A-570-922
Scope Inquiry
Public Document
AD/CVD 5: MAR

March 4, 2010

MEMORANDUM TO: John M. Andersen
Acting Deputy Assistant Secretary
for Antidumping and Countervailing Duty Operations

FROM: Laurie Parkhill
Office Director
AD/CVD Enforcement 5

SUBJECT: Raw Flexible Magnets from the People's Republic of China; Scope Request from It's Academic – Result of Inquiry - Final Scope Determination in Part.

SUMMARY

On June 4, 2009, the Department of Commerce (the Department) received a request in proper form from It's Academic, Inc. (It's Academic), asking the Department to determine that certain flexible magnet products that It's Academic imports from the People's Republic of China (PRC) are not within the scope of the antidumping duty order on raw flexible magnets from the PRC.[1] See *Antidumping Duty Order: Raw Flexible Magnets from the People's Republic of China*, 73 FR 53847 (September 17, 2008) (*Order*). On July 1, 2009, the petitioner, Magnum Magnetics Corporation (the petitioner), submitted comments on It's Academic's scope-ruling request.[2] It's Academic submitted rebuttal comments on July 16, 2009.[3] The petitioner submitted rebuttal comments on August 7, 2009.[4]

On September 2, 2009, the Department determined that three of the seven items presented for scope review by It's Academic are not within the scope of the order.[5]

With respect to the remaining four items, the Department initiated a scope inquiry in part on September 2, 2009, pursuant to 19 CFR 351.225(e).[6] Accordingly, this scope inquiry concerns four of seven items imported by It's Academic and identified herein. In support of this inquiry we issued a short questionnaire to It's Academic on September 10, 2009,[7] in accordance with 19 CFR 351.225(f)(2). It's Academic responded to the Department's request for additional

[1] See Letter from It's Academic to the Secretary of Commerce (June 4, 2009) (scope request).
[2] See Letter from Magnum Magnetics Corporation to the Secretary of Commerce (July 1, 2009).
[3] See Letter from It's Academic to the Secretary of Commerce (July 16, 2009).
[4] See Letter from Magnum Magnetics Corporation to the Secretary of Commerce (August 7, 2009).
[5] See Memorandum from Laurie Parkhill to John M. Andersen (September 2, 2009).
[6] See Memorandum from Laurie Parkhill to John M. Andersen (September 2, 2009).
[7] See Letter from Laurie Parkhill to It's Academic Inc. (September 10, 2009).

information in a letter dated November 2, 2009.[8] The petitioner commented on It's Academic's response to the Department's questionnaire in comments dated November 23, 2009.[9]

Pursuant to 19 CFR 351.225(k)(1), we recommend a determination that the four items in question are within the scope of the order.

LEGAL FRAMEWORK

The regulations governing the Department's antidumping scope determinations can be found at 19 CFR 351.225. In considering whether a particular product is within the scope of an order, the Department will take into account the descriptions of the merchandise contained in the petition, the initial investigation, and the determinations of the Department (including prior scope determinations) and those of the International Trade Commission (ITC). See 19 CFR 351.225(k)(1). If the Department determines that these descriptions are dispositive of the matter, the Department will issue a final scope ruling as to whether the subject merchandise is covered by the order. See 19 CFR 351.225(k)(1). When the Department determines that these criteria are not dispositive the Department can consider the additional factors set forth at 19 CFR 351.225(k)(2). These criteria are as follows: i) the physical characteristics of the merchandise; ii) the expectations of the ultimate purchasers; iii) the ultimate use of the product; iv) the channels of trade in which the product is sold; v) the manner in which the product is advertised and displayed. These factors are commonly known as the *Diversified Products*[10] criteria.

If the Department finds that it cannot make a determination based solely on the application and the descriptions of the merchandise referred to in 19 CFR 351.225(k)(1), it will initiate a scope inquiry and issue a final scope ruling after a further period of inquiry. See 19 CFR 351.225(d) and (e). The determination as to which analytical framework, either 19 CFR 351.225(k)(1) or (k)(2), is appropriate in a given scope inquiry is made on a case-by-case basis after consideration of all record evidence before the Department.

SCOPE OF THE ORDER

The Department initially identified the scope of this product in its notice of initiation of an antidumping duty investigation.[11] In the final determination of sales at less than fair value,[12] the Department clarified product coverage by reordering the scope language and adding certain explanatory definitions. The revised scope language neither enlarged nor contracted product

[8] See Letter from It's Academic to the Secretary of Commerce (November 2, 2009).
[9] See Letter from Magnum Magnetics Corporation to the Secretary of Commerce (November 23, 2009).
[10] *Diversified Products Corp. v. United States*, 572 F. Supp. 883 (CIT 1983).
[11] *Notice of Initiation of Antidumping Duty Investigations: Raw Flexible Magnets from the People's Republic of China and Taiwan*, 72 FR 59071 (October 18, 2007).
[12] *Final Determination of Sales at Less Than Fair Value: Raw Flexible Magnets from the People's Republic of China*, 73 FR 39669 (July 10, 2008) (*LTFV Final*).

coverage.[13] There have been no subsequent changes to the scope. The scope description as published in the scope of the *Order* is as follows:

> The products covered by this order are certain flexible magnets regardless of shape,[14] color, or packaging.[15] Subject flexible magnets are bonded magnets composed (not necessarily exclusively) of (i) any one or combination of various flexible binders (such as polymers or co-polymers, or rubber) and (ii) a magnetic element, which may consist of a ferrite permanent magnet material (commonly, strontium or barium ferrite, or a combination of the two), a metal alloy (such as NdFeB or Alnico), any combination of the foregoing with each other or any other material, or any other material capable of being permanently magnetized. Subject flexible magnets may be in either magnetized or unmagnetized (including demagnetized) condition, and may or may not be fully or partially laminated or fully or partially bonded with paper, plastic, or other material, of any composition and/or color. Subject flexible magnets may be uncoated or may be coated with an adhesive or any other coating or combination of coatings.
>
> Specifically excluded from the scope of this order are printed flexible magnets, defined as flexible magnets (including individual magnets) that are laminated or bonded with paper, plastic, or other material if such paper, plastic, or other material bears printed text and/or images, including but not limited to business cards, calendars, poetry, sports event schedules, business promotions, decorative motifs, and the like. This exclusion does not apply to such printed flexible magnets if the printing concerned consists of only the following: a trade mark or trade name; country of origin; border, stripes, or lines; any printing that is removed in the course of cutting and/or printing magnets for retail sale or other disposition from the flexible magnet; manufacturing or use instructions (*e.g.*, "print this side up," "this side up," "laminate here"); printing on adhesive backing (that is, material to be removed in order to expose adhesive for use such as application of laminate) or on any other covering that is removed from the flexible magnet prior or subsequent to final printing and before use; non-permanent printing (that is, printing in a medium that facilitates easy removal, permitting the flexible magnet to be re-printed); printing on the back (magnetic) side; or any combination of the above.
>
> All products meeting the physical description of subject merchandise that are not specifically excluded are within the scope of this order. The products subject to the order are currently classifiable principally under subheadings 8505.19.10 and 8505.19.20 of the Harmonized Tariff Schedule of the United States ("HTSUS").

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[13] See *LTFV Final*, 73 FR at 39671.

[14] The term "shape" includes, but is not limited to profiles, which are flexible magnets with a non-rectangular cross-section.

[15] Packaging includes retail or specialty packaging such as digital printer cartridges.

> The HTSUS subheadings are provided only for convenience and customs purposes; the written description of the scope of the order is dispositive.

See *Order*, 73 FR at 53847.

BACKGROUND

It's Academic imports seven packaged sets of magnets that can be grouped into three different types of merchandise. Pursuant to 19 CFR 351.225(c)(1)(i), It's Academic requests that the Department find that these magnet products are not within the scope of the order. See scope request at 2. Included in the scope request were descriptions and pictures of the items. See scope request at 3 and Attachment 1, respectively. It's Academic also submitted samples of the merchandise in question with the scope request. On September 9, 2009, the Department issued a final determination regarding two types of merchandise. These two types of merchandise included three of the seven sets of magnets for which It's Academic requested a scope review.[16]

This scope inquiry covers the remaining type of merchandise that consists of Universal Product Code (UPC) 7-25150-96106-2, 0-20755-96109-8, 7-25150-96100-0, and 7-25150-96103-1. Each of these four products consists of a set of four magnet products packaged according to one of four themes where the products picture text, cartoon human characters, sea creatures, or a mix of hearts and flowers. This category is referred to as "Magnets Attached to Injection-Molded PVC" herein. For the purposes of this final ruling we refer to items by the UPC or by the product category designated above.

