

Analysis on Innovation and Application of Anti-counterfeiting Technology of Printed Matter

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Abstract: This paper deeply focuses on the innovation and application of printed matter anti-counterfeiting technology, through a variety of advanced anti-counterfeiting technology principle, characteristics and rich application examples to carry out a detailed study, a comprehensive and in-depth analysis of its protection of product safety, resolutely prevent counterfeiting and fully maintain market order and other aspects of the key and important role. At the same time, the future development trend of anti-counterfeiting technology and the current severe challenges are deeply discussed, aiming at providing a very valuable and meaningful reference for the in-depth research and practical operation in related fields.

Keywords: Printed matter; Anti-counterfeiting technology; Innovate; Apply.

1. Introduction

In the current era of highly developed market economy and fierce competition, fake and shoddy products are flooding like a monster, which has become an extremely severe and urgent problem. These fake and shoddy products not only ruthlessly violate the legitimate rights and interests of consumers, so that they suffer economic losses, and may even pose a potential threat to their health. At the same time, for enterprises, the epidemic of fake and shoddy products has seriously damaged their carefully built brand image, greatly reduced consumers' trust in the brand, and then had a huge impact on the economic benefits of enterprises, resulting in a shrinking market share and a sharp decline in profits.

As the key carrier of product identification, packaging and publicity, printed matter carries the important mission of conveying product information, shaping brand image and attracting consumers. In this process, the clever application of anti-counterfeiting technology is particularly crucial and indispensable. As the pace of scientific and technological development continues to accelerate, the innovation achievements like the stars are endless, and the print anti-counterfeiting technology also conforms to the trend of The Times, and continues to innovate and develop in continuous exploration and practice. These rapid changes are like a sharp sword, providing us with a more powerful and effective weapon in the difficult battle against counterfeit and shoddy products, helping us to take a more solid and powerful step on the road of maintaining a fair competition environment in the market and protecting the legitimate rights and interests of consumers.

2. Second, the Classification of Printed Matter Anti-counterfeiting Technology

2.1. Optical anti-counterfeiting technology

Laser holographic anti-counterfeiting technology is a high-tech anti-counterfeiting method based on the principle of laser interference. It works by cleverly using the coherence of the laser to record the three-dimensional image of the object in an extremely fine way on a specially made hologram. When viewed from a certain Angle, it is amazing to be able to

present a lifelike stereoscopic image and even a dazzling dynamic effect. This unique visual effect makes it difficult for counterfeiters to imitate, thus providing highly reliable anti-counterfeiting protection for products. For example, in some high-end luxury packaging, such as the packaging box of expensive watches, laser holographic anti-counterfeiting labels are often used. Through different angles of observation, consumers can see that the brand logo of the watch presents a three-dimensional and dynamic effect, which not only increases the mystery and advanced sense of the product, but also more effectively prevents the emergence of counterfeit products. The core of anti-counterfeiting technology of photovisible ink lies in its unique color-changing characteristics. The color of this ink is not fixed, but will change significantly with subtle changes in the Angle of observation. This magical property gives the print its unique anti-counterfeiting properties, making it difficult for counterfeiters to copy. In practical applications, such as some high-value stamp printing, prints printed with light-varying inks, when the stamp is tilted or rotated, the color will change significantly, such as from gold to green, or from blue to purple. This instant color change not only increases the artistic value of the stamp, but also becomes an insurmountable anti-counterfeiting barrier.

2.2. Magnetic anti-counterfeiting technology

The key to magnetic anti-counterfeiting technology is to carefully add a specific magnetic material to the ink. These magnetic materials are perfectly integrated with the ink during the printing process and are distributed in specific areas of the print. These magnetic features can be keenly detected by specially designed detection equipment. Once the magnetic signal that meets the preset standard is detected, the authenticity of the product can be confirmed; On the contrary, if the corresponding magnetic characteristics are not detected or the detection results are abnormal, it can be judged as a counterfeit product. For example, in the printing of some important documents and certificates, such as academic certificates, real estate certificates, etc., magnetic ink will be used to print specific anti-counterfeiting marks. When verifying the authenticity of the certificate, the relevant departments only need to use the special magnetic detection equipment for scanning, which can quickly and accurately

determine the authenticity of the certificate, and effectively prevent the falsification and tampering of the certificate.

2.3. Digital watermarking technology

Digital watermarking technology is a kind of advanced anti-counterfeiting means that the specific digital information is cleverly embedded into the image or text of printed matter. This process is extremely delicate, and the embedded digital information does not have any noticeable impact on the appearance of the print, thus maintaining the original visual integrity and aesthetics of the print. However, through specially developed software and detection equipment, these hidden digital information can be accurately detected and read out.

In practical application scenarios, such as some important commercial contracts and legal documents, key data such as copyright information and signature date embedded by digital watermarking technology can be read and verified by dedicated software when authenticity identification or copyright traceability is needed, providing a reliable basis for the legitimacy and authenticity of documents.

