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AVAILABLE PORTFOLIOS

IMAGING / DISPLAY / MULTIMEDIA

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Advanced Field Emission Technologies Related To Carbon Nanotubes & Cathode Devices

Till Keesmann

The Keesmann patent portfolio consists of assets comprising technologies in two distinct areas. The first collection of assets relates to the use of carbon nanotubes (CNTs) as field emission displays (CNT FED Portfolio), while the second grouping is comprised of assets related to field emission devices with individually positioned atoms (Atom Portfolio). In addition to the domestic patent protection provided by these assets in the United States, the portfolio provides additional foreign coverage in various countries around the world including the United Kingdom, France, Germany, China, Japan, and more.

Field emission refers to the emission of electrons from the surface of an electric conductor under the action of an electric field exceeding 10.sub.9 V/m. Field strengths of this magnitude are realized at sharp edges or tips, where the field strength is amplified. Accordingly, field emission cathodes are used in various technologies including electron accelerators and high-power switches in field electron microscopes, as well as in field emission diodes and field emitter arrays in vacuum microelectronics.

Traditional methods for producing field emission cathodes utilize vacuum microelectronics and microprocess technologies involving etching and sputtering. These methods however result in cathodes in which the electron stream declines with operating time, since the tips or edges are destroyed by the positive ions of the unavoidable residual gas in the system. The reason for this primarily is that the material structure of the emission tips is not uniquely defined. Thus, the geometry and microstructure of the tip and thus the work function of the electrons can vary within such wide limits that the electron streams from several tips, which were produced in one process, can differ by orders of magnitude, and furthermore change with operating time.

Value Proposition: The key component of this patent portfolio offering is U.S. asset RE 38,223, entitled "Field Emission Cathode Having an Electrically Conducting Material Shaped of Narrow Rod or Knife Edge." This patent was identified by Nanotechnology Law and Business and cited by the Intellectual Property & Technology Law Journal in December 2004 as one of the top 10 nanotech patents in the U.S. with the ability to "dramatically impact the development of nanotechnology". In their examination of several thousand patents, RE 38,223 was identified as one of the assets most likely to play an important role in the commercialization of nanotechnology. In addition, an independent valuation of U.S. asset RE 38,223 performed by Pantros IP resulted in an eight figure valuation for this individual asset standing on its own.

The technology in the Keesman portfolio avoids the disadvantages of traditional production methods and assures high emission quality, makes possible a longer lifetime, and in particular resists bombardment with residual gas ions. This is achieved through the use of an electrically conducting material having the shape of a narrow rod or a knife edge to achieve high magnification of the electric field strength; in this case, a carbon nanotube.

The CNT FED Portfolio should be of interest to companies involved in the manufacture of various display market technologies including mobile phones, touch-screen devices, televisions, monitors, consumer electronics, and more. The Atom Portfolio should be of interest not only to some of these same companies, but more specifically to those involved in areas such as lighting, x-ray, and medical imaging and diagnostics. These portfolios can be purchased together or separately.

Priority Date: 02-23-1994

Forward Citing Companies: Canon, Sony, Chevron, Samsung, Alcatel-Lucent, IBM

Representative Claim: US RE 38,223 – Claim #1
A field emission cathode which consists of an electrically conducting material having the shape of a narrow rod or a knife edge to achieve high magnification of the electric field strength, such that the electron-emitting part of the field emission cathode has cylindrical molecules formed at least in part as single-shell or multiple-shell carbon nano-cylinders.

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CNT FED PORTFOLIO OVERVIEW

Technologies Related to the Use of Carbon Nanotubes as Field Emission Displays

Flat screens and small, light displays have increasingly squeezed cathode ray tube (CRT) monitors out of the market and the trend is set to continue. Field emission displays are superior to the widely available thin-film transistor (TFT) displays in their quality and cost-effectiveness and will therefore play an important role in the future. They generate images in the same way as CRT monitors – with electrons impacting on a phosphor layer; however, in the case of the field emission display, each pixel has its own cathode from which electrons are expelled by field emission. The individual pixels are controlled as a kind of matrix, which means a similar physical depth is achieved as with the TFT display.