Pursuant to 19 CFR 351.225(c)(1)(ii), It's Academic explains that its products are magnets designed to be used as decorative magnets for school lockers and should be found to be outside the scope based on the language of the *Order*, the petition, and the ITC's record collectively. Further, it argues, its products were never intended to be considered "raw flexible magnets" that are subject to the order. See scope request at 2. It's Academic argues that, "even if the scope language is found to be ambiguous, the Department should find that its magnets are excluded from the scope, as they are clearly a different product from the merchandise subject to the original antidumping investigation and resulting order." *Id.*

The language in the *Order* allows for the exclusion of "printed flexible magnets" where a layer bonded to a flexible magnet "bears printed text and/or images" unless that printing meets one of the following descriptions: is temporary; is designed to be removed in further processing; consists of a makers or country-of-origin mark; consists of borders, stripes, or lines; consists of instructions; is on the magnet itself (on the reverse of the product); is on a removable backing material. It's Academic contends that its "magnets consist of multicolored text or images on polyvinyl chloride (PVC). The PVC layer is glued to the magnetic base. The text {or} image {is} in effect printed on the PVC through an injection molding process." See scope request at 3.

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[16] See Memorandum from Laurie Parkhill to John M. Andersen (September 2, 2009).

The petitioner describes the same items as "flexible magnets to which {are} glued in each case a layer of PVC, which in turn bears multiple pieces of colored, injection-molded plastic foam that are arranged in patterns to create various images. Neither {the} flexible magnet, the PVC layer, nor the injection-molded plastic bears any printed image or text." See the petitioner's July 1, 2009, comments at 2.

It's Academic's "Magnets Attached to Injection-Molded PVC" are constructed by bonding an injection-molded, multilayer, plasticized PVC form with a flat back to a similarly shaped, cutout piece of flexible magnet sheet. It's Academic explains that "{t}he text and images are in effect printed on the PVC through an injection molding process." See scope request at 3. "Rather than stamping a piece of material (*e.g.*, PVC, foam *etc*.) into a shape and then printing it, the injection molding process both creates that shape of the text or image and 'prints' the colors on it through the use of specific colored dyes in the molding process." *Id*. It's Academic contends that "{t}he result is identical to a traditional printing process, namely, a flexible magnet to which has been affixed a multicolored text or images for retail sale." *Id.*

Further, in its November 2, 2009, response It's Academic explains that the PVC form is created by injecting several different colored PVCs into a mold. This mold is then heated to solidify the PVC. Once the colored layer has solidified, the mold is removed from the oven and the mold is filled with black PVC to act as a base to the colored layer. This layer is left flat on the top. The mold is returned to the oven to solidify the black PVC. After cooling and being removed from the mold, the injection-molded PVC piece is bonded to a flexible magnet that is cut in the same shape. The colored part of the injection-molded form, the layer that was injected first, depicts text or images when it is separated from its mold (and affixed to the magnet). See It's Academic's November 2, 2009, response at 2 and Exhibit 1 therein.

The petitioner disagrees with It's Academic's contention that the injection-molded plastic part of the merchandise is printed. In the petitioner's opinion, the injection molding is another material layer that is bonded to the flexible magnet. The petitioner states that "{n}either the flexible magnet, the PVC Layer, nor the injection-molded plastic bears any printed text or image" (here "PVC Layer" refers to the black backing layer of the molded PVC part, as described above, and the "injection-molded plastic" refers to the colored PVC layer) and that these items "do not incorporate materials bearing 'printed text and/or images' and therefore are not excluded as 'printed flexible magnets'." See the petitioner's July 1, 2009, comments at 2-3. Further, the petitioner specifically counters It's Academic's arguments concerning the nature of the injection-molding process, stating that It's Academic's claim that the "arrangement of colored plastic pieces 'in effect' is printing" is unfounded because this process "is nothing more than further lamination or bonding with plastic." Specifically, the petitioner claims that, "{b}ecause none of {the} pieces of plastic laminated or bonded to the magnet 'bears printed text and/or images,' the …magnets do not qualify for the clear language of the specific exclusion for 'printed flexible magnets'" available in the scope of the order. *Id.* at 5.

It's Academic argues that "{t}he injection molding process allows achievement of three-dimensional text or images similar to other forms of three-dimensional printing." See It's Academic's November 2, 2009, response at 3. It's Academic explains that "{t}here are several methods of 'printing' that involve the creation of three-dimensional text and/or images on a surface by applying layers of liquid polymer material." See It's Academic's July 16, 2009, comments at 2. Additionally, It's Academic supplies literature that describes "3D printing" and "Stereolithography" in Exhibit 1 of its July 16, 2009, comments. The petitioner refutes this categorization of It's Academic's manufacturing processes, stating that, "as the literature included in It's Academic's own submission makes clear, the "3D printing" process to which it refers "is a form of additive manufacturing technology" and is not in fact "printing" at all. See the petitioner's August 7, 2009, comments at 3.

In the petitioner's November 23, 2009, comments at 2 it compares a dictionary definition of the verb "to print" with the definition of injection-molding, whereby "to print" means to impress or stamp in or on and injection-molding is "a method of forming articles (as of plastic) by heating a molding material until it can flow and injecting it into a mold." The petitioner argues that this comparison reveals a clear distinction between printing and injection-molding; printing makes a depression or impression in or on a material and injection-molding forms a material with a mold and heat. It's Academic's injection-molding process forms articles by heating a liquid to solidify or cure it once the liquid polymer has been injected in a form. The definition describes a process where heat is used to change a material from a solid to a liquid in order to inject it into a mold. It's Academics process does the reverse; it uses heat to stop the flow of a liquid. Whether heat is used to initiate or stem the flow of the molding material the result is the same - the formation of new articles and not the impression or stamping on or in another surface.

ANALYSIS

The Department initiated a scope inquiry pursuant to 19 CFR 351.225(e) in order to ascertain a better understanding of the injection-molding production process employed in the manufacture of It's Academic's "Magnets Attached to Injection-Molded PVC." Information obtained during this inquiry broadened our understanding of It's Academic's manufacturing process. We are now able to make a determination pursuant to 19 CFR 351.225(k)(1) in this matter.

In discussing the interpretive process the Department should follow in making scope rulings pursuant to 19 CFR 351.225(k)(1), the Court of Appeals for the Federal Circuit (CAFC) stated that "a predicate for the interpretative process {in a scope inquiry} is language in the order that is subject to interpretation." See *Duferco Steel, Inc. v. United States*, 296 F.3d 1087, at 1096 (CAFC 2002) (*Duferco Steel*).[17] In *Duferco Steel*, the CAFC reiterated "the importance of the language of the final scope order in defining the merchandise subject to the order." *Id.* at 1097. Furthermore, the CAFC stated that "{s}cope orders may be interpreted as including subject

[17] Such an approach differs from earlier Court of International Trade (CIT) precedent that required the Department to give ample deference to the petitioner's intent when examining a petition's description of the subject merchandise. See, *e.g.*, *Torrington Co. v. United States*, 995 F. Supp. 117, 121 (CIT 1998).

merchandise only if they contain language that specifically includes the subject merchandise or may be reasonably interpreted to include it." *Id.* at 1089.

The issue in this scope inquiry is whether It's Academic's magnet products are excluded from the scope of the order because they contain a material that "bears printed images and/or text" that is laminated or bonded to a magnet. Therefore, the Department must determine whether the injection-molding of a multiple-layer, multiple-part form of colored, plasticized (bendable) PVC is a *printed* image and/or text. The term "printing" commonly describes a wide range of manufacturing processes[18] including (but not limited to) printing with ink,[19] three-dimensional printing with plastics and other materials,[20] and the machine printing of components onto circuit boards.[21] All printing makes three-dimensional structures; even ink printed on a page is not two-dimensional. Finally, all printing transfers substances, shape, or components to create a multi-dimensional depiction on or in another surface either by the addition of material or by the deformation of a receiving surface.

It's Academic's injection-molding process is not a printing process because it neither transfers material to another surface to create an image or text on it nor does it impress or stamp a depiction of an image or text into another surface. Not all processes that result in images and/or text are printing processes. For It's Academic's products, the PVC form is not "printed" because the form that depicts the image or text was not transferred onto the surface of another material. It's Academic's injection-molding process creates a three-dimensional object that depicts text or images but it does not print that text or image on or in another surface. Rather it molds a three-dimensional object that depicts text or images and later bonds it to a flexible magnet. This process is similar to the molding of clay and porcelain, both of which are heat-cured after molding or shaping as is the PVC form.

It's Academic contends that its process has the same effect as three-dimensional printing. While the effect of its process may be similar, the Department finds that the scope exclusion only applies to printed magnets. The Department agrees with the petitioner that "Magnets Attached to Injection-Molded PVC" are flexible magnets bonded to plastic and are within the scope of the order. Because It's Academic's magnets are not printed, they are subject to the order, regardless of the effect of the injection-molding process.

