of the article in which the design is embodied;
- (2) Description of the figure(s) of the drawing;
- (3) Feature description;
- (4) A single claim;
- (5) Drawings or photographs;

(6) Executed oath or declaration.

In addition, the filing fee set forth in 37 CFR 1.16(f) is also required. See insert for schedule of current fees. If applicant is a small entity, (an independent inventor, a small business concern, or a non-profit organization), the filing fee is reduced by half if the small entity files a Statement Claiming Small Entity Status (PTO/SB/09 - see insert for sample form).

3.7 The Preamble

The Preamble, if included should state the name of the applicant, the title of the design, and a brief description of the nature and intended use of the article in which the design is embodied. All information contained in the preamble will be printed on the patent, should the claimed design be deemed patentable.

3.8 The Title

The Title of the design must identify the article in which the design is embodied by the name generally known and used by the public. Marketing designations are improper as titles and should not be used. A title descriptive of the actual article aids the examiner in developing a complete field of search of the prior art and further aids in the proper assignment of new applications to the appropriate class, subclass, and patent examiner, as well as the proper classification of the patent upon allowance of the application. It also helps the public in understanding the nature and use of the article embodying the design after the patent has been published. Thus, applicants are encouraged to provide a specific and descriptive title.

3.9 The Figure Descriptions

The Figure Descriptions indicate what each view of the drawings represents, i.e., front elevation, top plan, perspective view, etc.

Any description of the design in the specification, other than a brief description of the drawing, is generally not necessary since, as a general rule, the drawing is the design's best description. However, while not required, a special description is not prohibited.

In addition to the figure descriptions, the following types of statements are permissible in the specification:

1. Description of the appearance of portions of the claimed design which are not illustrated in the drawing disclosure (i.e., "the right side elevational view is a mirror image of the left side").
2. Description disclaiming portions of the article not shown, that form no part of the claimed design.
3. Statement indicating that any broken line illustration of environmental structure in the drawing is not part of the design sought to be patented.
4. Description denoting the nature and environmental use of the claimed design, if not included in the preamble.

3.10 A Single Claim

A design patent application may only include a single claim. The claim defines the design which applicant wishes to patent, in terms of the article in which it is embodied or applied. The claim must be in formal terms to "The ornamental design for (the article which embodies the design or to which it is applied) as shown." The description of the article in the claim should be consistent in terminology with the title of the invention.

When there is a properly included special description of the design in the specification, or a proper showing of modified forms of the design, or other descriptive matter has been included in the specification, the words "and described" should be added to the claim following the term "shown", and the claim should read "The

ornamental design for (the article which embodies the design or to which it is applied) as shown and described.”

3.11 Drawings or Photographs

The drawing disclosure is the most important element of the application. Every design patent application must include either a drawing or a photograph of the claimed design. As the drawing or photograph constitutes the entire visual disclosure of the claim, it is of utmost importance that the drawing or photograph be clear and complete, that nothing regarding the design sought to be patented is left to conjecture. The design drawing or photograph must comply with the disclosure requirements of 35 U.S.C. 112, first paragraph. To meet the disclosure requirements of 35 U.S.C. 112, the drawings or photographs must include a sufficient number of views to constitute a complete disclosure of the appearance of the design claimed.

Drawings are normally required to be in black ink on white paper. Photographs, in lieu of drawings, are permitted subject to the requirements of 37 CFR §1.84 and §1.152. Applicant should refer to these rules, included in Appendix II of this guide. These rules set forth in detail the requirements for proper drawings in a design patent application.

3.12 The Views

The drawings or photographs should contain a sufficient number of views to completely disclose the appearance of the claimed design, i.e., front, rear, right and left sides, top and bottom. While not required, it is suggested that perspective views be submitted to clearly show the appearance and shape of three dimensional designs. If a perspective view is submitted, the surfaces shown would normally not be required to be illustrated in other views if these surfaces are clearly understood and fully disclosed in the perspective.

Views that are merely duplicates of other views of the design or that are merely flat and include no ornamentality may be omitted from the drawing if the specification makes this explicitly clear. For example, if the left and right sides of a design are identical or symmetrical, a view should be provided of one side and a statement made in the drawing description that the other side is identical/symmetrical. If the bottom of the design is flat, a view of the bottom may be omitted if the figure descriptions include a statement that the bottom is flat and unornamented. The term “unornamented” should not be used to describe visible surfaces which include structure that is clearly not flat. In some cases, the claim may be directed to an entire article, but because all sides of the article may not be visible during normal use, it is not necessary to disclose them. A sectional view which more clearly brings out elements of the design is permissible, however a sectional view presented to show functional features, or interior structure not forming part of the claimed design, is neither required, nor permitted.

3.13 Surface Shading and Drafting Symbols

The drawing should be provided with appropriate surface shading which shows clearly the character and contour of all surfaces of any 3-dimensional aspects of the design. Surface shading is also necessary to distinguish between any open and solid areas of the design. Solid black surface shading is not permitted except when used to represent the black color as well as color contrast. Lack of appropriate surface shading in the drawing as filed may render the design non-enabling under 35 U.S.C. 112, first paragraph. Additionally, if the shape of the design is not evident from the disclosure as filed, the addition of surface shading after filing may be viewed as new matter. New matter is anything that is added to, or deleted from, the claim, drawings or specification, that was neither shown nor suggested in the original application (see 35 U.S.C. 132 and 37 CFR § 1.121 in Appendix III and IV, respectively).

3.14 Broken Lines

A broken line disclosure is understood to be for illustrative purposes only and forms no part of the claimed design. Structure that is not part of the claimed design, but is considered necessary to show the environment in which the design is used, may be represented in the drawing by broken lines. This includes any portion of an article in which the design is embodied or applied to that is not considered part of the claimed design.

When the claim is directed to just surface ornamentation for an article, the article in which it is embodied must be shown in broken lines.

In general, when broken lines are used, they should not intrude upon or cross the showing of the claimed design and should not be of heavier weight than the lines used in depicting the claimed design. Where a broken line showing of environmental structure must necessarily cross or intrude upon the representation of the claimed design and obscures a clear understanding of the design, such an illustration should be included as a separate figure, in addition to the other figures which fully disclose the subject matter of the design.

3.15 Photographs

The Office will accept high quality black and white photographs in design patent applications only after the granting of a petition filed under 37 CFR §1.84(b)(1) requesting that photographs be accepted. Petitions to accept photographs as drawings will be considered by the Primary Patent Examiner and will be granted if the requirements of 37 CFR § 1.84(b) are complied with. That is, the appropriate fee set forth in 37 CFR § 1.17(h) has been included and the three sets of photographs required under 37 CFR §1.84(b)(1)(ii) have been included. If other provisions of 37 CFR §1.84(b) for photographs have not been complied with (e.g., the photographs are not on double weight photographic paper, are not properly mounted, or details are not adequately reproducible), such lack of compliance will not bar the grant of a petition to accept the photographs but rather will form the basis of subsequent objection to the quality of the photographic disclosure. If the details, appearance and shape of all the features and portions of the design are not clearly disclosed in the photographs, this also will not be a bar to the grant of a petition to accept the photographs but would form the basis of a rejection of the claim under 35 U.S.C. 112, first paragraph as non-enabling.

Photographs submitted on double weight photographic paper must have the drawing figure number entered on the face of the photograph. Photographs mounted on Bristol board may have the figure number shown in black ink on the Bristol board proximate the corresponding photograph.

Photographs and ink drawings must not be combined in a formal submission of the visual disclosure of the claimed design in one application. The introduction of both photographs and ink drawings in a design application would result in a high probability of inconsistencies between corresponding elements on the ink drawings as compared with the photographs. Photographs submitted in lieu of ink drawings must not disclose environmental structure but must be limited to the claimed design itself.

Color drawings and color photographs will be accepted as formal drawings in design applications as long as they meet the requirements set forth in 37 CFR § 1.84(a)(2).

If color photographs are submitted as informal drawings and the applicant does not consider the color to be part of the claimed design, a disclaimer must be added to the specification as follows: "The color shown on the claimed design forms no part thereof." Color will be considered an integral part of the disclosed and claimed design in the absence of a disclaimer filed with the original application. If no disclaimer has been included, the omission of color in the later filed formal drawings will be treated as introducing new matter into the claim, 35 U.S.C. 132. A disclaimer may only be used when filing informal drawings as 37 CFR § 1.152(a)(2) requires that the disclosure in formal photographs be limited to the design for the article claimed.

3.16 The Oath or Declaration

The oath or declaration required of the applicant must comply with the requirements set forth in 37 CFR §1.63 (see insert for sample declaration form and see Appendix IV for a copy of the rule).

So that the applicant will better understand what constitutes a complete disclosure, examples of drawing disclosures and their accompanying specifications are provided on the following pages.

3.17 Disclosure Examples

Example 1 - Disclosure of the Entire Article

To the Commissioner of Patents and Trademarks:

Your petitioner, John Doe, a citizen of the United States and a resident of Alexandria, VA, prays that letters patent may be granted for the design for a jewelry cabinet, as set forth in the following specification. The claimed jewelry cabinet is used to store jewelry and could sit on a bureau.

Fig. 1 is a front elevational view of a jewelry cabinet showing my new design;

Fig. 2 is a rear elevational view thereof;

Fig. 3 is a left side elevational view thereof;

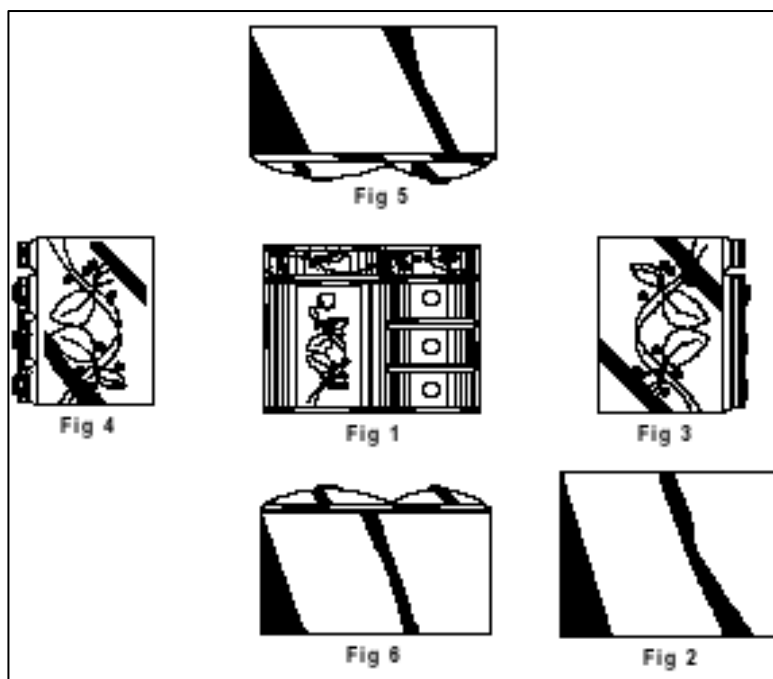
Fig. 4 is a right side elevational view thereof;

Fig. 5 is a top plan view thereof; and

Fig. 6 is a bottom plan view thereof.

I claim: the ornamental design for a jewelry cabinet as shown.

Specification



Drawing Disclosure

Example 2 - Disclosure of only the surfaces of an article that are visible during use (no bottom view or description necessary)

To the Commissioner of Patents and Trademarks:

Your petitioner, John Doe, a citizen of the United States and a resident of Alexandria, VA, prays that letters patent may be granted for the design for a jewelry cabinet, as set forth in the following specification. The claimed jewelry cabinet is used for storing jewelry and could sit on a bureau.

Fig. 1 is a front elevational view of a jewelry cabinet showing my new design;

Fig. 2 is a rear elevational view thereof;

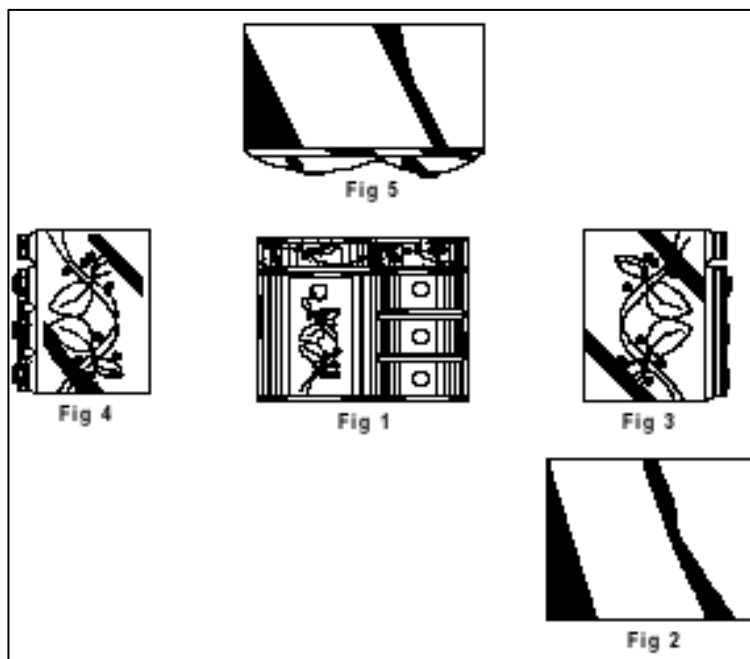
Fig. 3 is a left side elevational view thereof;

Fig. 4 is a right side elevational view thereof;

Fig. 5 is a top plan view thereof.

I claim: the ornamental design for a jewelry cabinet as shown.

Specification



Drawing Disclosure

Example 3 - Disclosure of only the surfaces of an article that are visible during use - The rear view disclosed by description

To the Commissioner of Patents and Trademarks:

Your petitioner, John Doe, a citizen of the United States and a resident of Alexandria, VA, prays that letters patent may be granted for the design for a jewelry cabinet, as set forth in the following specification. The claimed jewelry cabinet is used for storing jewelry and could sit on a bureau.

Fig. 1 is a front elevational view of a jewelry cabinet showing my new design;

Fig. 2 is a left side elevational view thereof;

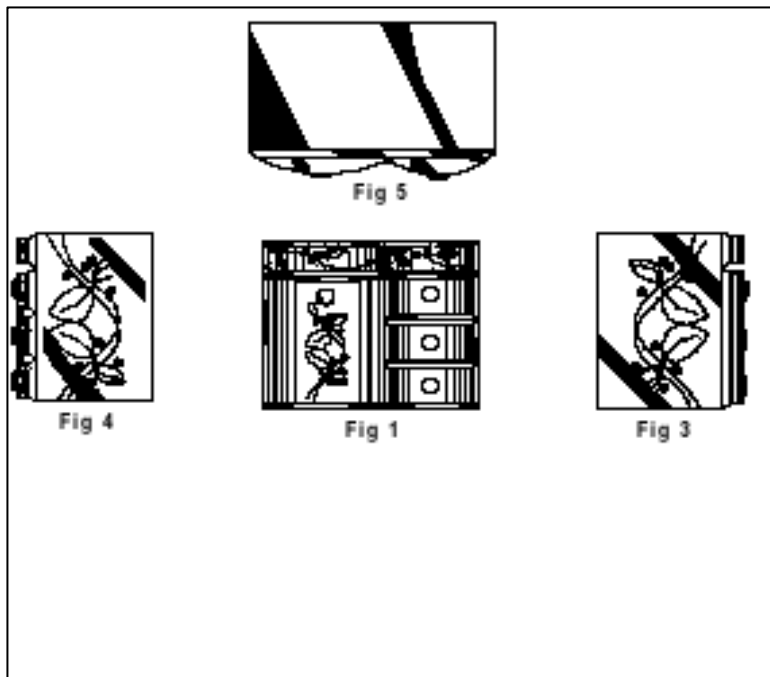
Fig. 3 is a right side elevational view thereof, and

Fig. 4 is a top plan view thereof.

The rear of the jewelry cabinet is flat and unornamented.

I claim: the ornamental design for a jewelry cabinet as shown

Specification



Drawing Disclosure

Example 4 - Disclosure of only the surfaces of an article that comprise the claimed design (no bottom view or description necessary)

To the Commissioner of Patents and Trademarks:

Your petitioner, John Doe, a citizen of the United States and a resident of Alexandria, VA, prays that letters patent may be granted for the design for a jewelry cabinet, as set forth in the following specification. The claimed jewelry cabinet is used for storing jewelry and could sit on a bureau.

Fig. 1 is a front elevational view of a jewelry cabinet showing my new design;

Fig. 2 is a left side elevational view thereof;

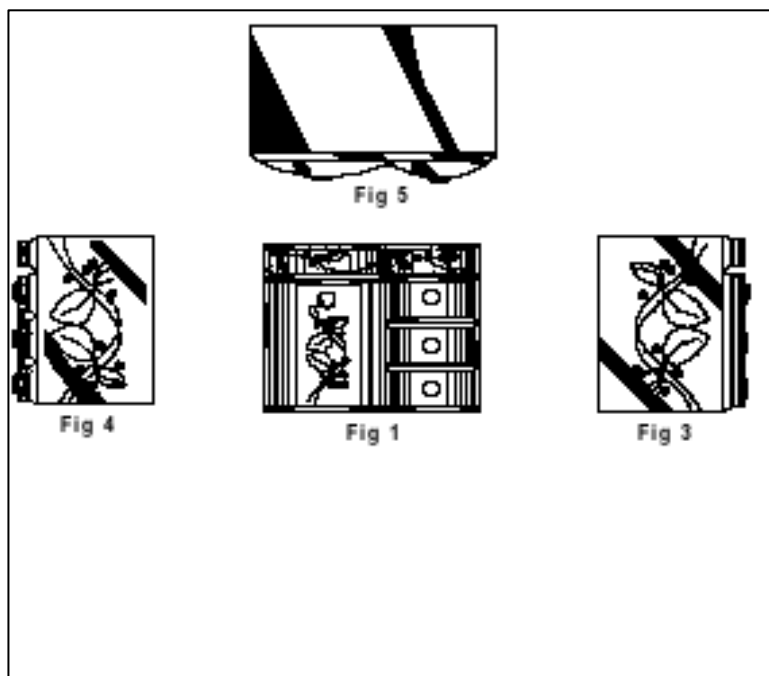
Fig. 3 is a right side elevational view thereof, and

Fig. 4 is a top plan view thereof.