2.4. Special printing technology

The essence of microprint is to reduce text to extremely small sizes, often requiring the help of a magnifying glass or even a microscope to clearly identify. This tiny text size is far beyond the ability of the average counterfeiter to reproduce, thus providing a unique anti-counterfeiting identity for printed matter. For example, on the instructions of some drugs, key information such as the production batch and expiration date of the drug will be printed in miniatures. When buying a drug, consumers can carefully view these miniatures through a magnifying glass to confirm the authenticity and legality of the drug. The magic of invisible printing technology is the use of special inks for printing, so that the printed pattern or text is completely invisible under normal light. Only under certain conditions, such as ultraviolet light or specific wavelengths of light, will these hidden patterns and words magically appear. In practical applications, such as the printing of some tickets, coupons, etc., invisible printing technology will be used to print anti-counterfeiting codes or verification information. When entering or exchanging, the ultraviolet light can quickly verify the authenticity of tickets or coupons, effectively preventing the circulation of fake tickets and invalid coupons.

3. Third, the Innovation of Printed Matter Anti-counterfeiting Technology

3.1. Material innovation

In the field of anti-counterfeiting technology, material innovation has always been one of the important driving forces for development. Researchers are constantly committed to developing new anti-counterfeiting materials to improve anti-counterfeiting performance and increase the difficulty of forgery. Nanomaterials with special optical properties are an important direction of material innovation. These nanomaterials can exhibit unique optical phenomena under certain conditions, such as fluorescence characteristics of quantum dots and surface plasmon resonance of nano-metals. The application of these nanomaterials to print anti-counterfeiting can achieve more fine and complex optical effects, making it difficult for counterfeiters to imitate. Intelligent color-changing materials are also new anti-

counterfeiting materials that have attracted much attention in recent years. This kind of material can automatically change color according to changes in the external environment, such as temperature, humidity, light, etc. For example, a smart color-changing ink is colorless at room temperature, but turns red when the temperature rises to a certain extent, and returns colorless after the temperature decreases. This dynamic color-changing effect provides a new idea and means for anti-counterfeiting. Through the continuous development and application of these new anti-counterfeiting materials, the anti-counterfeiting level of printed matter can be greatly improved, and a stronger guarantee can be provided for the authenticity and security of products.

3.2. Technological innovation

In the development of print anti-counterfeiting technology, process innovation has always played a crucial role. By combining the advanced printing process with anti-counterfeiting technology, more complex, fine and unique anti-counterfeiting patterns and structures can be achieved, thereby effectively improving the anti-counterfeiting effect. Intaglio printing is a printing process with high precision and high resolution. Its characteristics are that the graphic part of the printing plate is lower than the blank part, and the ink is filled in the dented graphic part when printing, and then transferred to the substrate. Since gravure printing can achieve extremely fine lines and extremely deep ink layers, it is often used to print currencies and securities with high anti-counterfeiting requirements. In relief printing, the graphic part of the plate is higher than the blank part, and the ink is attached to the raised surface of the graphic part during printing, and then stamped onto the substrate. Letterpress printing can produce obvious relief effects, which can give people a strong tactile perception when printing anti-counterfeiting signs, increasing the difficulty of anti-counterfeiting. Screen printing has the advantages of strong printing adaptability and thick ink layer, which can be used to print anti-counterfeiting patterns with special texture and three-dimensional sense, such as frosted effect and three-dimensional texture. Combining these advanced printing processes with anti-counterfeiting technology can create more complex and difficult-to-copy anti-counterfeiting patterns and structures, such as the combination of miniature text and fine lines, multi-level overprinting effects, and special texture printing. These innovative process means not only increase the difficulty of counterfeiting, but also improve the reliability and stability of anti-counterfeiting.

3.3. Technology integration and innovation

With the continuous progress of science and technology, a single anti-counterfeiting technology has been difficult to meet the increasingly complex anti-counterfeiting needs. Therefore, the integration of a variety of anti-counterfeiting technologies to form a comprehensive anti-counterfeiting system has become an important trend of current print anti-counterfeiting technology innovation. The combination of optical and magnetic anti-counterfeiting technology is a common way of fusion. For example, on an anti-counterfeiting label, a three-dimensional optical image can be presented by laser holographic technology, and magnetic characteristics can be detected by magnetic ink. Such dual anti-counterfeiting means greatly improve the reliability and security of anti-counterfeiting. The combination of digital watermarking and special printing technology is also an

innovative application. For example, digital watermark information is first embedded in the printed matter, and then secondary encryption is carried out through special printing technologies such as microprint or invisible printing. In this way, even if counterfeiters can find digital watermarks, it is difficult to break the barriers set up by special printing technology. Technology integration innovation can not only give full play to the advantages of various anti-counterfeiting technologies, but also form complementary and synergistic effects, making the anti-counterfeiting system more perfect and powerful. At the same time, this fusion innovation also opens up new ideas and space for the development of anti-counterfeiting technology, and constantly promotes anti-counterfeiting technology to a higher level.