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[18] See Exhibit 1 – National Institute of Industrial Research, *The Complete Book on Printing Technology* (Delhi, India: Asia Pacific Business Press Inc., 2009), at 39-42.
[19] See Exhibit 2 - Kipphan, Helmut, *Handbook of Print Media: Technologies and Production Methods* (Heidelberg, Germany: Heidelberger Druckmaschinen, 2001), at 40.
[20] See Exhibit 3 - "A Factory on Your Desk," *The Economist*, London: September 3, 2009, Vol. 392, Iss. 8647, at 26.
[21] See Exhibit 4 – US Patent 7,617,774 (November 17, 2009).

RECOMMENDATION

Based on the foregoing analysis and pursuant to 19 CFR 351.225(e), we recommend that you determine, based on a review of the descriptions of the products contained in the *Order*, the petition, and the determinations of the Secretary and the ITC, that It's Academic's "Magnets Attached to Injection-Molded PVC" are within the scope of the antidumping duty order on raw flexible magnets from the People's Republic of China.

______Agree ______Disagree

____
John M. Andersen
Acting Deputy Assistant Secretary
for Antidumping and Countervailing Duty Operations

____
(Date)

Exhibit 1

contemporary Latin alphabet.

There were still some problems with the consistency of rules to be worked out, how-ever. Early Greek and Roman writing was done by scribes all with different "penman-ship." Some wrote from left to right; some wrote from right to left. Combine these differences with the lack of agreement on the use of punctuation marks or spaces between words or sentences, and the whole system could be quite a mess.

It wasn't until movable metal type was introduced by Johann Gutenberg in the mid fifteenth century that any true standard of punctuation or sentence structure was achieved. It took printing technology to stabilize the phonetic symbol system as we know it today. Slight changes have been made, but the basic composition of our al-phabet has remained the same from the time of Gutenberg.

Printing Technology

All printing processes reproduce lines and/or dots that form an image. **Printing** is the process of manufacturing multiple copies of graphic images. Although most people think of printing as putting ink on paper, printing is not limited to any particular materials or inks. The embossing process uses no ink at all, and all shapes and sizes of metals, wood, and plastics are common receivers of printed messages.

Major Printing Processes

The following five major printing processes are used to reproduce graphic images:

- Relief printing
- Intaglio printing
- Screen printing
- Lithographic printing
- Electrostatic printing

Each of these processes is suited for specific applications, such as newspaper, book, package, or textile printing.

Relief Printing

The **relief printing** process includes letter-press printing, flexographic printing, and all other methods of transferring an image from a raised surface Although it was once a: major process in the printing industry, letterpress printing has been replaced largely by other printing processes. Most relief printing done today is done with flexography. Flexographic printing is used extensively in the packaging industry for printing on corru-gated board, paper cartons, and plastic film. Flexography is also becoming a significant process for printing newspapers, newspaper inserts, catalogue, and directories.

Intaglio Printing

Intaglio printing is the reverse of relief printing. An intaglio image is transferred from a sunken surface-Copperplate etching and engraving are two intaglio processes. Industrial intaglio printing is called **gravure.** Gravure is used for extremely long press runs. Cellophane and aluminum-foil candy bar wrappers are two common packaging materials printed with gravure printing. Reader's Digest and National Geographic are but two of the many national magazines that are printed with gravure.

Screen Printing

Screen printing transfers an image by allowing ink to pass through openings in a stencil that has been applied to a screen mesh The screen process is sometimes called silk screen printing. Silk is rarely used to hold the stencil industrially, however, because silk is not as durable as

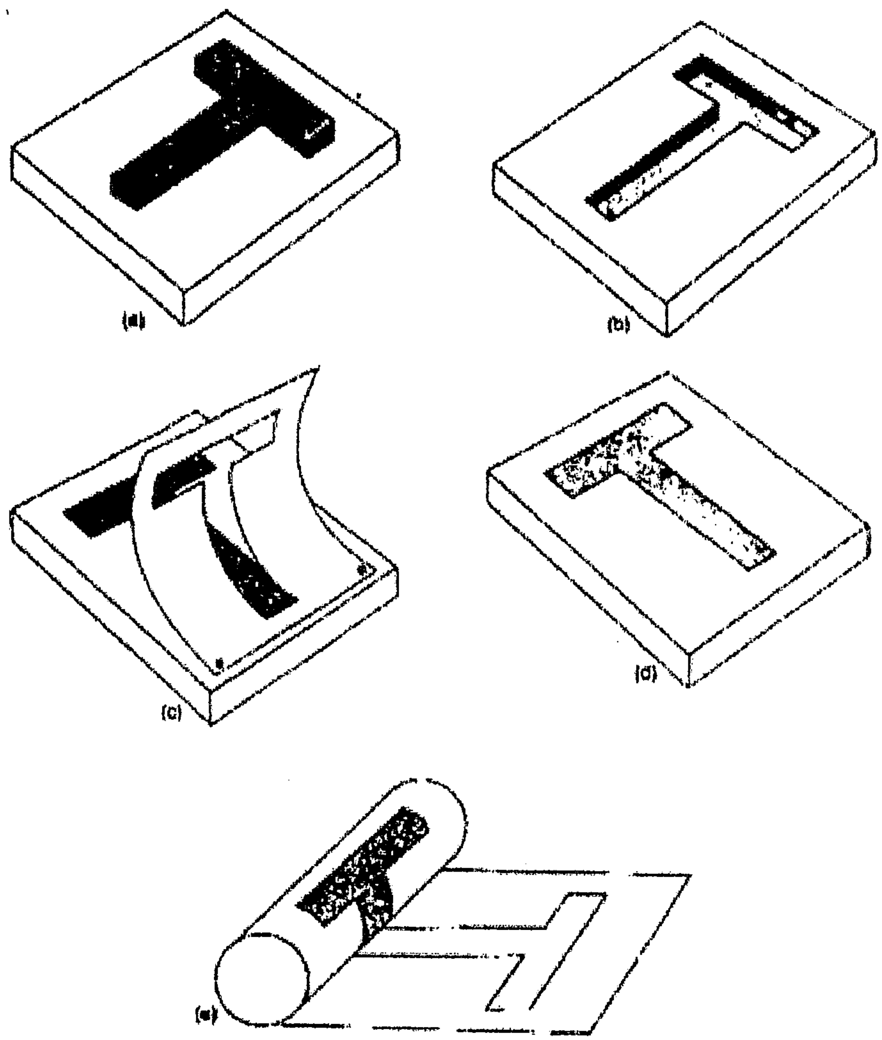


Figure 4 Five main printing processes. (a) Relief printing transfer an image from a raised surface. (b) Intaglio printing transfers an image from sunken surface. (c) Screen printing transfers an image througha stencil.(d) Lithographic printing transfers as image chemisically from a flat surface. (e) Electrostatic printing transfers an image using an electrostatic charge.

industrial screen materials. Some of the industrial uses for screen printing include printing on plastic such as round plastic containers, printing large dis-play signs and billboards, and printing on tex-tiles. Another major use for screen printing is in the manufacture of printed circuit boards for electrical/electronic equipment.

Lithography

Lithography as it is known today is a relatively new process, dating from around 1798. A lithographic image is transferred from a flat surface. Certain areas on the surface are chemically treated to accept ink while other areas are left untreated so that they will repel ink. When the surface is inked, the ink remains in the inkreceptive areas, but not in the untreated areas. When a material such as paper contacts the surface, ink is transferred to the paper . This process is sometimes called planography, Offset lithography, offset, or photo-offset lithography.

Offset lithographic printing is the most widely used printing process in the commercial printing industry. Its major application is for printing on paper; thus it is ideal for printing newspapers, books, magazines, pamphlets, and all other forms of paper publications.

Electrostatic Printing

Electrostatic printing was invented in 1937 by Chester Carlson. It involves creating an image by electrostatically charging areas of a special drum. As a result, the drum attracts a dry or liquid toner. The toner is then transferred and fused to a sheet of paper.

Even a decade ago, electrostatic printing would not have been classified as one of the major printing processes. However, today electrostatic reproduction has become a standard part of digital printing. When a "copier" can deliver 6000 or more images that meet or exceed traditional ink density targets in an hour, the copier must be recognized as a printing press. Although there are several older printing processes, such as collography, which prints from a fragile gelatin emulsion, these five major printing processes account for nearly 99 percent of all work done in the contemporary printing industry.

Printing technology has long been a powerful tool for social change. Edward George Bulwer Lytton wrote, "The pen is mightier than the sword." But his statement assumes that the ideas the pen recorded are distributed. Without 'printing, few would read the words, and the pen would be a very weak weapon.

Printers have long been the most influential individuals in the community early colonial printers helped to shape our country by reproducing, recording, and distributing the ideas and events of the period. Benjamin Franklin, an early American patriot, was proudest of his role as a printer. After being active in the Revolution, a signer of the Declaration of Independence, a member of the First and Second Continental Congresses, founder of the first American library, an au-thor, an inventor, a publisher, and ambassador to France, he directed that his epitaph should read "B. Franklin, Printer."