The rear of the jewelry cabinet forms no part of the claimed design.

I claim: the ornamental design for a jewelry cabinet as shown and described.

Specification



Drawing Disclosure

Example 5 - Disclosure of a surface pattern as the claimed design, applied to an article

To the Commissioner of Patents and Trademarks:

Your petitioner, John Doe, a citizen of the United States and a resident of Alexandria, VA, prays that letters patent may be granted for the design for a surface pattern applied to a jewelry cabinet, as set forth in the following specification.

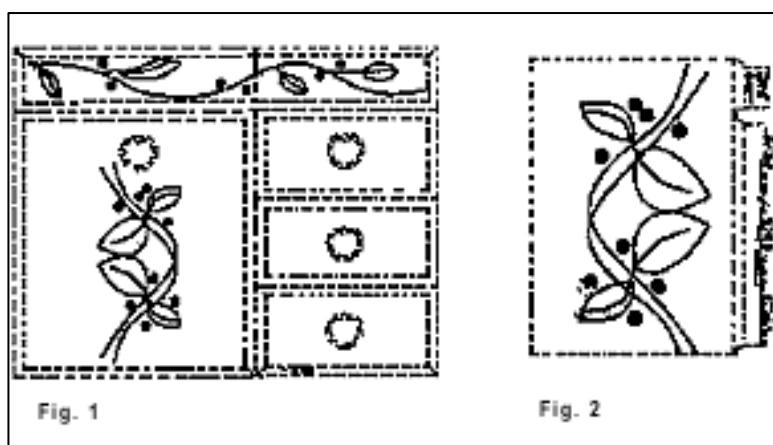
Fig. 1 is a front elevational view of a surface pattern applied to a jewelry cabinet showing my new design;

Fig. 2 is a left side elevational view thereof, the right side being a mirror image.

The jewelry cabinet is shown in broken lines for illustrative purposes only and forms no part of the claimed design.

I claim: the ornamental design for a surface pattern applied

Specification



Drawing Disclosure

3.18 The Design Patent Application Process

The preparation of a design patent application and the conducting of the proceedings in the Patent and Trademark Office to obtain the patent is an undertaking requiring the knowledge of patent law and rules and Patent and Trademark practice and procedures. A patent attorney or agent specially trained in this field is best able to secure the greatest patent protection to which applicant is entitled. It would be prudent to seek the services of a registered patent attorney or agent. Representation, however, is not required. A knowledgeable applicant may successfully prosecute his or her own application. However, while a patent may be obtained in many cases by persons not skilled in this work, there is no assurance that the patent obtained would adequately protect the particular design.

Of primary importance in a design patent application is the drawing disclosure, which illustrates the design being claimed. Unlike a utility application, where the "claim" describes the invention in a lengthy written explanation, the claim in a design patent application protects the overall visual appearance of the design, "described" in the drawings. It is essential that the applicant present a set of drawings (or photographs) of the highest quality which conform to the rules and standards which are reproduced in this guide. Changes to these drawings after the application has been filed, may introduce new matter which is not permitted by law (35 U.S.C. 132). It is in applicant's best interest to ensure that the drawing disclosure is clear and complete prior to filing the application, since an incomplete or poorly prepared drawing may result in a fatally defective disclosure which cannot become a patent. It is recommended that applicant retain the services of a professional draftsman who specializes in preparing design patent drawings. Examples of acceptable drawings and drawing disclosures are included in this Guide so that applicant will have some idea of what is required and can prepare the drawings accordingly.

In addition to the drawing disclosure, certain other information is necessary. While no specific format is required, it is strongly suggested that applicant follow the formats presented to ensure that the application is complete.

When a complete design patent application, along with the appropriate filing fee, is received by the Patent and Trademark Office, it is assigned an Application Number and a Filing Date. A "Filing Receipt" containing this information is sent to the applicant.

The application is then assigned to an examiner. Applications are examined in order of their filing date.

The actual "examination" entails checking for compliance with formalities, ensuring completeness of the drawing disclosure, and a comparison of the claimed subject matter with the "prior art". "Prior art" consists of issued patents and published materials. If the claimed subject matter is found to be patentable, the application will be "allowed" and instructions will be provided to applicant for completing the process to permit issuance as a patent.

The examiner may reject the claim in the application if the disclosure cannot be understood or is incomplete, or if a reference or combination of references, found in the prior art, shows the claimed design to be unpatentable. The examiner will then issue an Office action detailing the rejection and addressing the substantive matters which effect patentability. This Office Action may also contain suggestions by the examiner for amendments to the application. Applicant should keep this Office action for his or her files, and not send it back to the Office.

If, after receiving an Office action, applicant elects to continue prosecution of the application, a timely reply to the action must be submitted. This reply should include a request for reconsideration or further

examination of the claim, along with any amendments desired by the applicant, and must be made in writing. The reply must distinctly and specifically point out the supposed errors in the Office action and must address every objection and/or rejection in the action. If the examiner has rejected the claim over prior art, a general statement by the applicant that the claim is patentable, without specifically pointing out how the design is patentable over the prior art, does not comply with the rules.

In all cases where the examiner has said that a reply to a requirement is necessary, or where the examiner has indicated patentable subject matter, the reply must comply with the requirements set forth by the examiner, or specifically argue each requirement as to why compliance should not be required.

In any communication with the Office, applicant should include the following items:

1. Application number (checked for accuracy).
2. Group art unit number (copied from filing receipt or most recent Office Action).
3. Filing date.
4. Name of the examiner who prepared the most recent Office action.
5. Title of invention.

It is applicant's responsibility to make sure that the reply is received by the Office prior to the expiration of the designated time period set for reply. This time period is set to run from the "Date Mailed," which is indicated on the first page of the Office action. If the reply is not received within the designated time period, the application will be considered abandoned. In the event that applicant is unable to reply within the time period set in the Office action, abandonment may be prevented if a reply is filed within six (6) months from the mail date of the Office action provided a petition for extension of time and the fee set forth in 37 CFR § 1.17(a) are filed. The fee is determined by the amount of time requested, and increases as the length of time increases. These fees are set by Rule and could change at any time. An "Extension of Time" does not have to be obtained prior to the submission of a reply to an Office Action; it may be mailed along with the reply. See insert for a schedule of current fees. Note: an extension of time cannot be obtained when responding to a "Notice of Allowance."

To ensure that a time period set for reply to an Office Action is not missed, a "Certificate of Mailing" should be attached to the reply. This "Certificate" establishes that the reply is being mailed on a given date. It also establishes that the reply is timely, if it was mailed before the period for reply had expired and if it is mailed with the United States Postal Service. A "Certificate of Mailing" is not the same as "Certified Mail". A suggested format for a Certificate of Mailing is as follows:

"I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Box Design, Assistant Commissioner for Patents, Washington, D.C. 20231, on (DATE MAILED)"
(Name - Typed or Printed)

Signature

Date

If a receipt for any paper filed in the PTO is desired, applicant should include a stamped, self-addressed postcard, which lists, on the message side applicant's name and address, the application number, and filing

date, the types of papers submitted with the reply (i.e., 1 sheet of drawings, 2 pages of amendments, 1 page of an oath/declaration, etc.). This postcard will be stamped with the date of receipt by the Mail Room and returned to applicant. This postcard will be applicant's evidence that the reply was received by the Office on that date.

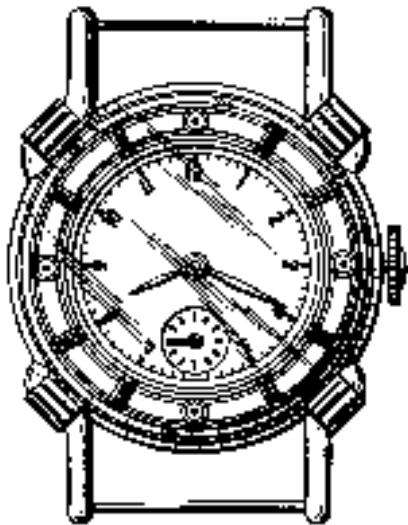
If applicant changes his or her mailing address after filing an application, the Office must be notified in writing of the new address. Failure to do so will result in future communications being mailed to the old address, and there is no guarantee that these communications will be forwarded to applicant's new address. Applicant's failure to receive, and properly reply to, these Office communications will result in the application being held abandoned. Notification of "Change of Address" should be made by separate letter, and a separate notification should be filed for each application.

Upon submission of a reply to an Office action, the application will be reconsidered and further examined in view of applicant's remarks and any amendments included with the reply. The examiner will then either, withdraw the rejection and allow the application, or, if not persuaded by the remarks and/or amendments submitted, repeat the rejection and make it Final. Applicant may file an appeal with the Board of Patent Appeals and Interferences after given a final rejection or after the claim has been rejected twice. Applicant may also file a new application prior to the abandonment of the original application, claiming benefit of the earlier filing date. This will allow continued prosecution of the claim.

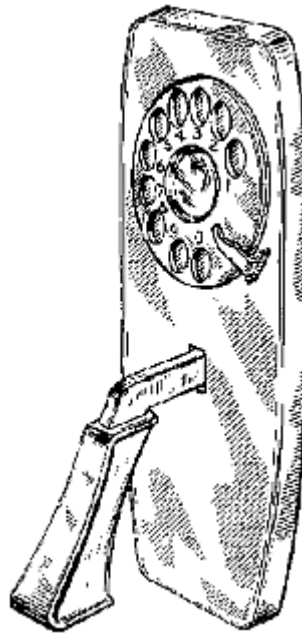
3.19 Drawing Examples

The two types of shading commonly employed in Design Patent Application drawings are straight line surface shading and stippling. Individually or in combination, they can effectively represent the character and contour of most drawing surfaces.

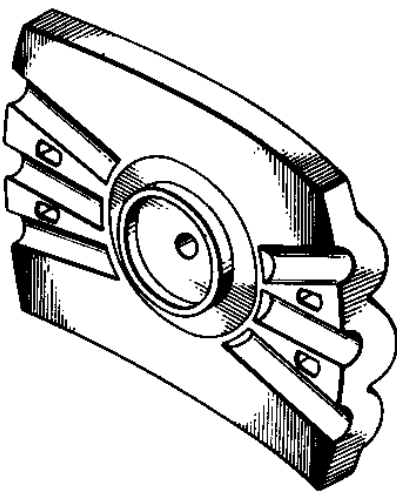
Straight Line Surface Shading



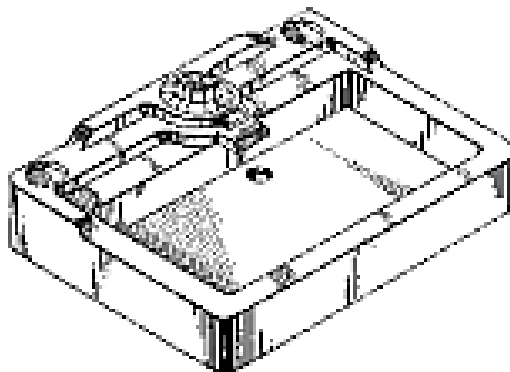
Watch



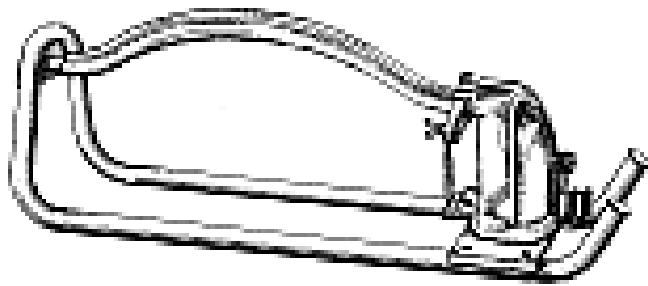
Door Lock Housing



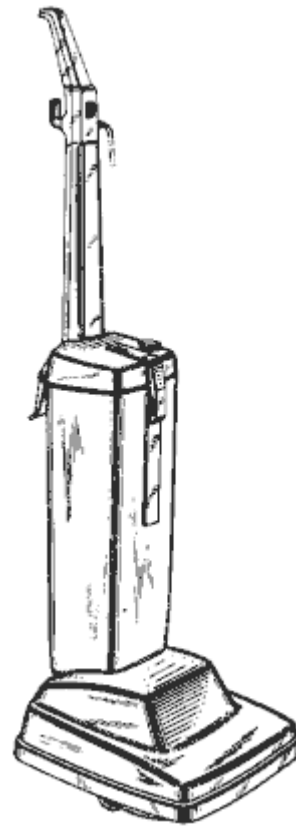
Antenna Insulator



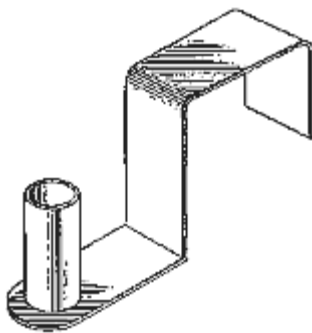
Sink



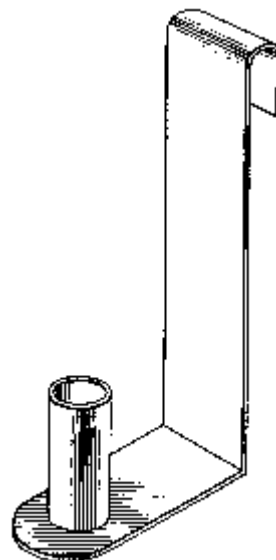
Lawn Sprinkler



Vacuum Cleaner



Toilet Tissue Holder
First Embodiment

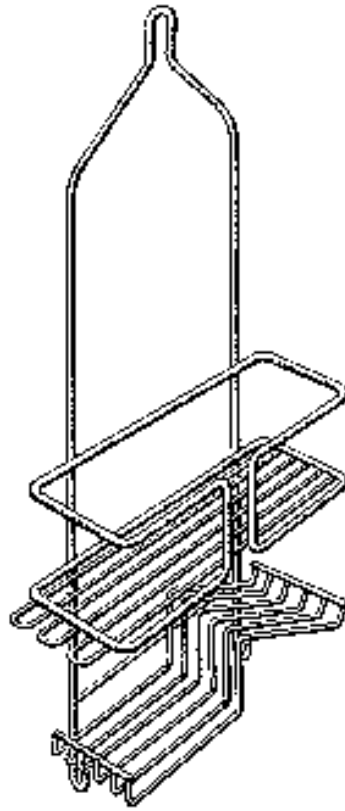


Toilet Tissue Holder
Second Embodiment

Stippling



Puppet



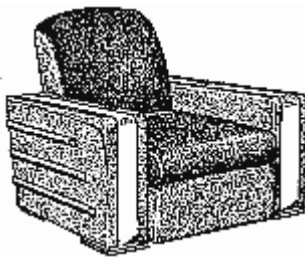
Shower Caddy

Combination of Straight Line Shading and Stippling

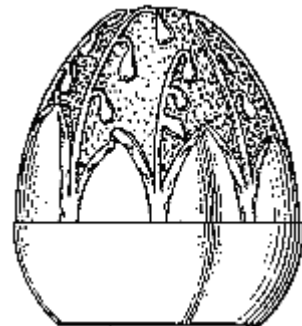
Note that both stippling and straight line surface shading, while permissible on the same object to show surface contrast, should not be used together on the same surface.



Door Knob



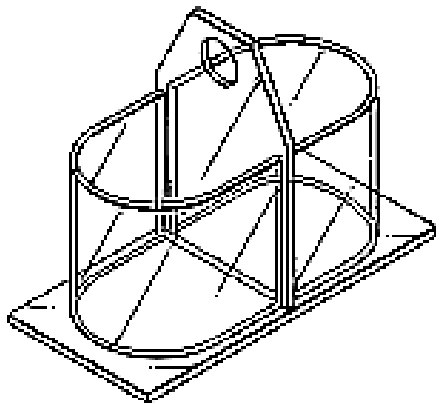
Chair



Cap

Transparent Materials

Note that elements visible behind transparent surfaces should be shown in light, full lines, not broken lines.

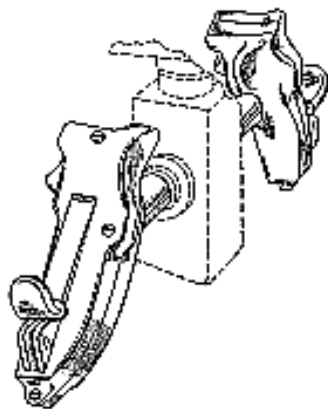


Aquarium

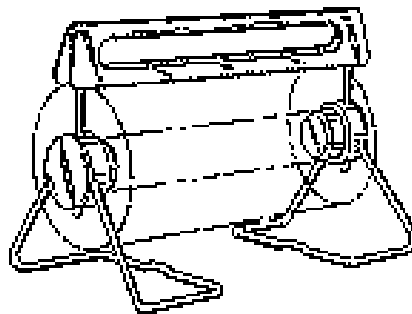


Perfume Bottle

Broken Line Disclosure



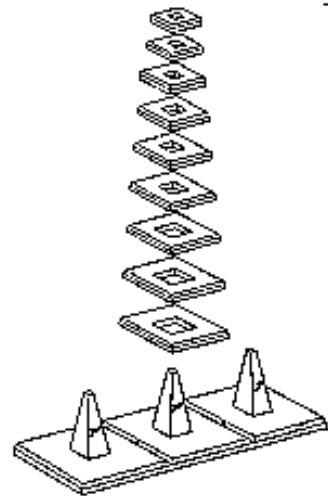
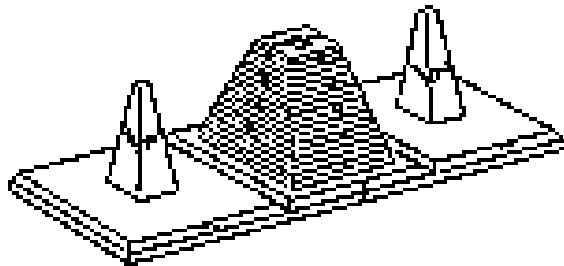
Handle Unit



Cutter

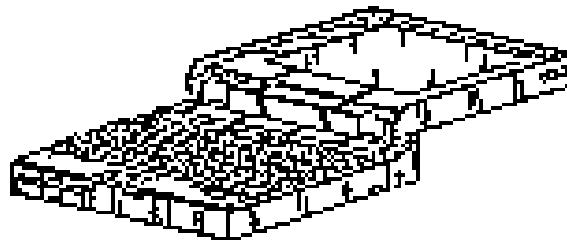
Exploded View

An exploded view is only supplementary to a fully assembled view. A bracket must be employed to show the association of elements.