4. Fourth, The Application of Printed Matter Anti-counterfeiting Technology

4.1. Application in commodity packaging

High-grade tobacco and wine packaging

In the high-end tobacco and alcohol market, brand image and product quality are crucial. In order to protect the brand reputation and the interests of consumers, advanced anti-counterfeiting technologies such as laser holography and photovisible ink have been widely used. Laser holographic technology can present colorful three-dimensional images on tobacco and wine packaging, such as brand logos and product names. These stereoscopic images not only have a strong visual impact, but also are difficult to be copied. By observing the holographic image on the package, consumers can quickly judge the authenticity of the product. The application of light variable ink adds more mysterious color to high-end tobacco and wine packaging. For example, on the label of a wine bottle, the use of light ink to print a brand name or a specific pattern, when viewed from a different angle, the color of the ink will change wonderfully, from gold to blue, or from red to green. This unique color change effect not only increases the interest and attractiveness of the product, but also provides an effective means for anti-counterfeiting. Through the application of these advanced anti-counterfeiting technologies, the packaging of high-end tobacco and wine products not only improves the grade and added value of the products, but also more effectively prevents the emergence of counterfeit and shoddy products, and protects the rights and interests of consumers and the reputation of the brand. The safety and traceability of medicines are important issues concerning public health. Therefore, the application of advanced anti-counterfeiting technology in pharmaceutical packaging is of vital significance. The application of digital watermarking technology in drug packaging can realize the hiding and encryption of drug information. By embedding specific digital watermarks in the pattern or text of the drug package, such as the batch, production date, expiration date and other key information of the drug, it can provide a unique identity for the drug without affecting the appearance of the package. Specialty printing technologies such as microprint and invisible printing also play an important role in pharmaceutical packaging. For example, the use of microprint on drug instructions and precautions, or the use of invisible printing technology on drug packaging boxes to print anti-counterfeiting labels, which can only be displayed under specific conditions. The application of these anti-counterfeiting technologies ensures the safety and traceability

of drugs in the production, circulation and use process, effectively prevents the flow of counterfeit drugs into the market, and ensures the safety of the public.

4.2. Application in bills and documents

Cash

As a symbol of national currency, banknotes are very important for their security and anti-counterfeiting performance. In order to ensure the security of currency and prevent counterfeiting and tampering, banknotes have integrated a variety of advanced anti-counterfeiting technologies. Magnetic fiber is one of the common means of banknote anti-counterfeiting. In the papermaking process, the magnetic fibers are evenly distributed in the paper. Through the special detection equipment, the distribution of magnetic fibers in the paper can be detected, so as to judge the authenticity of the banknote. Microprinting technology has also been widely used on banknotes. For example, hidden in the patterns of banknotes are tiny words that require a magnifying glass to make out clearly. These miniatures usually contain important information such as the issuing institution and denomination of the currency. Laser holographic technology provides a more dazzling anti-counterfeiting effect for banknotes. In specific areas of banknotes, such as watermarks or security lines, the application of laser holographic technology can present three-dimensional images and dynamic effects, which increases the difficulty of counterfeiting. Through the comprehensive application of these advanced anti-counterfeiting technologies, banknotes have extremely high anti-counterfeiting performance, ensuring the security and stability of the national currency. Passport visa as an important document for international travel and identity authentication, its anti-counterfeiting requirements are also very strict. Digital watermarking and special printing technology play an important role in the security of passport and visa. Digital watermarking technology can embed key data such as the holder's personal information and photos into the page of the passport visa in an encrypted form. The authenticity and integrity of this information can be verified quickly and accurately through a dedicated reading device. Special printing technologies such as invisible printing and photorefractive inks are also commonly used for passport and visa security. For example, the use of invisible printing technology to print security patterns or text on the page of a passport visa, which can only be displayed under certain light conditions; Or use photovisible ink to print important logos and information, and verify the authenticity of documents through color changes. The application of these anti-counterfeiting technologies effectively prevents the falsification and tampering of passports and visas, and ensures the safety and order of international travel.

4.3. Application in brand protection

For well-known brands, product labels are an important part of brand image and the first line of defense against counterfeit products. By applying unique anti-counterfeiting marks on product labels, brand image and reputation can be effectively maintained. For example, some internationally renowned cosmetics brands use special laser anti-counterfeiting logos on product labels. This anti-counterfeiting logo will show unique patterns and color changes under different light angles, and consumers can distinguish the authenticity of the product by simple

observation. Some high-end clothing brands will use microtext printing technology on product labels, printing information such as brand history, product material and origin in the form of microtext on the label. This information can only be read clearly through a magnifying glass, making it more difficult for the impostor to copy.

Through these unique anti-counterfeiting logos, well-known brands can effectively distinguish their genuine products from counterfeit products, protect the rights and interests of consumers, while maintaining the brand

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