Printing Cycle

Since the time of Franklin, the basic cycle of the printing industry has not changed much from the following procedures:

1. Identifying a need
2. Creating an image design
3. Reproducing the image design
4. Distributing the printed message.

The printing cycle begins with an identified need. The need might be as simple as the reproduction of a form or as sophisticated as a poster intended to change human attitudes. It could be as ordinary as a package designed to convince a consumer to buy one brand of cereal rather than another. Whatever the need, a graphic design evolves, special design agencies are often set up whose sole purpose is to sell ideas to clients and work closely with the printer as the design is turned into print.

The function of printing management is to be responsible for creating and controlling the reproduction process. Skilled workers must be employed and an organization created that efficiently and effectively delivers printed products. Once a job is proposed, the most efficient printing process must be iden-tified. Such variables as the type of material to be printed, length of run, number and types of colours, time requirements, desired quality, and customer's cost limitations must all be considered. An estimate must be made for each job. A profit must be made, and yet the estimate must be low enough to attract work in a very competitive market. If the customer approves the estimate, management must schedule the job, arrange to obtain all materials, ensure quality control, and keep track of all phases of production so the job is finished on schedule.

The final test of the cycle is the method of distributing the printed message. Without an audience for the graphic images created by the artist and printer, the printing cycle is useless. Printing is mailed; handed out on busy streets; sold on street corners; and shipped to department stores, corner drugstores, and local newsstands. It is passed out in highway tollbooths, filed in offices, pasted on bill-boards, carried on placards, or even thumbtacked to poster boards. The purpose of all this activity is to place printed matter in the hands of consumers.

Sequence of Steps in the Printing Processes

The printing industry has historically consisted of shops identified with particular processes, such as relief printing or lithography. Craftsmen were trained and then bound by union or guild structure to a particular process. Recently it has become common for a printing establishment to use a variety of printing processes. Regardless of the printing process used, however, there is a sequence of production steps that all printing

Exhibit 2

1.3 Printing Technologies

1.3.1 Overview of Printing Technologies

Current printing technologies are based on a wealth of inventions. The discoveries made in the engineering sciences, information technology, physics, and chemistry have left their mark on the development of printing technologies. In recent years it is computer and information technology that have had the most lasting impact on the printing industry and printing technologies, and this trend is continuing. The most important aspects in the history of printing technology are dealt with in section 13.1.

Definition of the Most Important Terms Relating to Printing Technology [1.3-1]

- *Printing* is a reproduction process in which printing ink is applied to a printing substrate in order to transmit information (images, graphics, text) in a repeatable form using an image-carrying medium (e.g., a printing plate).
- The *image carrying medium* is the storage element (i.e., printing plate or bitmap for controlling ink jet nozzles) that contains all the information needed to apply the ink for the reproduction of images and/or text by printing.
- The *printing plate* or *image carrier (master)* is the tool (material) by which ink is transferred to the printing substrate or an intermediate carrier for the reproduction of text, graphics and/or images. One printing plate usually generates many prints.
- The *print image* is the information provided by the entirety of all the print image elements in all operational stages of an image to be produced by printing.
- The *print image element* is an area that transfers and/or receives ink (e.g., letter type face, line, screen dot or cells) in any operational stage of the presentation to be reproduced by printing.
- The *ink* is the colored substance that is applied to the printing substrate during printing.
- The *printing substrate* is the material receiving the print.
- The *printing press* is the equipment with which the printing process is performed.
- The *printing process* serves to disseminate/reproduce information that is transmitted and processed within this procedural framework.

The relevant individual steps in the production of a printed product (see sec. 1.2) are illustrated in figure 1.3-1. The *printing stage* (press) is highlighted as the central production stage between prepress and postpress/finishing.

The production of printed products can be described as an information-processing system, within which the information specification and the information carrier change (i.e., original as slide, film, image, digital data record, impression, plate, print sheet, end product) [1.3-2]. The type of information carrier employed depends on the printing technology used.

Exhibit 3

Economist.com

SCIENCE
TECHNOLOGY QUARTERLY

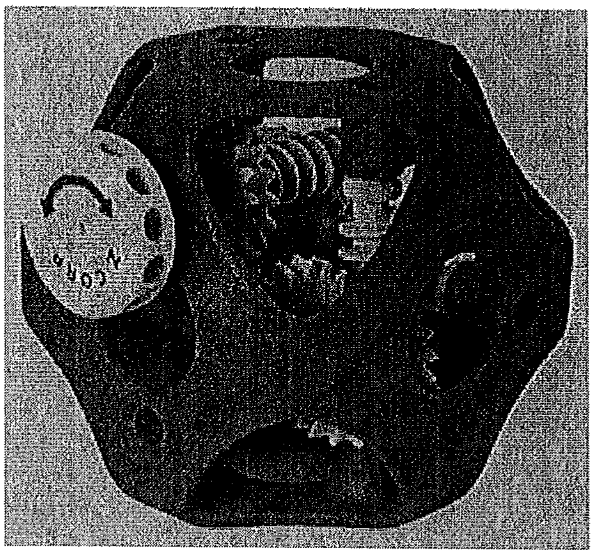
Case history

A factory on your desk

Sep 3rd 2009
From The Economist print edition

Manufacturing: Producing solid objects, even quite complex ones, with 3-D printers is gradually becoming easier and cheaper. Might such devices some day become as widespread as document printers?

Todd May



JUST before going on holiday you decide to buy a new pair of trainers. The usual procedure would be to pop down to the shops, select a style and try on a pair to make sure they are comfortable. Instead, imagine doing this: designing shoes exactly the right size in the style and colour you want on a computer, or downloading a design from the web and customising it. Then press print and go off to have lunch while a device on your desk manufactures them for you. On your return, your trainers are ready. But they are not quite right. So after another fiddle on the computer you print a second pair. Perfect.

The technology to print a pair of trainers, or at least to do so in one go rather than in parts that have to be glued together, is not yet available. But it is getting close. An increasing number of things, from mock-ups of new consumer products to jewellery and aerospace components, are being produced by machines that build objects layer by layer, just like printing in three dimensions. The general term the industry uses for this is "additive manufacturing", but the most widely used devices are called 3-D printers. Some of these printers are becoming small enough to be desktop devices. They are making their way not just into workshops and factories, but also into the offices of designers, architects and researchers, and are being embraced by entrepreneurs who are using them to invent entirely new businesses.

The 3-D printers currently available use a variety of technologies, each of which is suited to different applications. They range in price from under $10,000 to more than $1m for a high-end device capable of making sophisticated production parts. Depending on the size of the object, the material it is made from and the level of detail required, the printing process takes around an hour for a relatively small, simple object that would fit into the palm of your hand, and up to a day for a bigger, more sophisticated part. The latest machines can produce objects to an accuracy of slightly less than 0.1mm.

Terry Wohlers, a consultant based in Colorado who monitors the industry, reckons the global market for additive manufacturing was worth $1.2 billion in 2008 and that it could double in size by 2015. He estimates that 3-D printers of various sorts account for about 75% of sales, and high-performance industrial machines the remainder. He expects lower-cost 3-D printers to account for as much as 90% of the market as prices fall and performance improves. Model-making and rapid prototyping remain the most popular uses, but all types of machines are increasingly being used for direct manufacturing of parts for finished products, rather than just prototypes.

Although powerful design software allows the virtual creation of 3-D objects on a computer screen, many designers and their clients prefer to examine, touch and hold a physical object before committing to huge investments in manufacturing or construction. Models help take some of the guesswork out of the process. They are traditionally crafted by hand from materials such as clay, wood or metal. It is a slow and costly business. Even making a non-working model of what might seem to be a relatively simple thing, like a new sole for a shoe, is in fact a complex process. It used to take Timberland, an American firm, a week to turn the design of a new sole into a model, at a cost of around $1,200. Using a 3-D printer made by Z Corporation, based in Burlington, Massachusetts, it has cut the time to 90 minutes and the cost to $35.

The ability of 3-D printers to speed up the design process will have a big impact on industry.

The ability of 3-D printers to speed up the design process will have a big impact on industry. "Now engineers can think of an idea, print it, hold it in their hand, share it with other people, change it and go back and print another one," says David Reis, the chief executive of Objet Geometries, an Israeli firm that makes 3-D printers. "Suddenly design becomes much more innovative and creative." Objet's machines can produce not only solid things out of plastic-type materials, but complex ones with moving parts too, such as a working model of a bicycle chain or a small gearbox. And they can print objects in multiple materials, such as a plastic remote-control unit with rubbery buttons.

Little by little

The first step in all 3-D printing processes is for software to take cross-sections through the part to be created and calculate how each layer needs to be constructed. Different machines then take different approaches. Most processes can trace their roots back to the earliest form of 3-D printing: stereolithography. It was pioneered by 3D Systems, based in South Carolina, which made the first commercially available stereolithography machine in 1986.