Set of Game Components - Fully Assembled View

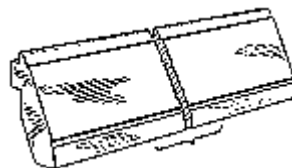
Set of Game Components - Exploded View



Personal Computer

Indeterminate Length

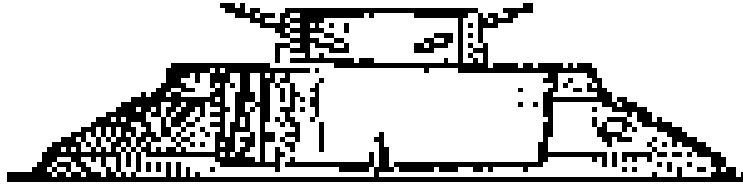
Note the use of a separation and a bracket to indicate that, for ease of illustration, the precise length of the molding is not claimed.



Picture Frame Molding

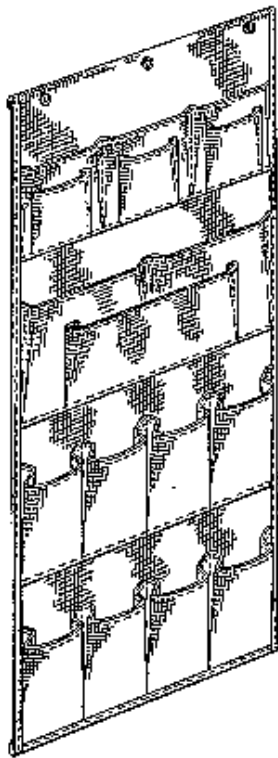
Cross-sectional View

Cross-sections may be employed to clarify the disclosure and to minimize the number of views.

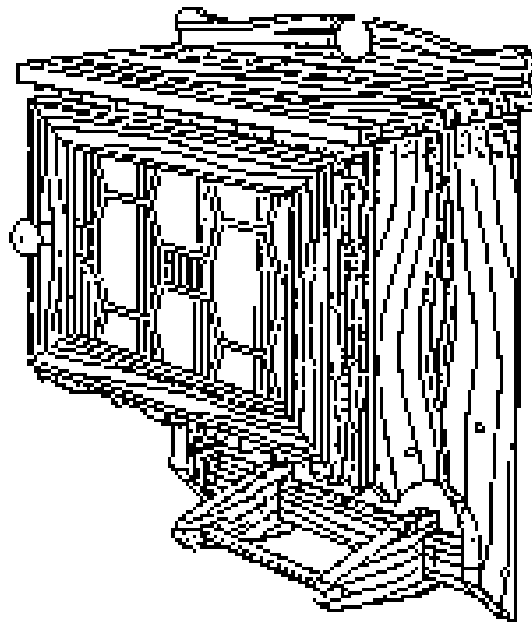


Christmas Tree Stand

Specific Materials



Multi-Pocketed Storage Bag

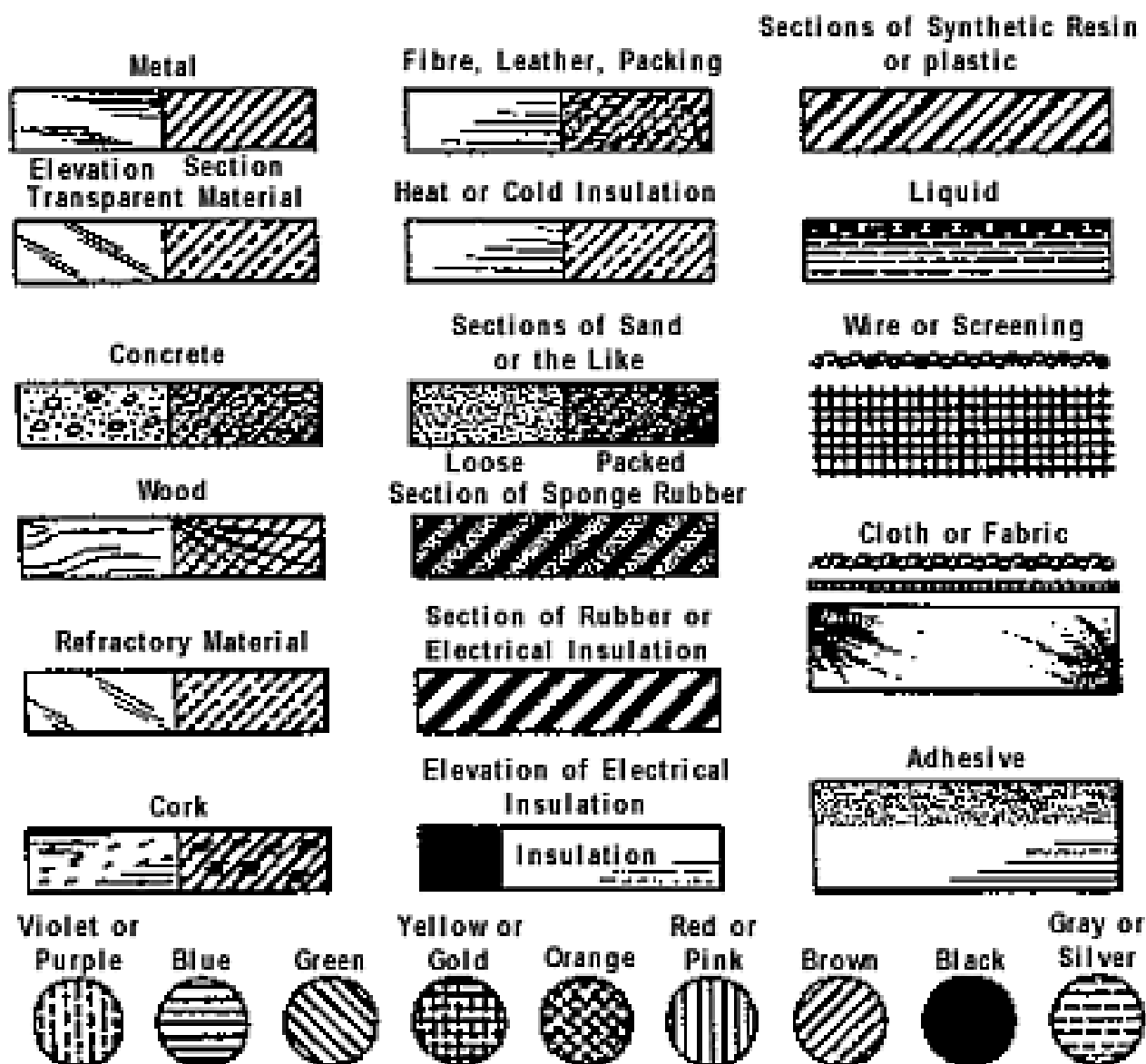


Combined Toilet Tissue Holder and Wall Cabinet

3.20 Symbols for Draftsmen

Rule 84(g) states that graphical symbols for conventional elements may be used on the drawing when appropriate, subject to approval by the Office. The symbols and other conventional devices which follow have been and are approved for such use. This collection does not purport to be exhaustive, other standard and commonly used symbols will also be acceptable provided they are clearly understood, are adequately identified in the specification as filed, and do not create confusion with other symbols used in patent drawings.

NOTES: In general, in lieu of a symbol, a conventional element, combination or circuit may be shown by an appropriately labeled rectangle, square or circle; abbreviations should not be used unless their meaning is evident and not confusing with the abbreviations used in the suggested symbols.



3.21 Patent Laws That Apply to Design Patent Applications

35 U.S.C. 171 Patents for Designs

Whoever invents any new, original, and ornamental design for an article of manufacture may obtain a patent therefor, subject to the conditions and requirements of this title.

The provisions of this title relating to patents for inventions shall apply to patents for designs, except as otherwise provided.

35 U.S.C. 173 Term of Design Patent

Patents for designs shall be granted for the term of fourteen years from the date of grant.

35 U.S.C. 102 Conditions for Patentability; Novelty and Loss of Right to Patent

A person shall be entitled to a patent unless

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or
- (c) he has abandoned the invention, or
- (d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or
- (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of 371(c) of this title before the invention thereof by applicant for patent, or
- (f) he did not himself invent the subject matter sought to be patented, or
- (g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

35 U.S.C. 103 Conditions for patentability; non-obvious subject matter

- (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.
- (b) 1. Notwithstanding subsection (a), and upon timely election by the applicant for patent to proceed under this subsection, a biotechnological process using or resulting in a composition of matter that is novel under section 102 and nonobvious under subsection (a) of this section shall be considered nonobvious if -
 - (A) claims to the process and composition of matter are contained in either the same application for patent or in separate applications having the same effective filing date; and
 - (B) the composition of matter, and the process at the time it was invented, were owned by the same person or subject to an obligation of assignment to the same person.

2. A patent issued on a process under paragraph (1)
 - (A) shall also contain the claims to the composition of matter used in or made by that process, or
 - (B) shall, if such composition of matter is claimed in another patent, be set to expire on the same date as such other patent, notwithstanding section 154.
3. For purposes of paragraph (1), the term "biotechnological process" means -
 - (A) a process of genetically altering or otherwise inducing a single- or multi- celled organism to -
 - (i) express an exogenous nucleotide sequence,
 - (ii) inhibit, eliminate, augment, or alter expression of an endogenous nucleotide sequence, or
 - (iii) express a specific physiological characteristic not naturally associated with said organism;
 - (B) cell fusion procedures yielding a cell line that expresses a specific protein, such as a monoclonal antibody; and
 - (C) a method of using a product produced by a process defined by subparagraph (A) or (B), or a combination subparagraphs (A) and (B).
- (c) Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

35 U.S.C. 112 Specification

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

A claim may be written in independent or, if the nature of the case admits, in dependent or multiple dependent form.

Subject to the following paragraph, a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.

A claim in multiple dependent form shall contain a reference, in the alternative only, to more than one claim previously set forth and then specify a further limitation of the subject matter claimed. A multiple dependent claim shall not serve as a basis for any other multiple dependent claim. A multiple dependent claim shall be construed to incorporate by reference all the limitations of the particular claim in relation to which it is being considered. An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

35 U.S.C. 132 Notice of rejection; reexamination.

Whenever, on examination, any claim for a patent is rejected, or any objection or requirement made, the Commissioner shall notify the applicant thereof, stating the reasons for such rejection, or objection or requirement, together with such information and references as may be useful in judging of the propriety of continuing the prosecution of his application; and if after receiving such notice, the applicant persists in his claim for a patent, with or without amendment, the application shall be reexamined. No amendment shall introduce new matter into the disclosure of the invention .

3.22 Rules That Apply to the Drawings of a Design Patent Application

37 CFR 1.84 Standards for Drawings

(a) Drawings

There are two acceptable categories for presenting drawings in utility patent applications:

(1) Black ink - Black and white drawings are normally required. India ink, or its equivalent that secures solid black lines, must be used for drawings, or

(2) Color - On rare occasions, color drawings may be necessary as the only practical medium by which to disclose the subject matter sought to be patented in a utility patent application or the subject matter of a statutory invention registration. The Patent and Trademark Office will accept color drawings in utility patent applications and statutory invention registrations only after granting a petition filed under this paragraph explaining why the color drawings are necessary. Any such petition must include the following:

(i)-The fee set forth in §1.17(I);

(ii) - Three (3) sets of color drawings; and

(iii) - The specification must contain the following language as the first paragraph in that portion of the specification relating to the brief description of the drawing: "The file of this patent contains at least one drawing executed in color. Copies of this patent with color drawing(s) will be provided by the Patent and Trademark Office upon request and payment of the necessary fee." If the language is not in the specification, a proposed amendment to insert the language must accompany the petition.

(b) Photographs

(1) Black and White - Photographs are not ordinarily permitted in utility patent applications. However, the Office will accept photographs in utility patent applications only after the granting of a petition filed under this paragraph which requests that photographs be accepted. Any such petition must include the following:

(i)-The fee set forth in §1.17(I); and

(ii)-Three (3) sets of photographs. Photographs must either be developed on double weight photographic paper or be permanently mounted on Bristol board. The photographs must be of sufficient quality so that all details in the drawings are reproducible in the printed patent.

(2) Color - Color photographs will be accepted in utility patent applications if the conditions for accepting color drawings have been satisfied. See paragraph (a)(2) of this section.

(c) Identification of drawings Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawings a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page. In addition, a reference to the application number, or, if an application number has not been assigned, the inventor's name, may be included in the left-hand corner, provided that the reference appears within 1.5 cm (5/8 inch) from the top of the sheet.

(d) Graphic forms in drawings Chemical or mathematical formulae, tables, and waveforms may be submitted as drawings and are subject to the same requirements as drawings. Each chemical or mathematical formula must be labeled as a separate figure, using brackets when necessary, to show that information is properly integrated. Each group of waveforms must be presented as a single figure, using a common vertical axis with time extending along the horizontal axis. Each individual waveform discussed in the specification must be identified with a separate letter designation adjacent to the vertical axis.

(e) Type of paper - Drawings submitted to the Office must be made on paper which is flexible, strong, white, smooth, non-shiny, and durable. All sheets must be free from cracks, creases, and folds. Only one side of the sheet shall be used for the drawing. Each sheet must be reasonably free from erasures and must be free from alterations, overwriting, and interlineation. Photographs must either be developed on double weight photographic paper or be permanently mounted on Bristol board. See paragraph (b) of this section for other requirements for photographs.

Size of paper - All drawing sheets in an application must be the same size. One of the shorter sides of the sheet is regarded as its top. The size of the sheets on which drawings are made must be:

- (1) 21.0 cm. by 29.7 cm. (DIN size A4), or
- (2) 21.6 cm. by 27.9 cm. (8 1 / 2 by 11 inches).

Margins - The sheets must not contain frames around the sight (i.e., the usable surface), but should have scan target points (i.e., cross-hairs), printed on two catercorner margin corners. Each sheet must include a top margin of at least 2.5 cm. (1 inch), a left side margin of at least 2.5 cm. (1 inch), a right side margin of at least 1.5 cm. (5/8 inch), and a bottom margin of at least 1.0 cm. (3/8 inch), thereby leaving a sight no greater than 17.0 cm. by 26.2 cm. on 21.0 cm. by 29.7 cm. (DIN size A4) drawing sheets, and a sight no greater than 17.6 cm. by 24.4 cm. (6 15/16 by 9 5/8 inches) on 21.6 cm. by 27.9 cm. (8 1/2 by 11 inch) drawing sheets.

(h) Views - The drawing must contain as many views as necessary to show the invention. The views may be plan, elevation, section, or perspective views. Detail views of portions of elements, on a larger scale if necessary, may also be used. All views of the drawing must be grouped together and arranged on the sheet(s) without wasting space, preferably in an upright position, clearly separated from one another, and must not be included in the sheets containing the specifications, claims, or abstract. Views must not be connected by projection lines and must not contain center lines. Waveforms of electrical signals may be connected by dashed lines to show the relative timing of the waveforms.

(1) Exploded views - Exploded views, with the separated parts embraced by a bracket, to show the relationship or order of assembly of various parts are permissible. When an exploded view is shown in a figure which is on the same sheet as another figure, the exploded view should be placed in brackets.

(2) Partial views - When necessary, a view of a large machine or device in its entirety may be broken into partial views on a single sheet, or extended over several sheets if there is no loss in facility of understanding the view. Partial views drawn on separate sheets must always be capable of being linked edge to edge so that no partial view contains parts of another partial view. A smaller scale view should be included showing the whole formed by the partial views and indicating the positions of the parts shown. When a portion of a view is enlarged for magnification purposes, the view and the enlarged view must each be labeled as separate views.

(i) Where views on two or more sheets form, in effect, a single complete view, the views on the several sheets must be so arranged that the complete figure can be assembled without concealing any part of any of the views appearing on the various sheets.

(ii) A very long view may be divided into several parts placed one above the other on a single sheet. However, the relationship between the different parts must be clear and unambiguous.

(3) Sectional views - The plane upon which a sectional view is taken should be indicated on the view from which the section is cut by a broken line. The ends of the broken line should be designated by Arabic or Roman numerals corresponding to the view number of the sectional view, and should have arrows to indicate the direction of sight. Hatching must be used to indicate section portions of an object, and must be made by regularly spaced oblique parallel lines spaced sufficiently apart to enable the lines to be distinguished without difficulty. Hatching should not impede the clear reading of the reference characters and lead lines. If it is not possible to place reference characters outside the hatched area, the hatching may be broken off wherever reference characters are inserted. Hatching must be at a substantial angle to the surrounding axes or principal lines, preferably 45 degrees. A cross section must be set out and drawn to show all of the materials as they are shown in the view from which the cross section was taken. The parts in cross section must show proper material(s) by hatching with regularly spaced parallel oblique strokes, the space between strokes being chosen on the basis of the total area to be hatched. The various parts of a cross section of the same item should be hatched in the same manner and should accurately and graphically indicate the nature of the material(s) that is illustrated in cross section. The hatching of juxtaposed different elements must be angled in a different way. In the case of large areas, hatching may be confined to an edging drawn around the entire inside of the outline of the area to be hatched. Different types of hatching should have different conventional meanings as regards the nature of a material seen in cross section.