The strengths of the field emission display lie in the image quality and cost advantages for large screens. The field emission cathodes with CNT, as invented, are especially well suited for field emission displays. Essentially, the physical advantages of using carbon nanotubes as field emission cathodes consist of optimal field amplification at the ends of the cylindrical nanotubes, advantages in the production of the cathode, and advantages in the service life of the tips.

In order to strengthen the legal position of this basic patent, a reissue patent was registered in accordance with US patent regulations, in which the claims are more succinctly formulated for enforcing patent rights. The patent was issued under patent number RE 38,223 in August of 2003.[2] A further reissue patent with patent number RE 38,561 was issued in August of 2004 with the main claim (10) now stating "A field emission cathode comprising an electron-emitting part of the cathode formed at least in part as a carbon nano-cylinder."

This essentially states that every field emission cathode with CNT makes use of this claim. An additional follow-on application was submitted to the US Patent Office in 2004 with the title "Field emission cathode using carbon fibers" and claims patent protection for all carbon fibers used as electron-emitting components in cathodes.

In addition to the previously disclosed valuation for U.S. asset RE 38,223, the market size of next-generation display components was estimated at $6 billion in 2008 and is expected to grow exponentially by 2014 because of the increasing use of the next generation display components in consumer electronics.[3]

TECHNOLOGY
FIELD EMISSION DISPLAYS

NOVELTY
FIELD EMISSION CATHODES WITH CNT ARE ESPECIALLY WELL SUITED FOR FIELD EMISSION DISPLAYS RESULTING IN HIGHER IMAGE QUALITIES AND COST ADVANTAGES FOR LARGE SCREENS

IMPORTANCE
HIGHLY RELEVANT TO THE NEXT GENERATION DISPLAY MARKET AND MAY PROVIDE SIGNIFICANT BENEFITS OVER EXISTING TECHNOLOGIES

NUMBER OF ASSETS
10

US PATENTS (3)
5,773,921
RE 38,561
RE 38,223

OTHER PATENTS (5)
AT 801805
CH 801805
DE 801805
FR 801805
GB 801805

APPLICATIONS (2)
PCT/DE95/00221
AT 19950910405

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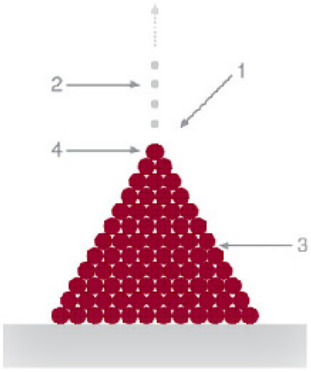
ATOM PORTFOLIO OVERVIEW

Technologies Related to Field Emission Devices with Individually Positioned Atoms

In a field emission, the type of cathode and materials used can significantly vary both the voltage required and the quantity of emitted electrons. The field emission device according to the disclosed patent portfolio achieves an optimal increase of field force by means of individually positioned atoms or molecules that form e.g. a cylindrical, ball or pyramid-shaped cathode point. This application is a continuation of and addition to the so-called "Keesmann Patent". (Patent nos.: Europe: EP 0 801 805 (DE, FR, GB, AT, CH/LI); USA: US 5,773,921; RE 38,223; RE 38,561).

The technology in this portfolio relates to a field emission device comprising a cathode having an emission region (1) for electrons (2).[4] The field emission device is embodied for generating technically useful electron currents at a voltage which is as low as possible, in such a way that the emission region (1) has an arrangement of a plurality of individually positioned or positionable atoms (4) or molecules. As such, this technology could have practical applications in a variety of markets. The field emission device may be usable in a field emission microscope, in a scanning tunneling microscope, in an atomic force microscope, or for ionizing gases. Furthermore, the disclosed field emission device could not only serve in the field of illuminants or backlights, but could also be utilized on circuit boards, in microdevices, and in the field of data carriers. Additional related markets could include measuring sensors, hand-held x-ray fluorescence analysis devices, in x-ray devices, and in computer tomography.