Such machines build up objects, a layer at a time, by dispensing a thin layer of liquid resin and using an ultraviolet laser, under computer control, to make it harden in the required pattern of the cross-section. The build tray then descends, a new liquid surface is applied and the process is repeated. At the end, the excess soft resin is cleaned away using a chemical bath. A related approach, which also dates back to the 1980s, is selective laser-sintering, in which a high-temperature laser is used to melt and fuse together powdered ceramics, metal or glass, one layer at a time, to produce the desired 3-D shape.

Both Z Corporation and Objet, by contrast, use modified forms of inkjet printing. Z Corporation uses the printing heads in its machine to squirt a liquid binder onto a bed of white powder, but only in the areas where the layer needs to be solid. Colour is applied at the same time, allowing multicoloured objects to be created. The bed is lowered by a fraction of a millimetre and a new layer of powder is spread and rolled. The print head then repeats the process to create the next layer. When the process is complete and the material is set, the loose powder is blown away with an air jet to reveal the completed structure. The powder can be one of several substances including plastic, a special material that can be treated to become flexible like rubber, and casting materials suitable for making moulds. Each layer takes 15-30 seconds to output.

Objet's machines have print heads that slide back and forth depositing extremely thin layers of two types of liquid photopolymer. One type is printed where the cross-section is required to be solid, and the other where there are cavities, overhangs and other features with spaces. After each layer is printed, an ultraviolet light-source in the print head hardens the polymer in the areas that need to be solid, and causes the second polymer to assume a gel-like state to provide structural support. The build tray then moves down and the process is repeated for the next layer. At the end, a jet of water washes away the gel-like support material. The machine is capable of making objects out of multiple kinds of solid photopolymer, each with different colours or properties.

Another form of 3-D printing is "fused deposition modelling". Stratasys, based in Minneapolis, is the market leader in this field. This approach involves unwinding a filament of thermoplastic material from a spool and feeding it through a moving extrusion nozzle, heating the material to melt it and deposit it in the desired pattern on the build tray. The material then hardens to form the solid parts required in each layer. As subsequent layers are added the molten thermoplastic fuses to the layers below. In areas such as overhangs, physical supports can be added and removed later, or water-soluble materials can be deposited and then washed away.

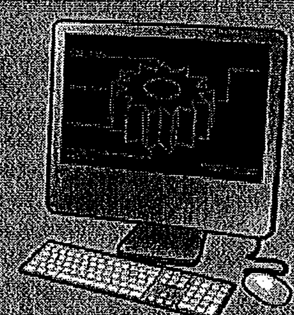
3-D printers can already be found in the workshops of artists and enthusiasts.

Fred Fischer of Stratasys sees the market developing in two directions. On one hand there will be more demand for cheaper and simpler 3-D printers capable of quickly turning out concept models, which are likely to sit on the desks of engineers and designers. On the other hand there will also be demand for more elaborate machines with added features and higher performance, the most elaborate of which will provide a cost-effective way to manufacture thousands, and perhaps even tens of thousands, of components. Today's rapid prototyping, in other words, will shade into tomorrow's rapid manufacturing. Mr Fischer draws an analogy with the development of document printers, which range from small, cheap devices for home use to industrial printing presses capable of producing high-quality glossy magazines.

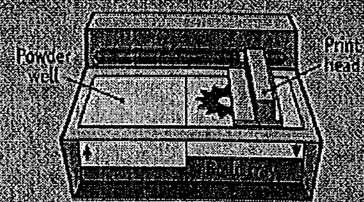
Today's largest and most expensive 3-D printing machines, capable of directly producing complex plastic, and metal and alloy components using selective laser-sintering, are becoming increasingly popular in the consumer-electronics, aerospace and carmaking industries. It is not just their ability to make a small number of parts, without having to spread the massive tool-up costs of traditional manufacturing across thousands of items, that makes these machines useful. They can also be used to build things in different ways, such as producing the aerodynamic ducting on a jet-fighter as a single component, rather than assembling it from dozens of different components, each of which has to be machined and tested.

Object lesson

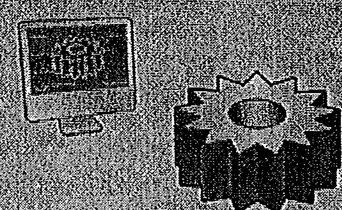
How a 3-D printer works



1. A model of the object is created on a computer. Software analyses this model, taking a series of cross-sections and working out the distribution of space and solid matter within each layer.



2. The 3-D printer builds up the object, one layer at a time, using one of several methods. A bed of powder may be laid down and then solidified in certain places by squirting a liquid binder onto it (above); lasers may be used to fuse together powdered ceramic, metal or glass in selected areas; plastic may be squirted out of a nozzle to build up material in the appropriate parts of each layer; or light may be used to harden selected regions of a photosensitive gel. Some devices can use more than one material for each layer, or apply inks to produce multicoloured objects.



3. Once each layer is complete, the build tray is lowered by a fraction of a millimetre and the construction of the next layer begins. When all the layers have been completed, any excess material is cleaned away to reveal the finished object.

Source: *The Economist*

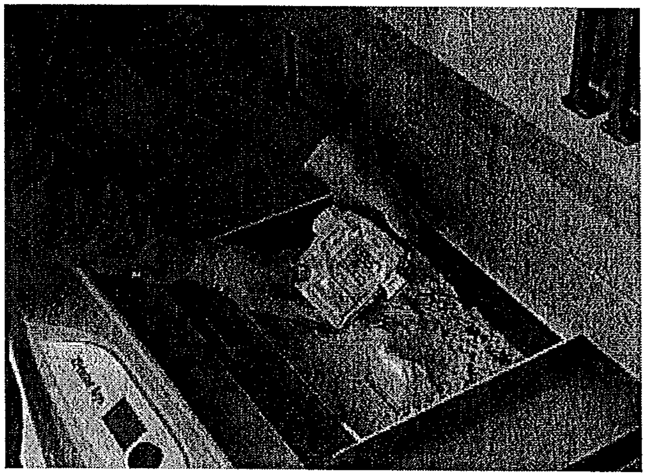
Some 3-D printers can already be found in the workshops of artists and enthusiasts. Jay Leno, an American television celebrity, bought a Stratasys machine to help keep his large collection of old cars on the road. He can scan a broken part that is no longer available into a computer, or design a missing one from scratch, and then print out a copy made of plastic. This can be fitted to a vehicle to check that the design is correct. After any adjustments, a final plastic copy can either be used by a machinist to make an exact copy from metal, or the model's numerical data can be fed directly into a computer-controlled milling machine. Mr Leno's 1907 White steam-driven car is now back on the road thanks to his 3-D printer.

Where now?

Many in the industry believe that low-cost 3-D printers for the consumer market will eventually appear. 3D Systems launched a new model costing less than $10,000 in May. That may sound a lot, but it is what laser printers cost in the early 1980s, and they can now be had for less than $100. Desktop Factory, a start-up based in Pasadena, California, hopes to launch a 3-D printer for $4,995 that is around the same size as an early laser printer.

Objet believes the way to the mass market is via inkjet technology, just as it has been with 2-D printers. The ability to print different materials with inkjet heads greatly increases not just model-making abilities but production possibilities, too. The firm thinks it is getting close to being able to print with engineering-quality plastics through inkjet heads. "When we reach that point, it would allow us to go to short-term manufacturing," says Amit Shvartz, Objet's head of marketing.

Todd May



One of Z Corporation's printers and (below) a finished model of a camcorder

As with 2-D printing, many individuals and small firms may not need sophisticated machines, especially if they can use 3-D printing bureaus to produce their more demanding digital creations. Some of these make-to-order services are starting to appear. Z Corporation's machines are being used by companies to let players of video games, including "World of Warcraft", "Spore" and "Rock Band", produce colourful, 3-D models of their in-game characters, for example. "We are at that point where people are looking at this technology and saying 'We can make a business out of that'," says Scott Harmon, head of business development at Z Corporation.

Shapeways, a firm based in the Netherlands, lets users upload designs, choose a construction material and get a production quote. It then turns the design into an object with a 3-D printer and ships it to the customer. 3D Systems recently set up a joint venture called MQast, which is an online provider of aluminium and stainless-steel parts produced using its machines. And iKix, based in Chennai, India, has equipped itself with Z Corporation machines and set up a chain of online service-bureaus to produce architectural models, for delivery anywhere on earth.

Mr Wohlers thinks medical applications of 3-D printing also have a lot of potential. It is already possible to print 3-D models from the digital slices produced by computed-tomography scans. These can be used for training, to explain procedures to patients and to help surgeons plan complex operations. Some hospitals have started using 3-D printing to produce custom-made metallic and plastic parts to be used as artificial implants and in reconstructive surgery. "It is possible to deposit living cells through inkjet printers onto a biodegradable scaffold," adds Mr Wohlers. "There are a lot of problems to overcome, like the creation of blood vessels, but eventually I think we will see replacement body parts being printed too."