- (4) Alternate position - A moved position may be shown by a broken line superimposed upon a suitable view if this can be done without crowding; otherwise, a separate view must be used for this purpose.
- (5) Modified forms - Modified forms of construction must be shown in separate views.
- (i) Arrangement of views - One view must not be placed upon another or within the outline of another. All views on the same sheet should stand in the same direction and, if possible, stand so that they can be read with the sheet held in an upright position. If views wider than the width of the sheet are necessary for the clearest illustration of the invention, the sheet may be turned on its side so that the top of the sheet, with the appropriate top margin to be used as the heading space, is on the right-hand side. Words must appear in a horizontal, left-to-right fashion when the page is either upright or turned so that the top becomes the right side, except for graphs utilizing standard scientific convention to denote the axis of abscissas (of X) and the axis of ordinates (of Y).
- (j) View for Official Gazette - One of the views should be suitable for publication in the Official Gazette as the illustration of the invention.
- (k) Scale
 - (1) The scale to which a drawing is made must be large enough to show the mechanism without crowding when the drawing is reduced in size to two-thirds in reproduction. Views of portions of the mechanism on a larger scale should be used when necessary to show details clearly. Two or more sheets may be used if one does not give sufficient room. The number of sheets should be kept to a minimum.
 - (2) When approved by the examiner, the scale of the drawing may be graphically represented. Indications such as "actual size" or "scale 1 / 2" on the drawings, are not permitted, since these lose their meaning with reproduction in a different format.
 - (3) Elements of the same view must be in proportion to each other, unless a difference in proportion is indispensable for the clarity of the view. Instead of showing elements in different proportion, a supplementary view may be added giving a larger-scale illustration of the element of the initial view. The enlarged element shown in the second view should be surrounded by a finely drawn or "dot-dash" circle in the first view indicating its location without obscuring the view.
- (l) Character of Lines, Numbers, and Letters - All drawings must be made by a process which will give them satisfactory reproduction characteristics. Every line, number, and letter must be durable, clean, black (except for color drawings), sufficiently dense and dark, and uniformly thick and well-defined. The weight of all lines and letters must be heavy enough to permit adequate reproduction. This requirement applies to all lines however fine, to shading, and to lines representing cut surfaces in sectional views. Lines and strokes of different thicknesses may be used in the same drawing where different thicknesses have a different meaning.
- (m) Shading - The use of shading in views is encouraged if it aids in understanding the invention and if it does not reduce legibility. Shading is used to indicate the surface or shape of spherical, cylindrical, and conical elements of an object. Flat parts may also be lightly shaded. Such shading is preferred in the case of parts shown in perspective, but not for cross sections. See paragraph (h)(3) of this section. Spaced lines for shading are preferred. These lines must be thin, as few in number as practicable, and they must contrast with the rest of the drawings. As a substitute for shading, heavy lines on the shade side of objects can be used except where they superimpose on each other or obscure reference characters. Light should come from the upper left corner at an angle of 45 degrees. Surface delineations should preferably be shown by proper shading. Solid black shading areas are not permitted, except when used to represent bar graphs or color.
- (n) Symbols - Graphical drawing symbols may be used for conventional elements when appropriate. The elements for which such symbols and labeled representations are used must be adequately identified in the specification. Known devices should be illustrated by symbols which have a universally recognized conventional meaning and are generally accepted in the art. Other symbols which are not universally recognized may be used, subject to approval by the Office, if they are not likely to be confused with existing conventional symbols, and if they are readily identifiable.

(o) Legends - Suitable descriptive legends may be used, or may be required by the Examiner, where necessary for understanding of the drawing, subject to approval by the Office. They should contain as few words as possible.

(p) Numbers, Letters, and Reference Characters

(1) Reference characters (numerals are preferred), sheet numbers, and view numbers must be plain and legible, and must not be used in association with brackets or inverted commas, or enclosed within outlines, e.g., encircled. They must be oriented in the same direction as the view so as to avoid having to rotate the sheet. Reference characters should be arranged to follow the profile of the object depicted.

(2) The English alphabet must be used for letters, except where another alphabet is customarily used, such as the Greek alphabet to indicate angles, wavelengths, and mathematical formulas.

(3) Numbers, letters, and reference characters must measure at least .32 cm. (1 / 8 inch) in height. They should not be placed in the drawing so as to interfere with its comprehension. Therefore, they should not cross or mingle with the lines. They should not be placed upon hatched or shaded surfaces. When necessary, such as indicating a surface or cross section, a reference character may be underlined and a blank space may be left in the hatching or shading where the character occurs so that it appears distinct.

(4) The same part of an invention appearing in more than one view of the drawing must always be designated by the same reference character, and the same reference character must never be used to designate different parts.

(5) Reference characters not mentioned in the description shall not appear in the drawings. Reference characters mentioned in the description must appear in the drawings.

(q) Lead lines - Lead lines are those lines between the reference characters and the details referred to. Such lines may be straight or curved and should be as short as possible. They must originate in the immediate proximity of the reference character and extend to the feature indicated. Lead lines must not cross each other. Lead lines are required for each reference character except for those which indicate the surface or cross section on which they are placed. Such a reference character must be underlined to make it clear that a lead line has not been left out by mistake. Lead lines must be executed in the same way as lines in the drawing. See paragraph (l) of this section.

(r) Arrows - Arrows may be used at the ends of lines, provided that their meaning is clear, as follows:

(1) On a lead line, a freestanding arrow to indicate the entire section towards which it points;

(2) On a lead line, an arrow touching a line to indicate the surface shown by the line looking along the direction of the arrow; or

(3) To show the direction of movement.

(s) Copyright or Mask Work Notice A copyright or mask work notice may appear in the drawing, but must be placed within the sight of the drawing immediately below the figure representing the copyright or mask work material and be limited to letters having a print size of .32 cm. to .64 cm. (1/8 to 1/4 inches) high. The content of the notice must be limited to only those elements provided for by law. For example, " © 1983 John Doe" (17 U.S.C. 401) and "*M* John Doe" (17 U.S.C. 909) would be properly limited and, under current statutes, legally sufficient notices of copyright and mask work, respectively. Inclusion of a copyright or mask work notice will be permitted only if the authorization language set forth in §1.71(e) is included at the beginning (preferably as the first paragraph) of the specification.

(t) Numbering of Sheets of Drawings The sheets of drawings should be numbered in consecutive Arabic numerals, starting with 1, within the sight as defined in paragraph (g) of this section. These numbers, if present, must be placed in the middle of the top of the sheet, but not in the margin. The numbers can be placed on the right-hand side if the drawing extends too close to the middle of the top edge of the usable surface. The drawing sheet numbering must be clear and larger than the numbers used as reference characters to avoid confusion. The number of each sheet should be shown by two Arabic numerals placed on either side of an oblique line, with the first being the sheet number and the second being the total number of sheets of drawings, with no other marking.

(u) **Numbering of Views** - The different views must be numbered in consecutive Arabic numerals, starting with 1, independent of the numbering of the sheets and, if possible, in the order in which they appear on the drawing sheet(s). Partial views intended to form one complete view, on one or several sheets, must be identified by the same number followed by a capital letter. View numbers must be preceded by the abbreviation "FIG." Where only a single view is used in an application to illustrate the claimed invention, it must not be numbered and the abbreviation "FIG." must not appear.

Numbers and letters identifying the views must be simple and clear and must not be used in association with brackets, circles, or inverted commas. The view numbers must be larger than the numbers used for reference characters.

(v) **Security Markings** - Authorized security markings may be placed on the drawings provided they are outside the sight, preferably centered in the top margin.

(w) **Corrections** - Any corrections on drawings submitted to the Office must be durable and permanent.

(x) **Holes** - No holes should be made by applicant in the drawing sheets. (See §1.152 for design drawings, §1.165 for plant drawings, and §1.174 for reissue drawings).

37 CFR 1.152 Design drawings

(a) The design must be represented by a drawing that complies with the requirements of §1.84, and must contain a sufficient number of views to constitute a complete disclosure of the appearance of the design.

(1) Appropriate and adequate surface shading should be used to show the character or contour of the surfaces represented. Solid black surface shading is not permitted except when used to represent the color black, as well as color contrast. Broken lines may be used to show visible environmental structure, but may not be used to show hidden planes and surfaces which cannot be seen through opaque materials. Alternate positions of a design component, illustrated by full and broken lines in the same view are not permitted in a design drawing.

(2) Color photographs and color drawings are not permitted in design applications in the absence of a grantable petition pursuant to §1.84(a)(2). Photographs and ink drawings are not permitted to be combined as formal drawings in one application. Photographs submitted in lieu of ink drawings in design patent applications must comply with §1.84(b) and must not disclose environmental structure but must be limited to the design for the article claimed.

(b) Any detail shown in the ink or color drawings or photographs (formal or informal) deposited with the original application papers constitutes an integral part of the disclosed and claimed design, except as otherwise provided in this paragraph. This detail may include, but is not limited to, color or contrast, graphic or written indicia, including identifying indicia of a proprietary nature, surface ornamentation on an article, or any combination thereof.

(1) When any detail shown in informal drawings or photographs does not constitute an integral part of the disclosed and claimed design, a specific disclaimer must appear in the original application papers either in the specification or directly on the drawings or photographs. This specific disclaimer in the original application papers will provide antecedent basis for the omission of the disclaimed detail(s) in later-filed drawings or photographs.

(2) When informal color drawings or photographs are deposited with the original application papers without a disclaimer pursuant to paragraphs (b)(1) of this section, formal color drawings or photographs, or a black and white drawing lined to represent color, will be required.

37 CFR 1.121 Manner of making amendments

(a) **Amendments in nonprovisional applications, other than reissue applications:** Amendments in nonprovisional applications, excluding reissue applications, are made by filing a paper, in compliance with §1.52, directing that specified amendments be made.

(1) **Specification other than the claims.** Except as provided in §1.125, amendments to add matter to, or delete matter from, the specification, other than to the claims, may only be made as follows:

(i) Instructions for insertions: The precise point in the specification must be indicated where an insertion is to be made, and the matter to be inserted must be set forth.

(ii) Instructions for deletions: The precise point in the specification must be indicated where a deletion is to be made, and the matter to be deleted must be set forth or otherwise indicated.

(iii) Matter deleted by amendment can be reinstated only by a subsequent amendment presenting the previously deleted matter as a new insertion.

(2) Claims. Amendments to the claims may only be made as follows:

(i) Instructions for insertions and deletions: A claim may be amended by specifying only the exact matter to be deleted or inserted by an amendment and the precise point where the deletion or insertion is to be made, where the changes are limited to:

(A) Deletions and/or

(B) The addition of no more than five (5) words in any one claim; or

(ii) Claim cancellation or rewriting: A claim may be amended by directions to cancel the claim or by rewriting such claim with underlining below the matter added and brackets around the matter deleted. The rewriting of a claim in this form will be construed as directing the deletion of the previous version of that claim. If a previously rewritten claim is again rewritten, underling and bracketing will be applied relative to the previous version of the claim, with the parenthetical expression "twice amended," "three times amended," etc., following the original claim number. The original claim number followed by the parenthetical expression must be used for the rewritten claim. No interlineations or deletions of any prior amendment may appearing the currently submitted version of the claim. A claim canceled by amendment (not deleted and rewritten) can be reinstated only by a subsequent amendment presenting the claim as a new claim with a new claim number.

(3) Drawings.

(i) Amendments to the original application drawings are not permitted. Any change to the application drawings must be by way of a substitute sheet of drawings for each sheet changed, submitted in compliance with §1.84.

(ii) Where a change to the drawings is desired, a sketch in permanent ink showing proposed changes in red, to become part of the record, must be filed for approval by the examiner and should be in a separate paper.

(4) [Reserved]

(5) The disclosure must be amended, when required by the Office, to correct inaccuracies of description and definition, and to secure substantial correspondence between the claims, the remainder of the specification, and the drawings.

(6) No amendment may introduce new matter into the disclosure of an application.

(b) Amendments in reissue applications: Amendments in reissue applications are made by filing a paper, in compliance with §1.52, directing that specified amendments be made.

(1) Specification other than the claims. Amendments to the specification, other than to the claims, may only be made as follows:

(i) Amendments must be made by submission of the entire text of a newly added or rewritten paragraph(s) with markings pursuant to paragraph (b)(1)(iii) of this section, except that an entire paragraph may be deleted by a statement deleting the paragraph without presentation of the text of the paragraph.

(ii) The precise point in the specification must be indicated where the paragraph to be amended is located.

(iii) Underlining below the subject matter added to the patent and brackets around the subject matter deleted from the patent are to be used to mark the amendments being made.

(2) Claims. Amendments to the claims may only be made as follows:

(i)(A) The amendment must be made relative to the patent claims in accordance with paragraph (b)(6) of this section and must include the entire text of each claim which is being amended by the current amendment and of each claim being added by the current amendment, with markings pursuant to paragraph (b)(2)(I)(C) of this section, except that a patent claim or added claim should be canceled by a statement canceling the patent claim or added claim without presentation of the text of the patent claim or added claim.

(B) Patent claims must not be renumbered and the numbering of any claims added to the patent must follow the number of the highest numbered patent claim.

(c) Underling below the subject matter added to the patent and brackets around the subject matter deleted from the patent are to be used to mark the amendments being made. If a claim is amended pursuant to paragraph (b)(2)(I)(A) of this section, a parenthetical expression "amended", "twice amended", etc., should follow the original claim number.

(ii) Each amendment submission must set forth the status (i.e., pending or canceled) as of the date of the amendment, of all patent claims and of all added claims.

(iii) Each amendment when originally submitted must be accompanied by an explanation of the support in the disclosure of the patent for the amendment along with any additional comments on page(s) separate from the page(s) containing the amendment.

(3) Drawings.

(i) Amendments to the original patent drawings are not permitted. Any change to the patent drawings must be by way of a new sheet of drawings with the amended figures identified as "amended" and with added figures identified as "new" for each sheet changed submitted in compliance with §1.84.

(ii) Where a change to the drawings is desired, a sketch in permanent ink showing proposed changes in red, to become part of the record, must be filed for approval by the examiner and should be in a separate paper.

(4) The disclosure must be amended, when required by the Office, to correct inaccuracies of description and definition, and to secure substantial correspondence between the claims, the remainder of the specification, and the drawings.

(5) No reissue patent shall be granted enlarging the scope of the claims of the original patent unless applied for within two years from the grant of the original patent, pursuant to 35 U.S.C. 251. No amendment to the patent may introduce new matter or be made in an expired patent.

(6) All amendments must be made relative to the patent specification, including the claims, and drawings, which is in effect as of the date of filing of the reissue application.

© Amendments in reexamination proceedings: Any proposed amendment to the description and claims in patents involved in reexamination proceedings must be made in accordance with §1.530(d).

Other Rules That Apply To Design Patent Applications

37 CFR 1.63 Oath or declaration.

(a) An oath or declaration filed under §1.51(b)(2) as a part of an application must:

(1) Be Executed in accordance with either §1.66 or §1.68;

(2) Identify the specification to which it is directed;

(3) Identify each inventor by: full name, including the family name, and at least one given name without abbreviation together with any other given name or initial, and the residence, post office address and country of citizenship of each inventor; and

(4) State whether the inventor is a sole or joint inventor of the invention claimed.

(b) In addition to meeting the requirements of paragraph (a), the oath or declaration must state that the person making the oath or declaration:

(1) Has reviewed and understands the contents of the specification, including the claims, as amended by any amendment specifically referred to in the oath or declaration;

(2) Believes the named inventor or inventors to be the original and first inventor or inventors of the subject matter which is claimed and for which a patent is sought; and

(3) Acknowledges the duty to disclose to the Office all information known to the person to be material to patentability as defined in §1.56.

(c) In addition to meeting the requirements of paragraphs (a) and (b) of this section, the oath or declaration in any application in which a claim for foreign priority is made pursuant to §1.55 must identify the foreign application for patent or inventor's certificate on which priority is claimed and any foreign application having a

filing date before that of the application on which priority is claimed, by specifying the application number, country, day, month, and year of its filing.

(d) (1) A newly executed oath or declaration is not required under §1.51 (b)(2) and §1.53(f) in a continuation or divisional application, provided that:

(I) The prior nonprovisional application contained an oath or declaration as prescribed by paragraphs (a) through (c) of this section;

(ii) The continuation or divisional application was filed by all or by fewer than all of the inventors named in the prior application;

(iii) The specification and drawings filed in the continuation or divisional application contain no matter that would have been new matter in the prior application; and

(iv) A copy of the executed oath or declaration filed in the prior application, showing the signature or an indication thereon that it was signed, is submitted for the continuation or divisional application.

(2) The copy of the executed oath or declaration submitted under this paragraph for a continuation or divisional application must be accompanied by a statement requesting the deletion of the name or names of the person or persons who are not inventors in the continuation or divisional application.

(3) Where the executed oath or declaration of which a copy is submitted for a continuation or divisional application was originally filed in a prior application accorded status under §1.47, the copy of the executed oath or declaration for such prior application must be accompanied by:

(I) A copy of the decision granting a petition to accord §1.47 status to the prior application, unless all inventors or legal representatives have filed an oath or declaration to join in an application accorded status under §1.47 of which the continuation or divisional application claims a benefit under 35 U.S.C. 120, 121, or 365^o; and

(ii) If one or more inventor(s) or legal representative(s) who refused to join in the prior application or could not be found or reached has subsequently joined in the prior application or another application of which the continuation or divisional application claims a benefit under 35 U.S.C. 120, 121, or 365^o, a copy of the subsequently executed oath(s) or declaration(s) filed by the inventor or legal representative to join in the application.

(4) Where the power of attorney (or authorization of agent) or correspondence address was changed during the prosecution of the prior application, the change in power of attorney (or authorization of agent) or correspondence address must be identified in the continuation or divisional application. Otherwise, the Office may not recognize in the continuation or divisional application the change of power of attorney (or authorization of agent) or correspondence address during the prosecution of the prior application.

(5) A newly executed oath or declaration must be filed in a continuation or divisional application naming an inventor not named in the prior application.

(e) A newly executed oath or declaration must be filed in any continuation-in-part application, which application may name all, more, or fewer than all of the inventors named in the prior application. The oath or declaration in any continuation-in-part application must also state that the person making the oath or declaration acknowledges the duty to disclose to the Office all information known to the person to be material to patentability as defined in §1.56, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

37 CFR 1.3 Business to be conducted with decorum and courtesy.

Applicants and their attorneys or agents are required to conduct their business with the Patent and Trademark Office with decorum and courtesy. Papers presented in violation of this requirement will be submitted to the Commissioner and will be returned by the Commissioner's direct order. Complaints against examiners and other employees must be made in correspondence separate from other papers.

37 CFR 1.153 Title, description and claim, oath or declaration.

- (a) The title of the design must designate the particular article. No description, other than a reference to the drawing, is ordinarily required. The claim shall be in formal terms to the ornamental design for the article (specifying name) as shown, or as shown and described. More than one claim is neither required nor permitted.
- (b) The oath or declaration required of the applicant must comply with §1.63.

3.23 Sample Specification

To the Commissioner of Patents and Trademarks:

Your petitioner, (Name) _____ a citizen of (Country) _____ and a resident of (City, State) _____, prays that letters patent may be granted for the design for a (Title) _____ as set forth in the following specification:

FIG. 1 is a _____ view of a _____ showing my new design;

FIG. 2 is a _____ view thereof;

FIG. 3 is a _____ view thereof;

FIG. 4 is a _____ view thereof;

FIG. 5 is a _____ view thereof; and

FIG. 6 is a _____ view thereof.

I claim: the ornamental design for a _____ as shown.

*Applicants are referred to the Disclosure Examples on Pages 9-13, to determine the proper wording and number of Figure Descriptions appropriate to their disclosure. Individual inventors should also complete a Statement Claiming Small Entity Status (FORM PTOS/SB/09), as well as a Declaration. Questions regarding an application and its forms may be directed to the Patent Assistance Center at +1-800-786-9199.



US005864630A

- [54] MULTI-MODAL METHOD FOR LOCATING OBJECTS IN IMAGES
- [75] Inventors: Eric Cosatto, Highlands; Hans Peter Graf, Lincroft, both of N.J.
- [73] Assignee: AT&T Corp, Middletown, N.J.
- [21] Appl. No.: 752,109
- [22] Filed: Nov. 20, 1996
- [51] Int. Cl.⁶ G06K 9/00
- [52] U.S. Cl. 382/103; 382/107; 382/118; 382/165; 382/304; 382/203
- [58] Field of Search 382/103, 107, 382/118, 162, 164, 165, 203, 304; 348/169

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Schuster "Color objects tracking with adaptive modeling" Proceedings of the workshop on Visual Behaviors pp. 91-96, Jun. 1994.

Primary Examiner—Jon Chang
Assistant Examiner—Jingge Wu

[57] ABSTRACT

A multi-modal method for locating objects in images wherein a tracking analysis is first performed using a plurality of channels which may comprise a shape channel, a color channel, and a motion channel. After a predetermined number of frames, intermediate feature representations are obtained from each channel and evaluated for reliability. Based on the evaluation of each channel, one or more channels are selected for additional tracking. The results of all representations are ultimately integrated into a final tracked output. Additionally, any of the channels may be calibrated using initial results obtained from one or more channels.