Meanwhile, what about making those trainers? A 3-D printer cheap enough to do that at home is probably many years away. But customising a standardised product by changing its outward appearance, like re-skinning a mobile phone,

Todd May

would be easier. "You can do that pretty much with existing technology," says Mr Harmon. You could also make other simple but useful things, like a missing piece for a broken toy. And you might even make your own 3-D printer. The RepRap project, an open-source group based at the University of Bath in England, has produced designs for a 3-D printer which can be built for around $700, including royalty-free designs that can be fed into the machine to produce the plastic parts needed to create another RepRap machine. This could be fun for the mechanically minded. Others might want to wait until the local hardware store buys a 3-D printer and begins to offer one-off manufacturing services on demand.

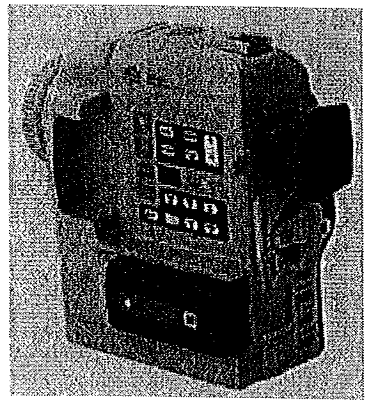


Exhibit 4

US007617774B2

(12) **United States Patent**
Walther et al.

(10) **Patent No.: US 7,617,774 B2**
(45) **Date of Patent: Nov. 17, 2009**

(54) **METHOD FOR PRINTING AN ELECTRONIC CIRCUIT COMPONENT ON A SUBSTRATE USING A PRINTING MACHINE**

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(73) Assignee: **manroland AG**, Offenbach am Main (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 480 days.

(21) Appl. No.: **11/118,725**

(22) Filed: **Apr. 29, 2005**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

May 3, 2004 (DE) 10 2004 021 643

(51) **Int. Cl.**
B41F 1/12 (2006.01)

(52) **U.S. Cl.** **101/490**; 101/183; 101/217; 101/230; 101/483; 101/492

(58) **Field of Classification Search** .... None
See application file for complete search history.

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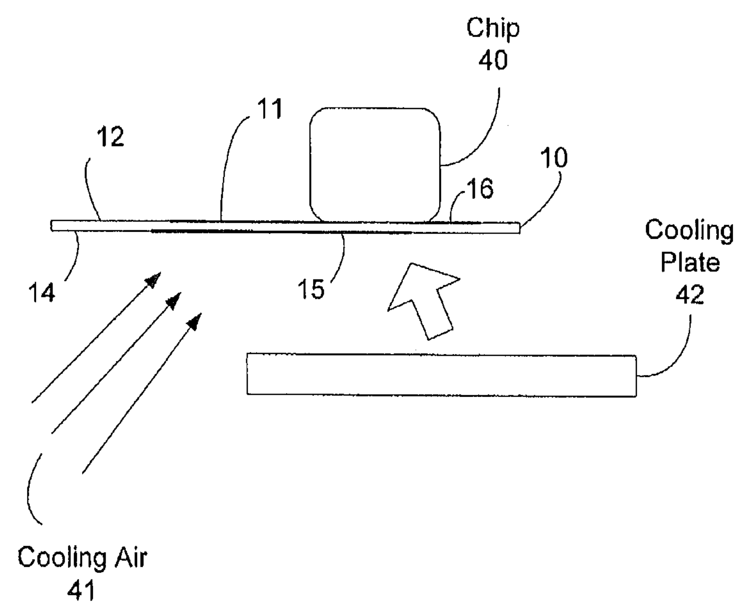
(74) *Attorney, Agent, or Firm*—Leydig, Voit & Mayer, Ltd.

(57) **ABSTRACT**

A method of printing an electronic circuit or components thereof uses a printing machine to print a conductive structure on the front printing side (back side of the sheet) of a printing substrate. The sheet is then reversed and a decorative printing motif is printed on the back side in one work step. Alternatively, the circuit or components of a circuit may be printed by having a printing machine for color printing preceded by a printing machine for printing on the back side of the printing substrate. A chip is applied to the printing substrate where the back side of the printing sheet with the printing motif is cooled to prevent any negative effect on the printing motif and/or the printing substrate.