27 Claims, 8 Drawing Sheets

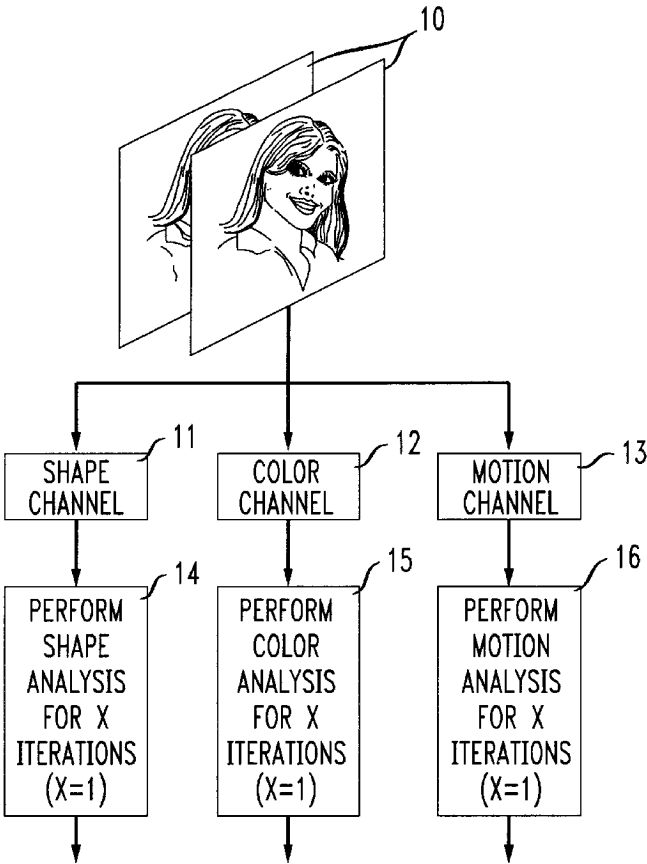


FIG. 1a

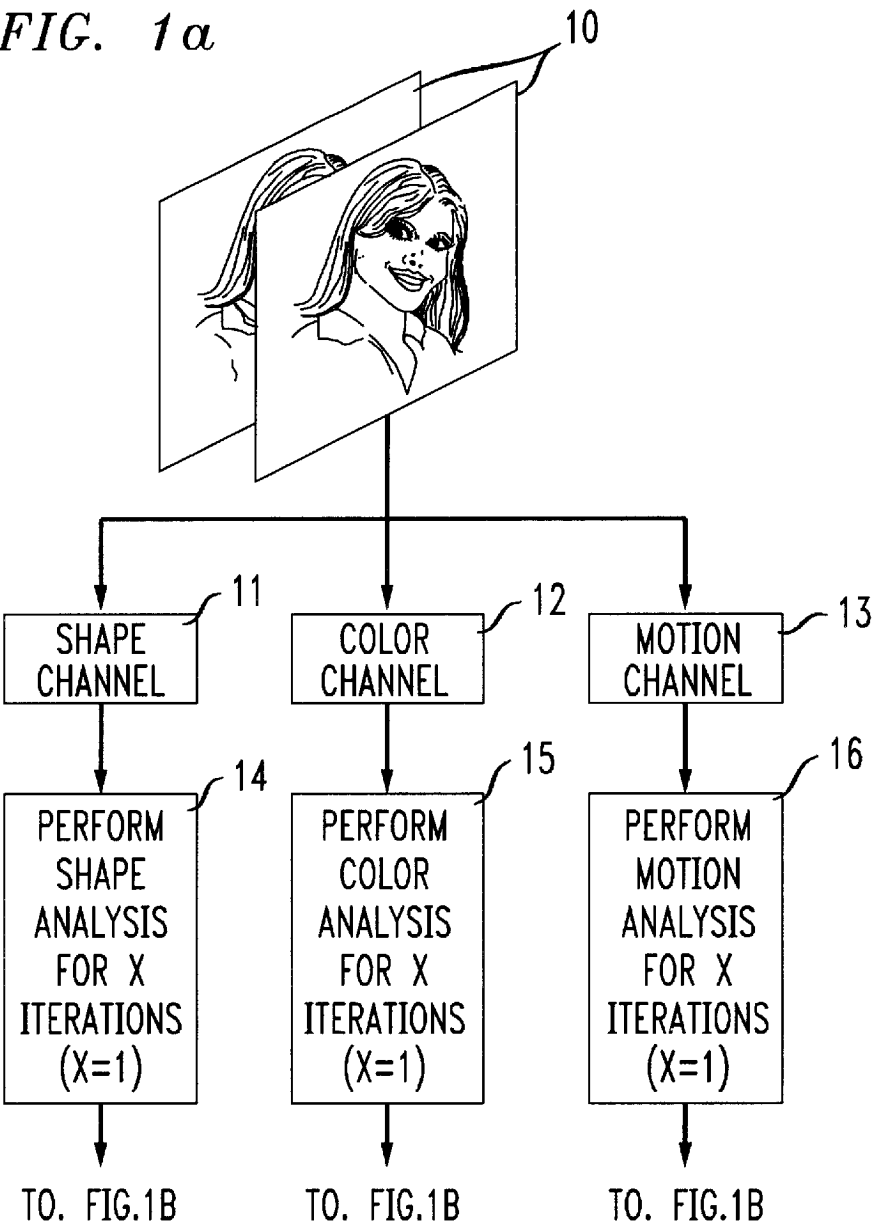


FIG. 1b

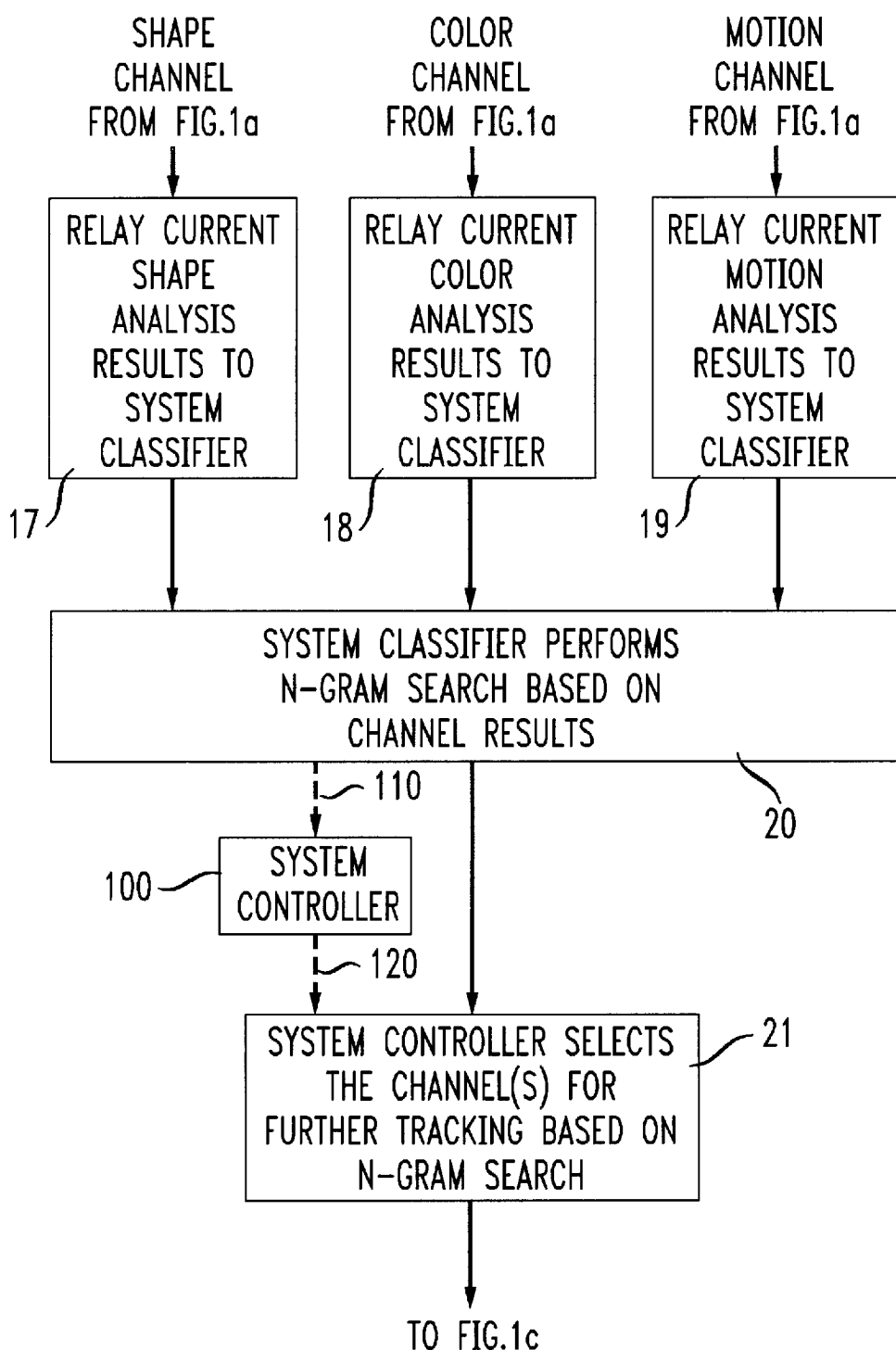


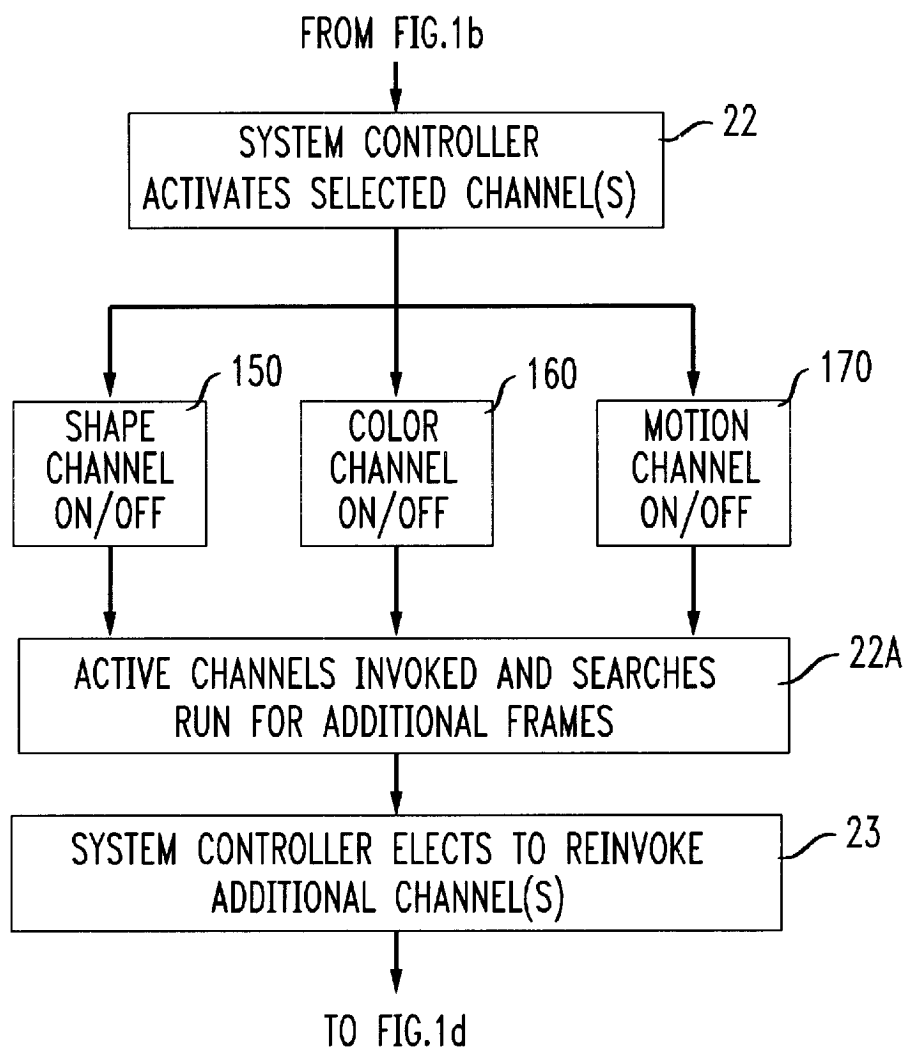
FIG. 1c

FIG. 1d

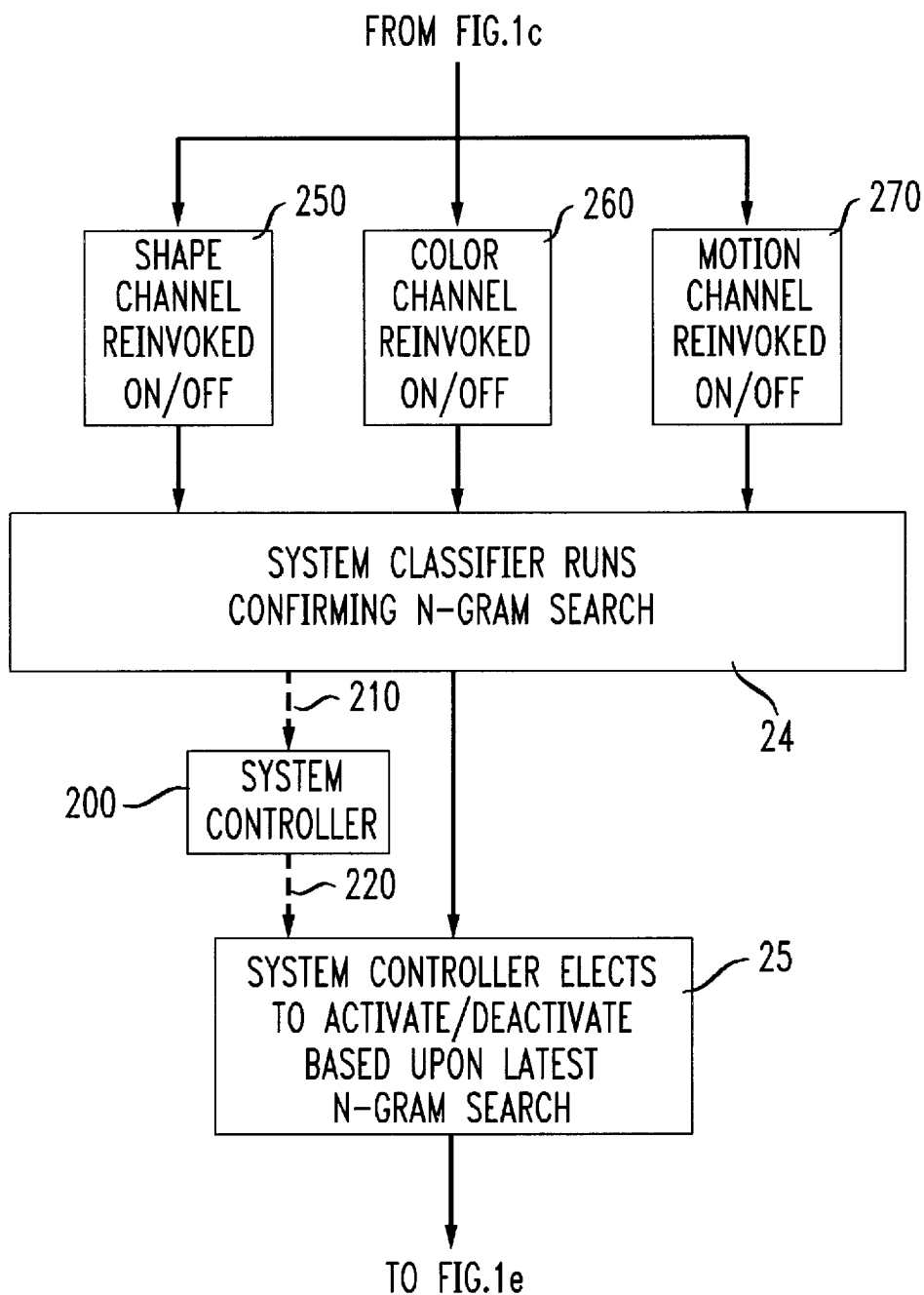


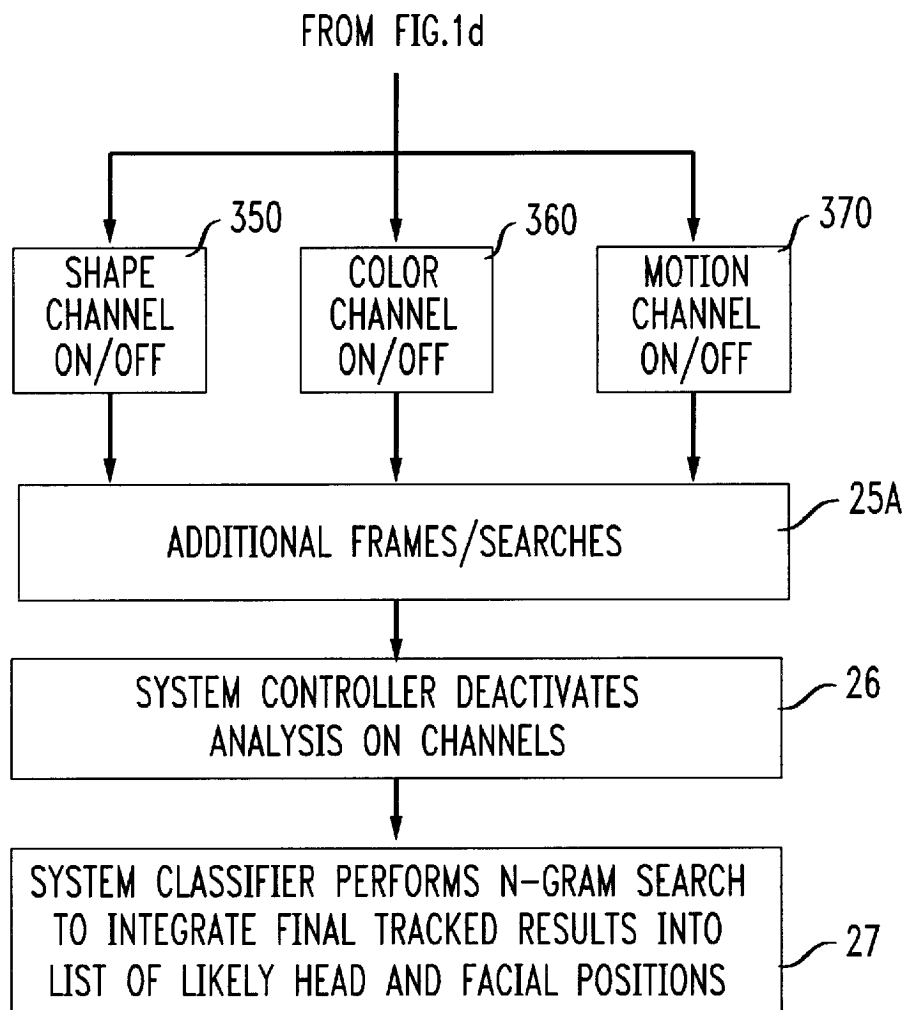
FIG. 1e

FIG. 2a

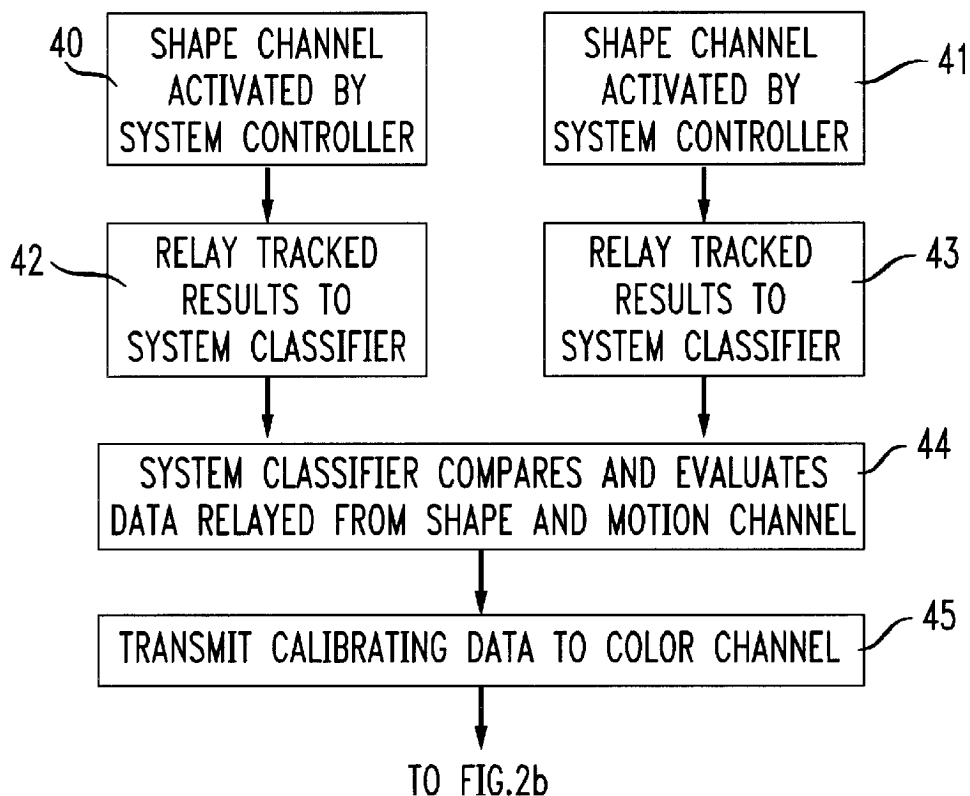


FIG. 2b

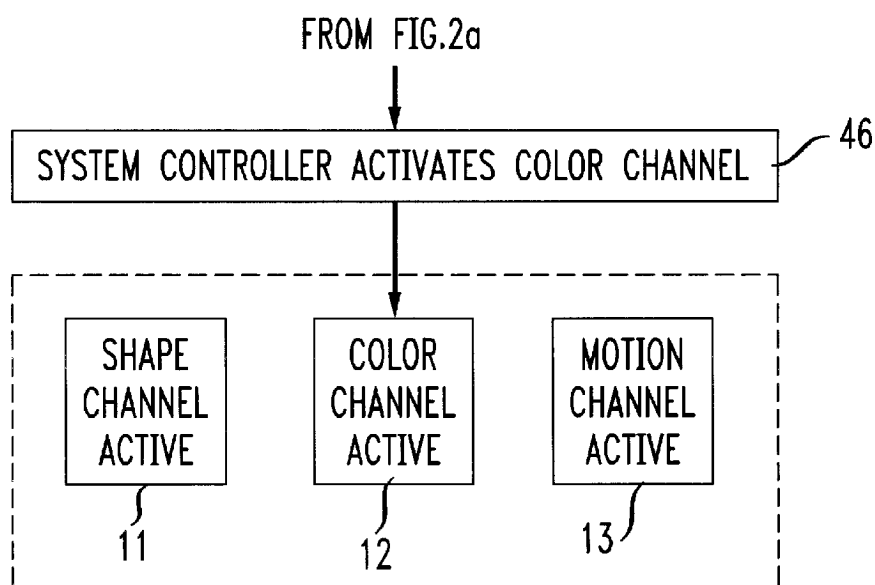


FIG. 3

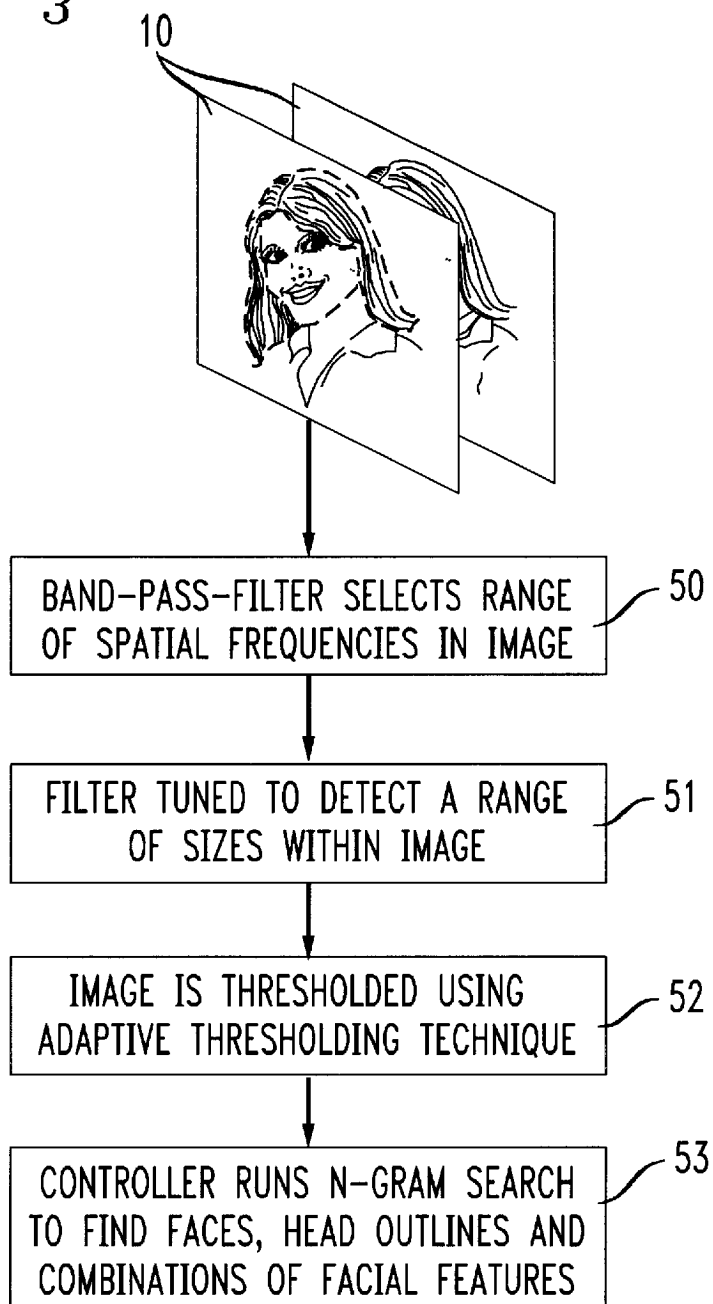
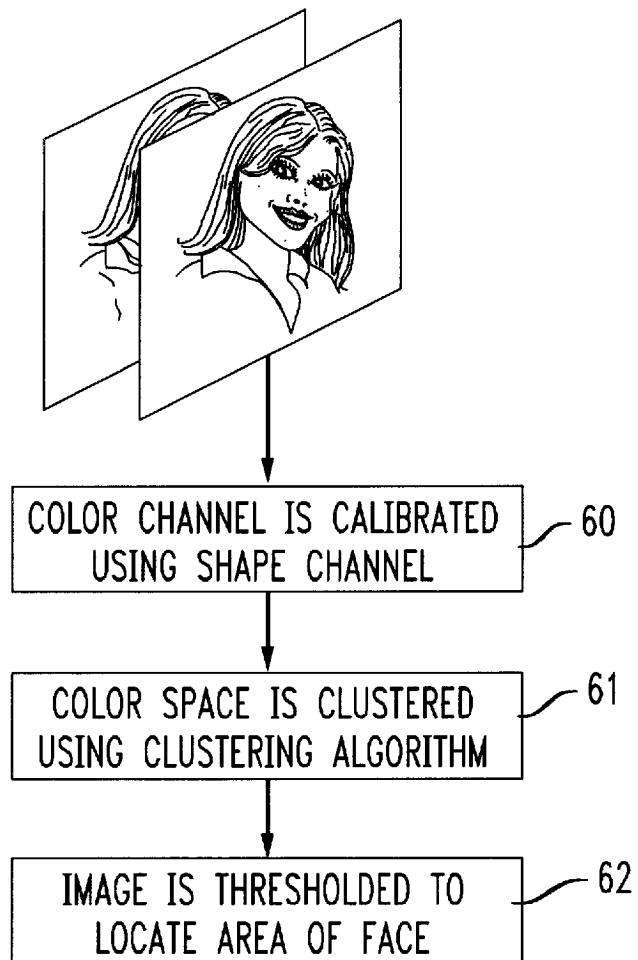


FIG. 4

MULTI-MODAL METHOD FOR LOCATING OBJECTS IN IMAGES

BACKGROUND OF THE INVENTION

The present invention relates to methods for identifying objects of varying shapes, sizes and orientations within complex images.

Although the principles of this invention are equally applicable in other contexts, the invention will be fully understood from the following explanation of its use in the context of locating heads and faces within still or moving pictures.

Various applications necessitate the design of a method for locating objects, such as heads and faces, within complex images. These applications include, for example, tracking people for surveillance purposes, model-based image compression for video telephony, intelligent computer-user interfaces, and other operations.

A typical surveillance tracking method may involve the use of a camera installed in a fixed location such as a doorway. The camera conveys its collected images to a modular control system, which locates and identifies heads and facial features of people entering the doorway. Instances of identification may then be communicated to an appropriate source such as an alarm system. Still other applications involve cameras installed on a computer workstation for tracking heads and facial features of persons seated in front of the workstation. Such tracking information may, in turn, be used for workstation access by identifying persons authorized to use the terminal. The foregoing applications are exemplary in nature, as numerous additional applications may be contemplated by those skilled in the art.

Any proposed tracking method should be capable of performing effectively in a practical setting. Tolerance to variations in environmental parameters is highly desirable. For instance, a useful tracking method should function competently over a large range of lighting conditions. A tracking method should likewise be tolerable to variations in camera and lens characteristics and other scene parameters.

Algorithms for identifying faces in images have been proposed in the literature. While these algorithms may suffice for use in environments involving a limited range of conditions, they routinely fail when deployed in a practical setting. Such prior algorithms include simple color segmentation which relies on skin color distinctions to track faces in images. Color segmentation algorithms require analysis of the single parameter of color; they are consequently very fast. Color segmentation provides accurate tracking results where a sufficient contrast exists between skin colors and the background colors of the collected images. Where the skin colors are similar to the background colors, however, these algorithms are typically unreliable.

Most practical applications further require that the tracking method be non-intrusive to the people being observed. For example, a surveillance system at a bank would be unduly intrusive if individuals in the bank were restricted in their movements. A proposed tracking method should therefore permit the free, unobstructed motion of persons under observation. Disadvantageously, simple color segmentation is inadequate where quick or complex movement occurs in the collected images. The color segmentation algorithms often cannot sufficiently evaluate rapidly changing images. Thus, where the persons portrayed are in constant motion, accurate tracking using this method is extremely difficult. The problem escalates where the background colors in subsequent frames become similar to skin colors. In short,

using simple color segmentation fails to address the tracking problems encountered in environments having constantly varying parameters such as lighting and motion.

Additionally, simple color segmentation relies on the evaluation of information from a single parameter to produce its results. Because color is the only parameter considered, the tracked results are often imprecise.

Other proposed recognition systems have been described in the literature which use multiple algorithms or classifiers. These classifiers typically rely on additional parameters, such as shape, motion, or other variables, to track the desired objects. Using additional parameters increases the accuracy of the tracked output. In these systems, several different classifiers evaluate an object independently, and then combine the results in a final step. This combinational step may be accomplished, for example, by a voting procedure. Other techniques combine the results of various classifiers using a weighted process that accounts for the error rates of each classifier. Generally, the use of additional parameters enables the tracking system to extract enhanced detail from the collected images. The accuracy of these algorithms and the robustness of the tracked output are therefore improved over that of simple color segmentation.

In addition, combining and integrating the final results provides information to the tracking system which may be used to train the system for subsequent tracking. Such training processes further increase the accuracy of algorithms based on more than one classifier.

One major disadvantage of existing multi-classifier algorithms is their substantially decreased tracking speed. Running a plurality of channels simultaneously requires complex and time-consuming computations. Thus the use of additional classifiers results in a much slower computation time. Moreover, analyses of shape parameters are usually slower than analyses of color parameters for a particular image. These differences in processing speed are attributed to the complexity of shapes within the collected images and the large number of computations required to identify combinations of shapes. For these reasons, speed advantages inherent in simple color segmentation are largely lost for algorithms involving combinations of classifiers.

Another problem with existing algorithms based on multiple classifiers is that each classifier typically operates independently of the others. No intermediate steps exist for comparing classifier results. The results are combined only as part of a final step in the process. As such, no single classifier may confirm the accuracy of its data, or compare its data with that of other channels, until the end of the analysis. This problem derives from the inherent characteristics of existing recognition systems. No relationship exists between the data gathered by one classifier and the data gathered by another. For example, one channel in the system may analyze and collect data based on the positioning of pixels on a screen, while another channel may generate tables of data based on an unrelated statistical extraction program. Results between such channels cannot be meaningfully compared until the end of the analysis, where complex algorithms are employed to combine and integrate the final data.

The problem is exacerbated where a channel has gathered inaccurate information for a large number of iterations. In such a case, the final result may be imprecise. Further, because the classifiers track their respective parameters independently, no ability exists for one classifier to calibrate another classifier before the latter initiates its analysis. These disadvantages result in more complicated algorithms and greater computation times.

The following needs persist in the art with respect to the development of algorithms for tracking objects in collected images: (1) the need for a tracking method which provides a more robust and accurate output; (2) the need for a tracking method which is considerably faster than existing algorithms based on multiple classifiers; (3) the need for an efficient tracking method based on multiple channels to enhance the accuracy of the output; (4) the need for a multi-channel tracking method where the accuracy of each channel is confirmed by results obtained from other channels; and (5) the need for a tracking method capable of simultaneously maximizing tracking speed and output precision.

It is therefore an object of the present invention to provide a tracking method which provides a more accurate and robust tracked output than existing algorithms.

Another object of the invention is to establish a tracking method which is faster than existing multi-classifier systems, and which achieves a maximum level of accuracy of the tracked result.

Another object of the invention is to provide a more efficient tracking method.

Another object of the invention is to set forth a multi-channel tracking method having the ability to confirm the accuracy of each channel's output by comparing results from other channels at various stages during the tracking process.

Another object of the invention is to provide a tracking method which produces an intermediate image for early evaluation and for optimal subsequent channel selection by the system.

Additional objects of the invention will be contemplated by those skilled in the art after perusal of the instant specification, claims, and drawings.

SUMMARY OF THE INVENTION

These objects of the invention are accomplished in accordance with the principles of the invention by providing methods which track objects such as heads and faces within complex images. The methods comprise a multi-channel tracking algorithm which intermediately measures the quality of its channels' outputs, and thereby determines an optimal tracking strategy to be used for the remainder of the algorithm. The methods provide for a substantial improvement in speed and accuracy over prior tracking systems.

The methods comprise the use of a combination of shape analysis, color segmentation, and motion information for reliably locating heads and faces in fixed or moving images. The methods further comprise the generation of an intermediate representation for each channel wherein tracked results are evaluated and compared by a system controller. Based on these results, the controller can make the decision as to which channels should remain active for the duration of the tracking process. This selection is made for achieving optimal tracking speed and output accuracy.

The methods use three channels for tracking three separate parameters. A first channel performs a shape analysis on gray-level images to determine the location of individual facial features as well as the outlines of heads. A second channel performs a color analysis using a clustering algorithm to determine areas of skin colors. The color channel may, but need not, be calibrated prior to activation by using results obtained from one or more separate channels. A third channel performs a motion analysis wherein motion information is extracted from frame differences. The motion analysis determines head outlines by analyzing the shapes of areas having large motion vectors.

In a preferred embodiment, the tracking analysis begins with an evaluation by all three channels. After one or more iterations, an intermediate representation of the collected tracking output is obtained from each. The intermediate representations comprise shapes where facial features or the outlines of heads may be present.

All three channels ideally produce identical representations of tracked head and facial positions. Hence, the information from each channel may be seamlessly integrated into a single result. Meaningful comparisons between the channel data may also be performed. In particular, a system classifier evaluates the quality of each channel's generated head and facial features. In a preferred embodiment, the evaluation is performed using an n-gram search. Based on this evaluation, the controller determines the optimal strategy for performing the remainder of the tracking analysis. This evaluation is advantageously performed at a very early stage in the algorithm. The final tracked output is therefore achieved much faster than as compared with previous algorithms.

The controller of the tracking system may be implemented in either hardware or software. The controller may, for instance, be a state machine designed to achieve a precise final result for the location of heads and faces. After obtaining intermediate representations from the channels and running an n-gram search, the controller selects an appropriate combination of channels for continued analyses. The shape, motion, or color channel, or any combination thereof, may be activated for a selected number of frames until the tracking process is completed. For example, the very fast color channel is often sufficiently reliable to run by itself for several frames.

By choosing one or two channels to run for part of the tracking process while keeping the remaining channel(s) inactive, the computation time is kept low. By the same token, the existence of three channels producing identical representations for eventual integration into the final tracked output provides for a high degree of accuracy and robustness.

In addition, the controller may reassess the tracked results at various stages after making the intermediate channel selection described above. It makes this reassessment by reinvoking additional channels for a selected number of frames, and then running an n-gram search as to the collective results. To sustain optimal tracking performance, the controller may choose to further invoke or deactivate channels until the completion of the analysis.

The system classifier integrates all collective representations using n-gram searches to form the tracked output. These searches may take place at the intermediate stage or any time thereafter as determined by the controller. The controller also invokes an n-gram search after activity on the channels concludes. These searches produce a list of likely head positions and the locations of facial features. The result is a tracking algorithm which balances the variables of speed and accuracy based on simple channel comparison.

In another preferred embodiment, the tracking method begins with a shape and motion analysis. After one or more iterations, the collected information is used to calibrate the color channel. Such calibration is particularly desirable where skin colors are difficult to distinguish from background colors. Following calibration, the tracking process may proceed pursuant to any method described herein. Using this process, accurate intermediate representations from the color channels can be obtained at a much earlier stage than if calibration were unavailable.

From the above methods of evaluating intermediate channel results to select the use of subsequent channels, numerous embodiments and variations may be contemplated. These embodiments and variations remain within the spirit and scope of the invention. Still further features of the invention and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1, also known as FIGS. 1a, 1b, 1c, and 1d, and 1e, depict a flow chart of an exemplary tracking algorithm in accordance with one embodiment of the present invention.

FIGS. 2a and 2b depict a flow chart representing the calibration of the color channel in accordance with one embodiment of the present invention.

FIG. 3 is a flow chart representing a method for performing a shape analysis in accordance with one embodiment of the present invention.

FIG. 4 is a flow chart representing a method for performing a color analysis in accordance with one embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, which depicts an algorithm in accordance with one embodiment of the present invention, images 10 are selected for tracking. It will be evident that certain steps within FIG. 1 are exemplary in nature and optional to the algorithm's implementation. The tracked objects in FIG. 1a comprise heads and facial features. The images 10 selected for tracking may comprise a single frame or a sequence of frames, and may originate from any of an unlimited number of sources. The frames may, for example, derive from a camera set up in a room. The images need not be created in a controlled environment. Images instead may be extracted from outdoors, from a dimly lit room, from an area having moving objects, or from another location. In this preferred embodiment, the algorithm is initiated by the activation of all three channels: the shape channel 11, the color channel 12, and the motion channel 13. Channels 11, 12, and 13 may be operated or invoked by a system controller or other appropriate hardware device. The channels may also be controlled by a software program.

The channels 11, 12, and 13 begin their respective analyses of shape, color and motion. The color channel 12 is provided with generic calibration parameters. These parameters may be supplied by the system controller or another source. If sufficient differences exist between the skin colors and the background colors of the images to be tracked, generic calibration parameters ordinarily suffice for the analysis.

As indicated by the steps 14, 15, and 16 in FIG. 1a, each channel 11, 12, and 13 performs its analysis for a predetermined number of iterations or frames x. Following the analyses, the channels relay their respective tracking data to a system classifier or other device (steps 17, 18, and 19, FIG. 1b). A system classifier can be broadly defined as a system or software program for analyzing data obtained from the channels. There are many types of classifiers. Typical examples are neural network classifiers and statistical classifiers. A preferred embodiment of the invention uses an n-gram classifier, as will be explained in detail below.

The data produced by each channel comprise a list of areas which may contain head outlines and facial features.

Thus, each channel generates an intermediate feature representation (not shown in the figures).

The channels' intermediate representations comprise information relating to the same tracked features, even though each channel uses a different parameter (color, motion, and shape) to obtain these features. For at least two reasons, the identical nature of the channels is highly advantageous. First, the channels' results may be evaluated without the need for complex, time-consuming transformations. Second, each channel's intermediate representation is amenable to meaningful integration into a single list of likely head and facial positions.

The feature representations of the channels may be capable of visual display on a screen, but more typically they are internal data structures compatible for prompt interpretation by the system classifier. These data structures mark areas perceived by the channels as comprising head outlines or facial features.

As indicated by the succeeding step 20 in FIG. 1b, the system classifier compares, evaluates and integrates the generated features. A preferred method for performing these functions is to use an n-gram search. Preferably, an n-gram search is performed after the passage of each frame wherein one or more channels are active. An n-gram search uses information obtained from all three channels to evaluate the quality of individual features, as well as combinations of features, within the representations. Using this search, the system classifier assigns a measure of confidence for each feature and each combination of features. Based on these measures of confidences produced by the system classifier using the n-gram search, the system controller determines which channel(s) should be used for further tracking to arrive at the final result.

As an illustration, the system classifier performs an initial n-gram search after it obtains the three channels' intermediate feature representations. Candidate facial features in the representations are marked with blobs of connected pixels. The classifier analyzes the shape of each individual feature, and discards those that definitely cannot represent a facial feature. This stage of the search is the uni-gram search. Exemplary facial features which may be considered at the uni-gram stage are the eyes, eye brows, nostrils, mouth, chin grooves, the left outline of a head, etc. The classifier associates a measure of confidence for each such feature based on its perceived level of accuracy. Next, the classifier evaluates and classifies combinations of two features in a bi-gram search. At this stage, the classifier considers whether connected components can represent a combination of two facial features, such as an eye pair, eye brows, an eye and a mouth, the left and right outlines of a head, etc. Based on this evaluation, the system classifier assigns a measure of confidence for each such combination. In the next stage, the classifier evaluates triple combinations of features in a tri-gram search, and likewise assigns measures of confidence for these combinations. Each stage of the search establishes information as to the reliability of the channels.

A tri-gram search may establish, for example, that perceived areas of skin colors reported by the color channel are accurate because the reported area falls within the perceived left and right head outlines obtained from the motion channel. Thus, the classifier would likely assign a high measure of confidence to the triple combination of left head outline, right head outline, and skin areas. From this and other information, the classifier may deduce that the color and motion channels are producing reliable information. Thus a high score may be given to the color and motion channels,

as described below. In other situations, the color channel may be inaccurate. For instance, the perceived areas of skin colors reported from the color channel may not fall within head outlines reported from the motion channel. By the same token, the perceived mouth area reported by the shape channel may be accurately positioned within the head out-
lines. Based on this information, the classifier would likely assign a low measure of confidence for the skin color area, but a high measure of confidence to the triple combination of head outlines and the mouth area. These results potentially reflect a low reliability for the color channel **12**, and higher reliabilities for the shape **11** and motion **13** channels.

The n-gram search may continue until sufficient data is obtained for the system controller: (1) to calculate, based on the obtained measures of confidence, which channel(s) is/are best suited for further tracking; and (2) to integrate, using the classifier or other dedicated program, the individual feature representations into a net representation for maintaining the tracked results. Feature representations obtained from future tracking steps are later integrated into the final output using one or more additional n-gram searches following each frame.

One goal of the invention is to arrive at the intermediate representation stage as quickly as possible. The earlier the generation of the feature representations, the faster the performance of a channel, and the faster the selection of channel(s) for additional tracking. In this manner, information relating to the tracked objects will be made available to the controller at a very early stage in the process. The total tracking time is consequently decreased. With the present invention, the results from channels **11**, **12**, and **13** are relayed to the system controller after a single iteration (i.e., $x=1$). Thus the system obtains channel evaluation at a very early stage in the analysis.

The interaction between the system classifier and the system controller is illustrated in FIG. 1b by the box **100** and the two dashed lines **110** and **120**. The results of the n-gram search are made available to the system controller **100**, as represented by the dashed line **110**. These results are used as part of the selection step **21** described below. The use of the results for channel selection is represented by the dashed line **120** and step **21**.

In the next step **21** depicted in FIG. 1b, the system controller determines which channels to select for further tracking. The selection is made based on the results of the n-gram search described above. In a preferred embodiment, the controller determines a general score **Y1**, **Y2**, and **Y3** for each channel **11**, **12**, and **13**. The determination of a general score facilitates the selection process. A variety of suitable means exist for determining the channels' general scores. Preferably, the system controller computes these general scores from the measures of confidence determined by the system classifier for individual features and combinations in the n-gram search. The controller then selects additional channel(s) to be used based on the channels' general scores. In making its channel selection based on general scores, the controller may select the channel(s) with the highest score (s). Alternatively, the controller may take additional variables into account, such as the relative speeds of the individual channels, before making its selection.

In addition, a fixed threshold measure of confidence may optionally be identified with each channel. This fixed quantity may, for example, represent the lowest permissible score for a channel. The quantity may vary depending on the terms of the algorithm or the nature of the images to be tracked, or other factors.

As an illustration, if the shape channel **11** has a subthreshold general score, continued use of that channel may produce unreliable results. Thus the analysis may continue using only color **12** or motion **13** analysis, or both. As another example, if the shape **11** and motion **13** channels' confidence measures exceed their respective threshold values, the system controller may decide to run only the shape analysis for a designated number of frames. Whatever channel is ultimately chosen, the tracking process is much faster because only one or two parameters are measured for several frames. This method is therefore superior to methods involving the full and continuous use of all three channels.

Depending on the confidence measure of each feature, the size of the microprocessor in the system controller, the complexity of the images to be tracked, and other factors, numerous approaches to the algorithm will be contemplated. Such variations are intended to fall within the scope of the invention.

In the next step **22** in FIG. 1c, the controller implements the channel or combination of channels to be run for a selected number of frames. For example, often the color analysis is perceived to be reliable based on the n-gram search results. Running the very fast color analysis alone for several frames advantageously increases tracking speed. Thus, if the color channel has a high enough general score **Y2**, the system controller may select the color channel **12** to run for a predetermined number of frames.

In other situations, the color channel **12** will have a low general score **Y2**. In that case, the controller may instead activate the shape **11** or motion **13** channels, or both, for a predetermined number of frames. The controller will therefore select a tracking strategy which minimizes the effect of the color channel **12** on the final output.

The particular channel selection, of course, will vary depending on the search results. The state of each channel (on or off) following channel activation is illustrated by boxes **150**, **160** and **170**.

Following this sequence of steps representing the initial channel selection by the system, the active channels continue to extract information in subsequent frames using the above described methods. Preferably, the classifier runs its analysis after each frame as the tracking algorithm proceeds. Thus one or more additional frames, together with a corresponding classifier analysis of each frame, are generally represented by box **22a**. The passage of frames represented by box **22a** may continue for a predetermined time or until the system controller prompts a change in the tracking procedure. A change may occur, for example, where the system controller deactivates activity on the channels. A change may also occur where the system controller elects to reinvok additional channels or deactivate selected channels as described below.

The system controller may decide to reactivate one or more channels at a later point in the tracking process, as illustrated by step **23** in FIG. 1c. The controller may reinvok channels for numerous reasons. For instance, the controller may elect to reconfirm results currently being obtained based on a previous channel selection. Reconfirmation is useful, among other situations, where an activated channel's general score **Y** was previously computed at a borderline value. Additionally, the controller may opt to reattempt use of the very fast color channel **12**, which was previously rejected as unreliable by an earlier n-gram search. The status of the channels after the reinvocation of additional channels (step **23**) is represented by boxes **250**, **260**, and **270**. After the newly reinvoked channel has run for a

frame, the controller invokes the classifier as usual to perform an n-gram search to evaluate the newest results (step 24, FIG. 1d). Based on these search results, the controller may activate or deactivate one or more selected channels to maintain tracking speed and accuracy (step 25, FIG. 1d). The interface between the controller and the classifier is represented by box 200 and corresponding dashed lines 210 and 220. The interface is analogous to the controller interface of FIG. 1b. In FIG. 1e, boxes 350, 360 and 370 represent the current state of the channels (i.e., on or off) following the activation step 25.

The following example illustrates the subsequent use of channels for reconfirmation. The controller determines in step 23 that the color channel 12 is best suited for further tracking. The color channel 12 is therefore invoked for several additional frames $x1$. No shape and motion computations are required during this time. In a preferred embodiment, $x1=10$, but in practice the quantity $x1$ can cover a wide range and still facilitate effective tracking. After the passage of $x1$ frames, the controller activates the motion channel 13 for a selected number of frames $x2$. The motion channel 13 and the color channel 12 run concurrently for $x2$ frames. The quantity $x2$ is selected by the controller. Preferably, $x2<10$. After the passage of each frame during the $x2$ frames, the controller compares the results of the motion channel 13 and the color channel 11 as previously described. If the color channel 11 receives a high general score $Y2$ for each frame based on high feature-based measures of confidence, the accuracy of the color channel is confirmed. In this event, the controller may either conclude the analysis or track for additional frames using only the color channel 12. Conversely, if the n-gram searches reveal that the color channel had lost its accuracy, the controller may select another combination of channels to run for the remainder of the algorithm.

In the example above, the color channel runs for a total of $x+x1+x2$ iterations, the shape channel runs for $x+x2$ iterations, and the motion channel runs for x iterations where $x=1$ (typically), and $x2$ is typically less than 10. During the majority of this process, only the very fast color segmentation process need be calculated (plus reduced analyses of the shape and/or motion channels 11 and 13). This method saves considerable computation time as compared with previous processes that run a full analysis of all three channels. Moreover, this method achieves a high accuracy due to the availability of multiple tracking parameters.

The controller may alternatively determine that the shape channel 11 is best suited for further tracking (step 21, FIG. 1b). The controller may also reinvoke the color channel 12 at a subsequent time in the analysis. If a higher general score $Y2$ for the color channel is later obtained, the results of the color channel may then be integrated into the final tracked output. The controller may also implement a calibration procedure for the color channel 12, and then reinvoke use of that channel.

Additional frames may pass, with corresponding searches run after each frame, using the activated/deactivated channels from step 25. This sequence of frames is generally represented by box 25a. Also, during the course of the algorithm, additional channel confirmation/activation steps may be performed (e.g., steps 23–25) depending on the quality of the obtained representations, or at the instigation of the controller, etc.

The system controller concludes the tracking analyses by deactivating all active channels (step 26, FIG. 1e). The channel-based tracking analysis is now complete. Together

with information already obtained from previous frames, the system classifier evaluates and integrates the final data (step 27, FIG. 1e). An n-gram search is preferably used to integrate the final output data. Using the n-gram method, features and combinations of features are again evaluated and classified, and the controller selects lists of perceived areas based on these classifications. In the end, the tracked output comprises a list of likely head and facial positions within the tracked images.