7 Claims, 4 Drawing Sheets



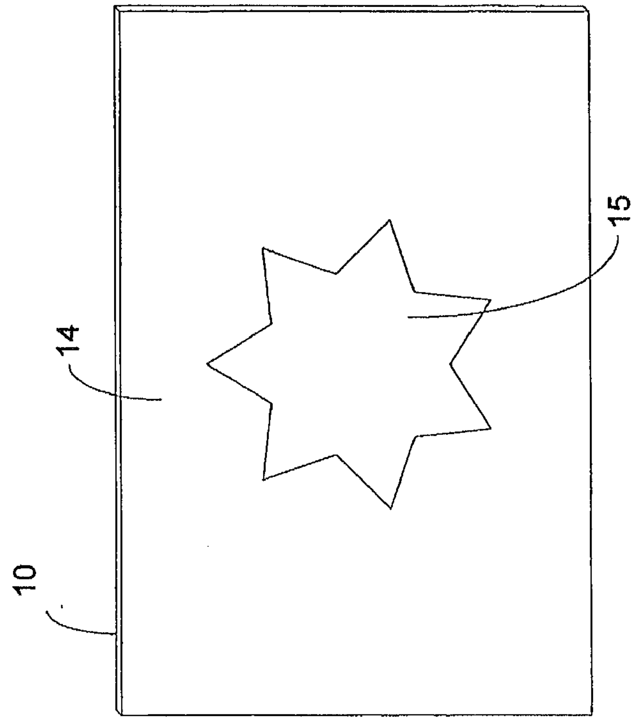


FIG. 1B

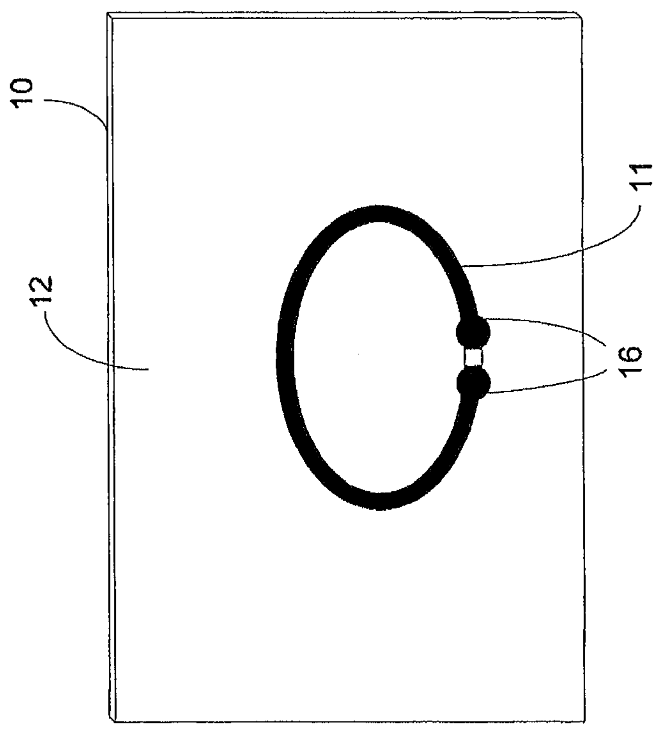


FIG. 1A

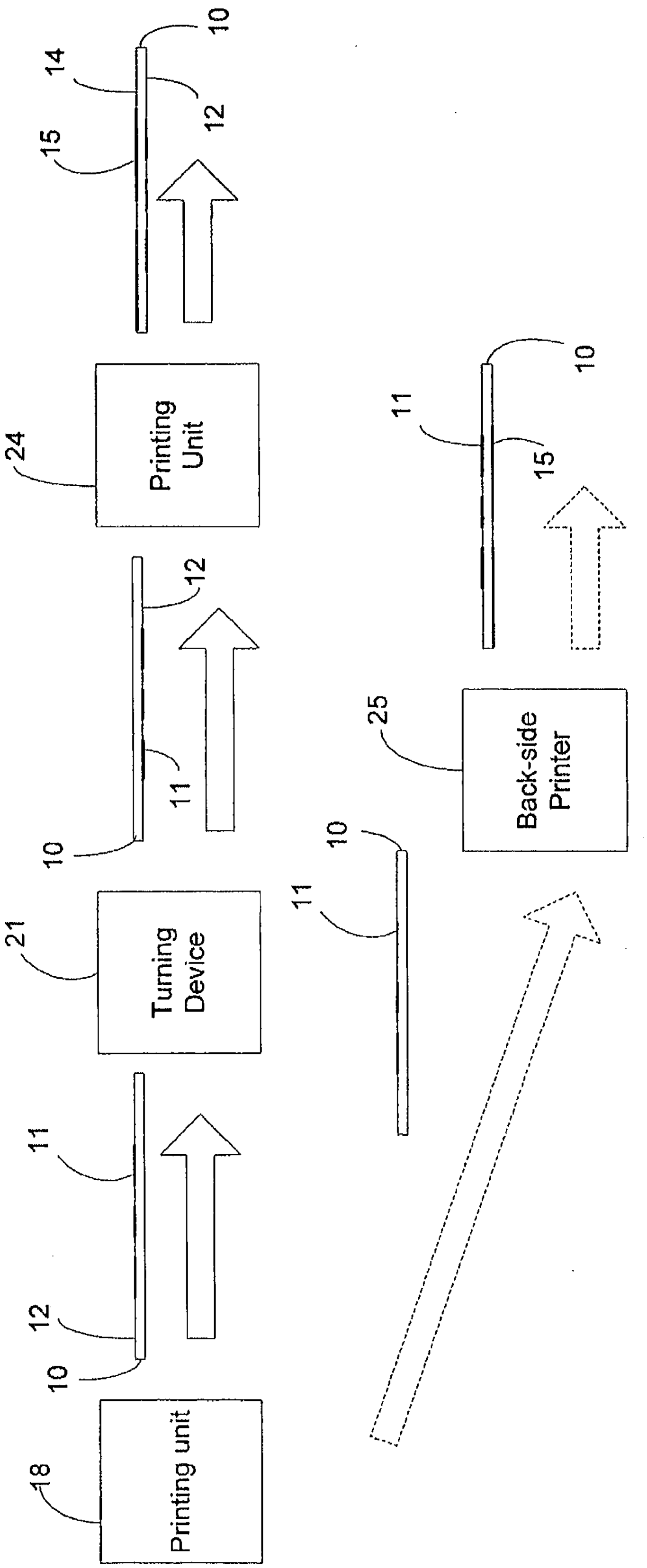

Printing unit
18
10
12
11
Turning Device
21
10
11
12
Printing Unit
24
14
15
12
10
10
11
Back-side Printer
25
11
15
10

FIG. 2

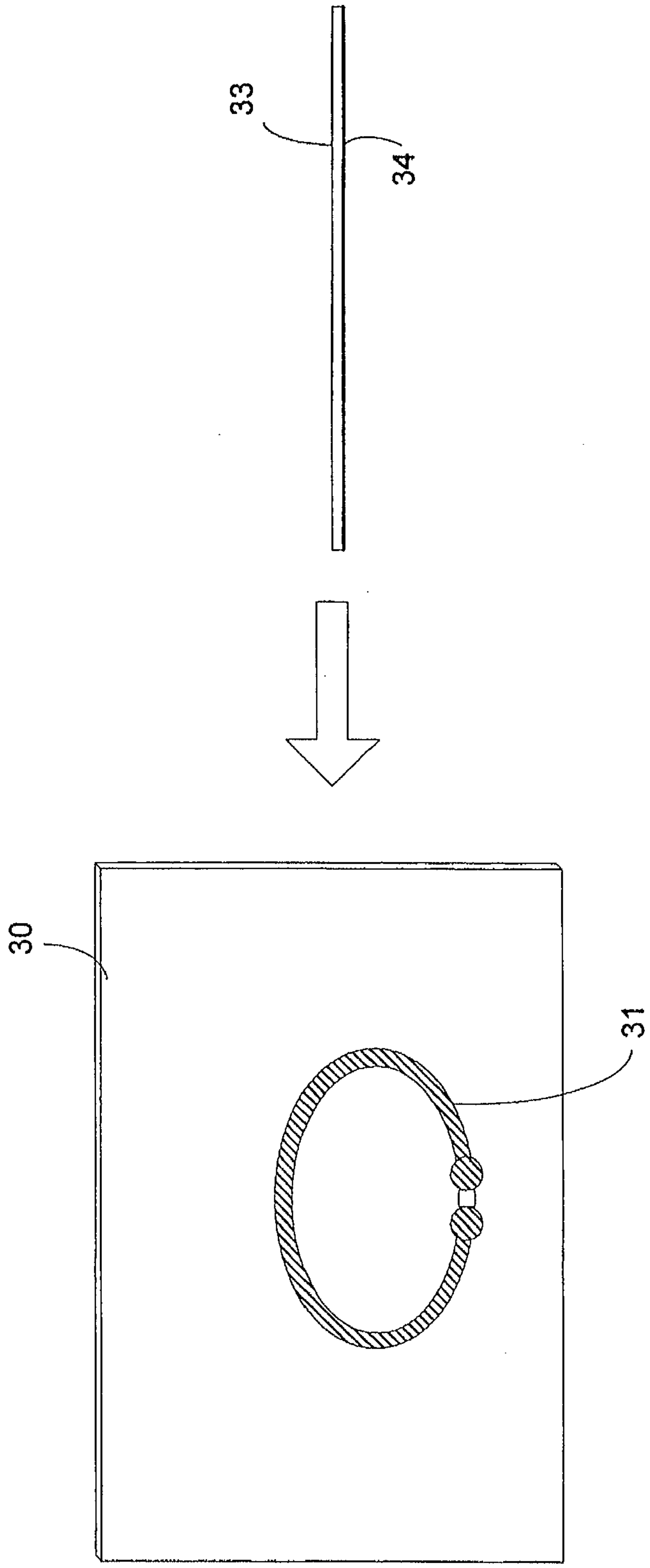


FIG. 3

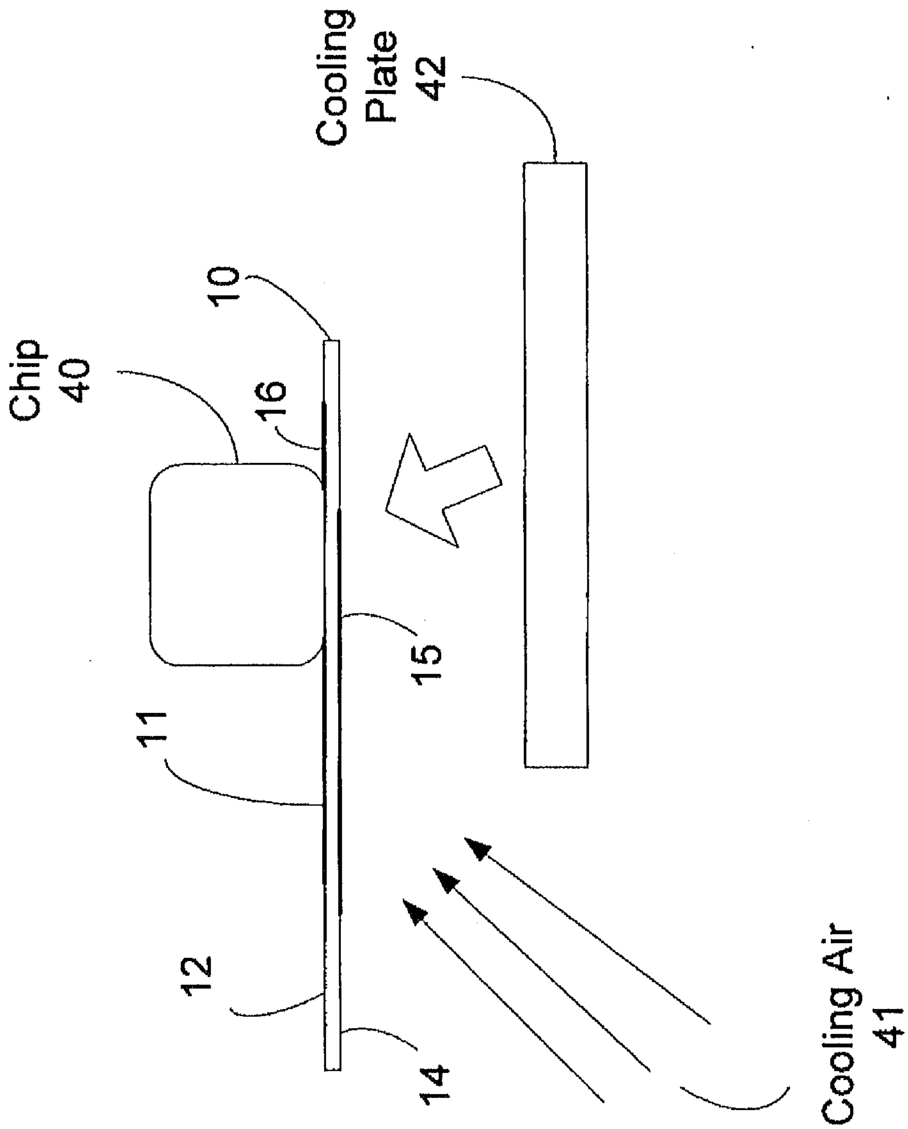


FIG. 4

METHOD FOR PRINTING AN ELECTRONIC CIRCUIT COMPONENT ON A SUBSTRATE USING A PRINTING MACHINE

FIELD OF THE INVENTION

The invention relates to methods of forming a printed electronic circuit, and more particularly to printing an electronic circuit component onto a substrate using a printing machine.