In sum, depending on the reliability of the channels as determined by the n-gram searches, the controller selects among a plurality of appropriate tracking strategies. The controller generally elects the strategy which maximizes both the speed and accuracy of the system. To maximize speed and accuracy, the system controller selects only the most reliable channel(s) to perform the majority of the tracking. The controller makes this selection by evaluating reliability data produced by the classifier.

Another preferred embodiment is depicted in FIGS. 2a and 2b. Here, the color channel is calibrated prior to activation. Calibration is particularly desirable where the background colors on the images to be tracked are akin to the facial colors. Proper calibration enables the color channel 11 to summarily reject background and extraneous colors on the tracked images. A faster, more precise color analysis is therefore achievable.

To accomplish calibration, the system controller first activates the shape 11 and motion 13 channels (steps 40, 41, FIG. 2a). These channels perform their usual analyses. After some predetermined number of iterations (often a single iteration), the shape channel and motion channels 11 and 13 relay their current results to the system classifier (steps 42 and 43). In the next step 44, the system classifier compares and evaluates the relayed data. This data may now be used to calibrate the color channel 11. Advantageously, the evaluation step 44 comprises a straightforward processing of data since the shape 11 and motion 13 channels use identical output formats as previously discussed.

Next, in step 45, the newly-formulated calibration parameters are transmitted to the color channel 12. In the next step 46 (FIG. 2b), the controller activates the color channel 12. All three channels are now performing their respective tracking analyses. The remaining steps of the process may proceed pursuant to any of the other embodiments, such as steps 14, 15 and 16 in FIG. 1a.

As an alternative to the above embodiment, the system controller may deactivate the shape 11 or motion 13 channels, or both, after calibrating the color channel 12. While calibration preferably occurs at the beginning of the analysis, it may occur at subsequent stages. Calibration may also be accomplished using a single channel such as the shape channel 11.

Calibration enables the very fast color channel 12 to produce a more reliable output. Having calibrating data to pinpoint perceived locations of heads and facial features, the color channel 12 can complete its tracking analysis more quickly and accurately. As such, the entire tracking algorithm is faster. Where background colors are dissimilar to skin colors, the calibrating step need not necessarily be performed.

The system controller may choose to activate the fast color analysis alone for the majority of the tracking process. As such, the total tracking speed is further increased. In addition, the controller may subsequently invoke one of the other two channels 11 and 13 to confirm results obtained from the color channel 12. Accuracy is thereby achieved

without the need for time-consuming computations like in prior art algorithms.

The preferred modes of operation for the particular channels will now be discussed.

Shape Analysis

It will be understood that the shape analysis may be implemented using a variety of appropriate methods. The method presently preferred by the inventors is set forth below.

The shape analysis seeks to find outlines of heads or combinations of facial features which indicate the presence of a face. Preferably, the shape analysis uses luminance only. As such, the analysis is effective even where cheap monochrome cameras are used.

For frontal views of faces, the algorithm first identifies candidate areas for facial features. The algorithm next searches for combinations of such features to find the whole faces. In images with a low resolution, individual facial features may not be distinguishable. A person may also turn away from the camera so that only the back of the head is visible. In such cases the algorithm seeks to find the outline of the head.

A key element of the shape analysis is to obtain an intermediate representation of the tracked results. From this representation, facial parts or head outlines can be tracked using straightforward computations. FIG. 3 depicts a preferred shape algorithm. An image 10 is transformed by two filters in steps 50 and 51. The first is a band-pass filter. Facial features exhibit intensity variations; hence their appearance can be emphasized by selecting a band of spatial frequencies. The band-pass filter is therefore comprised of a range of cutoff frequencies whereby only images having the desired range of spatial frequencies are accepted.

After the band-pass filtering step 50, the image passes through a second filter which is tuned to detect a range of sizes of simple shape. This filtering is accomplished in step 51. The second filter convolves the image with a shape such as a rectangle or an ellipse. Using this filtering method, areas of high intensity that are larger than the structuring kernel are emphasized, while smaller areas are reduced in intensity. Steps 50 and 51 reduce variations in the tracked images due to changing lighting conditions, and enhance areas of facial features and head boundaries.

After the filtering operations 50 and 51, the image is thresholded with an adaptive thresholding technique 52. The purpose of this technique is to identify the positions of individual facial features by using a simple connected component analysis. If the threshold level is selected properly, the areas of prominent facial features will become visible. In particular, areas such as eyes, mouth, eye brows, and the lower end of the nose are marked with blobs of connected pixels which are well separated from the remainder of the image. The algorithm can then locate the position of a face by searching for appropriate combinations of these blobs. The images are treated similarly for finding the outline of a head. For the head, however, both vertically and horizontally extended regions of high spatial frequencies are filtered out by the band-pass filter.

Once candidate facial features are marked with connected components as described above, combinations of such features which represent a face are next sought. This step 53 is preferably accomplished using the aforescribed n-gram method. The method discards connected components which cannot comprise facial features, and assigns a measure of accuracy to the remainder.

At each stage of the search, the connected components are evaluated with small classifiers that utilize inputs such as

component size, ratios of distances between components, and component orientation.

The search for the head outline proceeds in a similar manner. The first search scan selects those connected components that can represent left or right boundaries of a head. Next, the system classifier examines combinations of left and right edges. Finally, combinations of vertical and horizontal edges are evaluated. The head outline is approximated with an ellipse, and the coverage of an ellipse by connected components is taken as a measure of the quality of the fit. In addition, if results from the other two channels are available, they may be included in the n-gram search.

The computation of the n-gram search increases exponentially with n, the number of different components taken into account. Thus, the search is potentially costly and time-consuming. However, by using the hierarchical search algorithm described above and by eliminating components with low measures of quality from consideration, the computation can be kept very fast. In fact, the computation for the whole shape analysis is dominated by the time for the band-pass filtering step 50 and the shape filtering step 51. A typical search time for the shape analysis, using a 150 MHZ pentium microprocessor to track an image with a size of 360x240 pixels, is less than 0.5 seconds.

Certain parameters are required to implement the shape analysis. These include the cut-off frequencies of the band pass filter, the size of the structuring kernels for the shape filtering, and the thresholds for binarizing the results. These parameters may be determined using a method such as a fully automatic training procedure. In a preferred method, one-hundred images of twenty-five people are used to establish measurements for input into the tracking system. In the training procedure, the positions of the eyes, the left and right end points of the mouth, and the lower end of the nose can be measured by hand. Next, the sizes of the connected components representing facial features are measured. For an automatic optimization of the parameters, a quality measure of the following form is useful:

$$S=100-(a*(x-x(0)))-(b*(w-w(0)))$$

where

S=quality of the marking of the feature

x=position of the connected component

x(0)=desired position of the connected component

w=width of the connected component

w(0)=desired width of the connected component

a, b=scaling factors

Thus, an independent optimization of each parameter may be performed by scanning one parameter over its whole range of values while keeping the other parameters constant.

When tracking parameters are properly chosen, the facial features may be accurately tracked over a wide range of scales and conditions. For instance, eye regions may be found regardless of whether the eyes are open or closed. The same is true for mouths. Whether the mouth is open or closed has little influence on the ability of the described technique to mark the correct area on the image.

Advantageously, this approach enables the system to track a wide range of sizes of facial feature using a single set of parameters. Other existing approaches are inferior. For example, existing methods which use filters designed for detecting whole heads or faces tend to be very scale sensitive. Thus, for those methods, many search scans need be performed to permit the tracking of faces covering a range of sizes. The shape-tracking technique of the present invention, however, can handle a range of head sizes of more

than a factor of two. As an additional benefit, the invention accommodates such variances using a single set of parameters.

Color Analysis

FIG. 4 depicts a color algorithm in accordance with the present invention. The following algorithm comprises a preferred method of performing a search based on color; however, other suitable methods may be contemplated. Color information is an efficient vehicle for identifying facial areas and specific facial features. However, the system must often be calibrated to accommodate specific conditions. Unfortunately, these calibrations usually cannot be transferred to different cameras and to strongly varying conditions in the illumination. Skin colors can vary considerably. In addition, skin colors are often indistinguishable from similar background colors. For this reason, color analysis in the present invention is used only in combination with shape and motion analyses. Particularly where colors are difficult to distinguish, the color channel should be calibrated first.

After a calibration step 60 the color space is clustered with a leading clustering algorithm for finding a whole space, as in step 61. In this algorithm, one or two cluster centers are initialized to skin colors of a part of the face identified by the shape analysis. Normalized rgb values are chosen as color space:

$$r=R/(R+G+B)$$

$$g=G/(R+G+B)$$

$$b=B/(R+G+B)$$

Using normalized rgb values advantageously minimizes the algorithm's dependence on luminance. Dark pixels ($R+G+B<30$) are set to zero to avoid instabilities caused by the normalization process.

After skin colors have been identified with the calibration and the clustering process, the image is next thresholded in order to locate the area of the face (step 62).

When whole faces alone are to be tracked, color information is used only to identify larger areas. In such a case, the tracked image is typically subsampled to 40x30 pixels using bilinear interpolation. After binarization, each segment in the image is analyzed for its shape and size to determine whether or not it can represent a face. Faces are often the dominating set of connected components in the image, and thus the face position can be easily identified. Using a 90 MHZ pentium microprocessor, the typical time required for the color analysis following calibration is 10 milliseconds.

Motion Analysis

If multiple images of a video sequence are available, motion is often a parameter that is easily extracted. This parameter provides a quick method to locate an object such as a head. The first step in a preferred motion algorithm is to compute the absolute value of the differences in a neighborhood surrounding each pixel within the image to be tracked. A typical neighborhood is 8x8 pixels. When the accumulated difference for a pixel is greater than a predetermined threshold T, the system controller then classifies that pixel as belonging to a moving object. T is typically set at 1.5 times the temporal noise standard deviation, times the number of pixels in the neighborhood.

Applying the threshold to the accumulated difference as opposed to the individual pixel difference results in two advantages. First, T can be expressed with increased precision. Second, the neighborhood processing has an effect similar to morphological dilation. This helps fill small gaps that occur in areas where the moving object has similar pixel values to the background. The technique is effective for use

on images which contain a wide variety of cluttered background scenes.

Areas of moving objects are analyzed by using a contour-following algorithm to extract the region boundaries. For each region, the contour is smoothed, and the curvature of the contour is calculated. Feature points are identified along the contour at points of local extrema of the curvature.

The accumulated set of feature points for each region is compared to a model set of features corresponding to a head and shoulders shape. If a match is found, the head center coordinates are determined by calculating the mean value of the contour data for the portion of the contour that corresponds to the head. The size of the head is estimated as the mean distance from the head center to the contour. The temporal correlation of head center and size estimate is analyzed over several frames to identify spurious matches. Since only the outline of the head is analyzed, both front and back views, and usually also side views of heads are found.

This technique typically analyzes a frame in less than 30 milliseconds.

Combining the Channels—Training

Preferably, training procedures are used to provide the system controller with the necessary parameters for the n-gram search. The classifications are based on one or more head models chosen to represent expected situations. The models define all the size parameters required for the classifications and the order of the searches. To avoid a combinatorial explosion when exploring shape combinations, a greedy search is done, and a proper search order is thereby established. The order of the searches is based on a maximum entropy measure and is determined in the training procedure.

The model for frontal views are generated from a training set of 35 people looking into a camera. On this set the positions of the eyes and the eye pairs are measured. These measurements provide valuable information to the system controller when running the eye-pair search. Eye pairs can be found easily and reliably. The eye-pair search drastically reduces the number of shapes that have to be taken into account for further analysis. Thus, the preferred method of searching begins with the eye-pair search. Other features and feature combinations are classified in the same way, and an order of the searches is established by the training procedure.

It will be understood that the foregoing is merely illustrative of the principles of the invention, and that various modifications and variations can be made by those skilled in the art without departing from the scope and spirit of the invention. The claims appended hereto are intended to encompass all such modifications and variations.

We claim:

1. A method for locating objects in images, comprising: tracking designated objects in the images using a plurality of channels during a first number of frames, the objects comprised of one or more features, each of said channels producing an independent representation comprising perceived locations of said one or more features; determining a general score for each channel; selecting, based on said general scores, at least one channel for additional tracking; tracking the objects using said at least one channel during a second number of frames, each said at least one channel producing an independent representation comprising perceived locations of said one or more features; and combining said independent representations to produce a tracked output.

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2. The method according to claim 1, wherein said determining step comprises:

searching for said features and combinations of said features within said independent representations produced during said first number of frames;
 assigning measures of confidence to each said feature and each said combination of features; and
 computing, based on said measures of confidence, said general score for each channel.

3. The method according to claim 2, wherein said searching step comprises an n-gram search.

4. The method according to claim 1, wherein the number of channels used for said tracking during said first number of frames is three, said three channels programmed to perform respective analyses of shape, color and motion to track the objects.

5. The method according to claim 2, wherein the number of channels used for said tracking during said first number of frames is three, said three channels programmed to perform respective analyses of shape, color and motion to track the objects.

6. The method according to claim 4, wherein the number of channels used for said tracking during said second number of frames is one.

7. The method according to claim 6, wherein said one channel used for said tracking during said second number of frames comprises the color channel.

8. The method according to claim 5, wherein the number of channels used for said additional tracking during said second number of frames is one.

9. The method according to claim 8, wherein said channel used for said tracking during said second number of frames comprises the color channel.

10. The method according to claim 2, wherein said combining step comprises an n-gram search.

11. The method according to claim 6, wherein said first number of frames is one.

12. The method according to claim 10, further comprising:

tracking the objects during a third number of frames using at least one channel used for said tracking during said second number of frames and at least one additional channel, each channel used for said tracking during said third number of frames producing an independent representation comprising perceived locations of said one or more features.

13. A method for locating objects in images, comprising: tracking the objects during a first number of frames only using a channel programmed to perform a shape analysis and to produce calibrating data based on said analysis, said shape channel producing independent representations comprising perceived locations of the objects;

producing calibrating data by said shape channel after the passage of said first number of frames;

tracking the objects during a second number of frames using a channel programmed to perform a color analysis, said color channel calibrated using said calibrating data obtained by said shape channel, said color channel producing independent representations comprising perceived locations of the objects.

14. A method for locating objects in images, comprising: tracking the objects during a first number of frames only using a channel programmed to perform a motion analysis and to produce calibrating data based on said analysis, said motion channel producing independent representations comprising perceived locations of the objects;

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producing calibrating data by said motion channel after the passage of said first number of frames; and

tracking the objects during a second number of frames using a second channel programmed to perform a color analysis, said second channel calibrated using said calibrating data obtained by said motion channel, said color channel producing independent representations comprising perceived locations of the objects.

15. The method according to claim 13, further comprising integrating said independent representations into a tracked output.

16. The method according to claim 15, wherein said integration step comprises an n-gram search.

17. The method according to claim 14, further comprising integrating said independent representations into a tracked output.

18. The method according to claim 17, wherein said integration step comprises an n-gram search.

19. A method for locating heads and faces in images, comprising:

tracking the heads and faces during a first number of frames using a plurality of channels;

obtaining an independent intermediate feature representation from each of said plurality of channels after the passage of said first number of frames, said independent intermediate feature representations comprising data comprising perceived locations of head or facial features;

running a first n-gram search using said independent intermediate feature representations, wherein a measure of confidence is computed for each of said features and combinations of features within said independent intermediate feature representations, and wherein a general score is assigned to each channel based on said measures of confidence;

selecting one or more channels for additional tracking, said selection based on said general scores assigned to each channel;

tracking the heads and faces during a second number of frames using said one or more selected channels;

obtaining further independent feature representations from each of said one or more channels, each further independent feature representation comprising data comprising perceived locations of head or facial features; and

running a second n-gram search wherein said further independent feature representations are integrated into said independent intermediate feature representations to produce a tracked output.

20. The method of claim 19, wherein said plurality of channels used for tracking during said first number of frames comprise a shape channel, a motion channel, and a color channel.

21. The method of claim 19, wherein said plurality of channels used for tracking during said first number of frames comprise a shape channel, said tracking step using said shape channel further comprising:

passing the images through a band pass filter, said band pass filter having cutoff frequencies which permit the passage of facial features through said filter;

convolving the images with a structuring kernel using a second filter; and

thresholding the images using an adaptive thresholding technique, wherein said thresholding step transforms the head and facial features into connected components within the images.

22. A method for locating heads and faces within images, comprising:

tracking the images for a first number of frames using a plurality of channels;

obtaining, after the passage of said first number of frames, independent intermediate feature representations from each of said plurality of channels;

evaluating said independent intermediate feature representations, said evaluation step used to determine a level of reliability for each of said plurality of channels;

selecting, based on said determination of said reliability for each of said plurality of channels, one or more channels for additional tracking;

tracking the images for a second number of frames using said selected one or more channels;

obtaining further independent feature representations from said selected one or more channels after the passage of said second number of frames; and

combining said independent intermediate feature representations and said further independent feature representations into a net representation of likely head and facial locations.

23. The method according to claim 22, wherein said evaluating step and said combining step comprise an n-gram search.

24. The method according to claim 22, wherein said plurality of channels used for tracking during said first number of frames comprises a shape channel, a motion channel, and a color channel.

25. A method for locating objects in images, comprising: tracking the objects during a first number of frames using only a first channel programmed to perform a shape analysis and a second channel programmed to perform a motion analysis, said first and second channels producing calibrating data based on said analyses, said first and second channels each producing independent representations comprising perceived locations of the object;

producing calibrating data by said first and second channels after the passage of said first number of frames;

tracking the objects during a second number of frames using a channel programmed to perform a color analysis, said color channel calibrated using said calibrating data obtained by said first and second channels, said color channel producing independent representations comprising perceived locations of the objects.

26. The method according to claim 25, further comprising integrating said independent representations into a tracked output.

27. The method according to claim 26, wherein said integration step comprises an n-gram search.

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