BACKGROUND OF THE INVENTION

Conductive materials are often applied to a circuit board substrate using the screen printing technique. A conductive paste, which can contain, for example, silver, aluminum or conductive carbon black, is applied to a substrate to produce a conductor on the substrate. Applications are also known in which similar conductive printing methods are applied to a printing substrate in a lithographic printing method.

One of the possible applications is the so called radio frequency identification (RFID) tags. These RFID tags present the possibility of storing data on a product. The stored data can be used, for example, to control product streams and simplify the management of inventories. Because of the clearly higher data storage capacity compared to the known bar code decoding, RFID tags can conceivably have any number of additional application fields.

A RFID tag consists of an antenna, optionally additional electronic components, and the RFID chip, which is typically applied using the so called bonding method. Today, antennas of the RFID tags can be applied without a problem by offset printing, screen printing or flexoprinting, while the chips needed for the RFID tags are generally glued or soldered to the contact places of the antenna. However, it is conceivable that in the future complete electronic circuits will be printed on a printed product. The antennas can be designed as a coil or a dipole antenna, depending on the frequency band used.

However, the printed antennas can interfere with the desired visual design of the printed package, because of the color hue of the conductive printing inks and its relatively high layer density, which is required to achieve good conductivity of the seams. In addition, the RFID tag which is printed on the exterior of a package can be destroyed or removed easily. An additional problem arises if, in a later processing step, the chip is glued or soldered to the contact place of the antenna. During the adhesive process or soldering process, heat is often generated at the adhesion places, causing discoloration of the printing substrate or, in a worse case, burns on the printing substrate. The discoloration or burns are not desired if only because they interfere with the decorative appearance of the packages.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to a method for printing an electronic circuit or components thereof in a printing machine by the front-side printing and back-side printing method, where the conductive structure is printed on the printed front side of the printing substrate, the sheet is then reversed and the decorative printing motif or pattern is then printed on the back side in a single work step. As an alternative to the front-side and back-side printing method, the printed circuit can be printed by having the printing machines for color printing be preceded by a printing machine for printing on the back side of the printing substrate, so that the latter printing machine is turned from below against the advancing printing sheet. Furthermore, the patent describes a method for the application of

a chip to the printing substrate without causing discoloration or damages to the printing substrate or the motif on the other side of the substrate.

The invention will be described in greater detail below with reference to the drawings, of which:

BRIEF SUMMARY OF THE DRAWINGS

FIGS. **1**A and **1**B shows in a schematic manner an example of a printed circuit substrate that has a circuit component printed thereon;

FIG. **2** is a schematic view of a printing process for printing components of a circuit board on a substrate;

FIG. **3** is a schematic view of an alternative printing process for printing components of a circuit board on a substrate; and

FIG. **4** is schematic view of a process of applying an integrated circuit chip to a component printed on a substrate.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. **1**A and **1**B show a highly simplified example of a sheet-like substrate **10** that has a conductive structure printed thereon to form a component **11** of an electronic circuit. The component **11** may be, for example, an coil that serves as the antenna for an RFID circuit. For such an application, the ends of the coil may have contact patches **16** for attaching to a RFID chip. The component **11** is printed on one side, such as the backside **12**, of the printed substrate **10**, while the opposite side of the substrate, in this example the front side **14**, has a design or pattern **15**, such as decorative motif, printed thereon.

According to the invention, the problem of the prior art described earlier is solved by printing parts of the circuit on the inner side of the package (front printing side or back side of the sheet of the printing substrate using the S & W method). As shown in FIG. **2**, the circuit part or component **11** is printed using one printing unit **18** of the printing system **20**. The sheet **10** is then optionally dried again and reversed using a turnover device **21**, and the graphic decorative motif **15** is then printed on the back printing side of the printing substrate **10** by a second printing unit **24**.

This method has the advantage that the external appearance is not negatively affected by the applied antennas or by burns produced during the gluing and soldering of the chips. It can be advantageous to apply a preliminary print with a primer or a printing ink before applying the conductive structure, so that the often rougher back side of the printing substrate becomes more covered by the application of a primer/printing ink, and the conductive printing ink does not penetrate excessively into the printing substrate **10**.

The application prior to the turnover device **21** can be carried out by one or more flexoprinting machines or by one or more offset printing machines. It is also possible to combine the printing of the conductive structure **10** with the printing of a decorative motif **15**.

As an alternative to direct printing of the conductive printing ink, a film transfer method can be used. Here, as shown in FIG. **3**, the motif of the conductive structure is preprinted on the substrate **30** with an adhesive **31**. The back side **32** of the printing substrate, which is provided at the places of the motif with adhesive, is then brought into contact with a transfer film **33** in an additional work step, where the transfer layer **34** of the transfer film consists of a conductive material. At the places of the back side of the printing substrate which are provided with adhesive, this conductive transfer layer undergoes a transition to the places which have a motif provided with adhesive. Two different methods can be used for the film transfer. These methods differ in the type of adhesive used. One can use either a physically drying adhesive, or alternatively, an adhesive which hardens under exposure to UV radiation.

Sheet offset printing machines of appropriate design and with several printing machines in a series for the manufacture of colored prints with front-side printing and front-side printing and back-side printing are known from the patents DE 34 19 762 and DE 37 17 093. In DE 40 36 253, a printing machine is disclosed with presents a turnover device following a finishing apparatus. Thus, appropriate turnover devices are already known in multiple designs.

Instead of using a turnover device, the decorative motif may be printed onto the substrate using a back-side printing device. In that case, the turnover device **21** in FIG. **2** is no longer required, and the second printing device **24** is replaced with a back-side printing device **25**. So called back-side printing machines are also known, which, arranged below, print on the back side of the sheet without the turnover process. Such a device is disclosed, for example, in DE 29914812. The front-side and back-side printing method and the back-side printing method can be used according to the invention.

An advantage of printing the conductive structures on the backside of the printed substrate is that the conductive structure is smoothened or calendered during the pass through the subsequent printing machines by the back-side printing cylinder. Tests have shown that the conductivity of the conductive structure can be increased considerably by calendering/smoothing. An additional increase in the conductivity could be achieved by slightly heating the back-side printing cylinders which come in contact with the back side of the sheet containing the printed conductive structure. An optimal heat transfer is achieved by pressure and close contact. A temperature increase to >35° [C.] results in a more rapid increase of the conductivity after the printing.

Referring to FIG. **4**, an additional challenge relates to the way to fixing a chip **40** by means of bonding/gluing/soldering at the contact points **16** of the antenna **11** or of other conductive structures on the back side **12** of the printing substrate **10**. During the process of fixing the chip **40**, the heat can pass from the back side **12** of the printing substrate **10** to the front side **14** of the printing substrate, where it can lead to discoloration of the printing decorative image. The discolorations can be prevented if the printed front side of the printing substrates is cooled during the process of fixing the chip **40**. The cooling can be achieved by directing cooling air **41** to the printed front surface during the process of fixing the chip, by pressing the printed front side of the printing substrate against a cooled plate **42**, or by a cooling process of another type. Such cooling would be considerably more expensive to implement if the conductive structure/antenna is printed on the front side of the sheet together with the decorative printing motif. In that case, burns and discolorations would have to be expected.

The invention claimed is:

1. A method of attaching a chip to a conductive structure printed on a first side of a printing substrate, said printing substrate having a second side with a motif printed thereon, comprising:

applying cooling to the second side of the printing substrate;

while cooling is applied to the second side of the printing substrate, attaching the chip to the printed conductive structure on the first side.

2. A method according to claim **1**, wherein the step of applying cooling includes pressing the second side with the printed motif against a cooled plate.

3. A method according to claim **1**, wherein the step of applying cooling includes exposing the second side to cooling air.

4. A method according to claim **1**, wherein the printing substrate is paper.

5. A method according to claim **1**, wherein the printing substrate is a film.

6. A method of printing circuit components onto a printing substrate, comprising:

printing a conductive structure on a first side of the printing substrate, said conductive structure forming a circuit component;

printing a decorative image motif on a second side of the printing substrate, wherein the printing of the conductive structure and the printing of the decorative image motif are performed in one offset printing process; and

attaching a chip to the printed conductive structure on the first side of the printing substrate, wherein attaching the chip to the conductive structure further comprises:

applying cooling means to the second side of the printing substrate; and

while the cooling means is applied to the second side of the printing substrate, attaching the chip to the printed conductive structure on the first side.

7. A method of printing circuit components onto a printing substrate, comprising:

printing a conductive structure on a first side of the printing substrate, said conductive structure forming a circuit component;

printing a decorative image motif on a second side of the printing substrate, wherein the printing of the conductive structure and the printing of the decorative image motif are performed in one offset printing process; and

attaching a chip to the conductive structure printed on the first side of the printing substrate, wherein attaching the chip to the conductive structure further comprises:

applying cooling means to the second side of the printing substrate; and

while the cooling means is applied to the second side of the printing substrate, attaching the chip to the printed conductive structure on the first side.

* * * * *