Specifically related to the x-ray market, carbon nanotube field emission technologies solve the challenges of traditional products, i.e. limited resolution, high operating temperature, and slow response time. This technology is capable of producing ultra-high temporal resolution images and should find a significant home in not only the markets for both imaging and irradiation systems, but in other areas as well. According to an independent valuation by Pantros IP of the technology covered by the U.S. application in this patent portfolio, the size of the patent protected market is greater than $30 Million. In addition, the U.S. market for medical imaging products was valued at over $8.5 billion in 2009 and is expected to increase in the coming years after a 14.6% drop from 2008.[5]

Contact:
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TECHNOLOGY
LIGHTING/MEDICAL IMAGING

NOVELTY
CNT FIELD EMISSION TECHNOLOGIES PROVIDE SIGNIFICANT ADVANTAGES OVER TRADITIONAL PRODUCTS INCLUDING HIGHER RESOLUTION, LOWER OPERATING TEMPERATURE, AND FASTER RESPONSE TIME

IMPORTANCE
HIGHLY RELEVANT TO EXISTING MARKETPLACE, SPECIFICALLY X-RAY TECHNOLOGY AS THE DISCLOSED ASSETS ALLOW FOR MORE CONSISTENT CATHODE FIELD EMISSION PROPERTIES

NUMBER OF ASSETS
14

OTHER PATENTS (7)
AT 2092542
CH 2092542
FR 2092542
GB 2092542
IT 22424 BE/2010
NL 2092542
SE 2092542

APPLICATIONS (7)
CA 20072667653
CN 20078042058
DE 200610054206
JP 20090536600
KR 20097009979
PCT/DE07/02065
US 12/514,765

1. Intellectual Property & Technology Law Journal. Vol. 16, No. 12, December 2004 (See Appendix)
2. http://argus-holding.de/argus-holding-patente-lizenzen-patentverwertungen-forschung_entwicklung-kohlenstoff-nanoroehren-feldemissionskathoden.php?speak=english&PHPSESSID=b0d213ff7a0131a18d18f94048442f74
3. http://www.marketsandmarkets.com/Market-Reports/low-power-next-generation-display-market-115.html
4. http://argus-holding.de/argus-holding-patente-lizenzen-patentverwertungen-forschung_entwicklung-kohlenstoff-nanoroehren-feldemissionskathoden.php?speak=english&PHPSESSID=b0d213ff7a0131a18d18f94048442f74
5. http://www.the-infoshop.com/report/ida135774-us-med-imagi-equip.html

ICAP PATENT BROKERAGE

Techniques & Devices for High Resolution Image Display

Hewlett Packard Co

This portfolio discloses techniques and devices related to Wobulation technology. In particular, the assets relate to increasing the image resolution in digital projection displays without increasing the number of pixels in the spatial light modulator ("SLM").

Display devices such as screens, projectors, and other imaging systems produce an image by using pixels. These pixels are image elements arranged in a display in horizontal rows and vertical columns with the total number of pixels defining the resolution of the displayed image. This resolution is affected by the resolution of the display device as well as the resolution of the image data being processed. Typically, the resolution of the display device and that of the image data used to produce the displayed image must be increased to augment the resolution of the displayed image. The drawback however, is that increasing the resolution of the display device increases both cost and complexity. Furthermore, higher resolution image data can be difficult to generate or may not be available at all.

Value Proposition: This portfolio discloses techniques for displaying a high resolution image generated from image data. Sub-frames of the image are defined and then interlaced to display a high resolution image on a display screen, with the interlacing performed by alternating between displaying multiple sub-frames in different positions spatially offset from each other on the display screen. Therefore, an enlarged image of higher resolution is displayed using the image data. In addition, this portfolio also discloses devices with a control unit for managing the display of image data on a display screen. Defective pixels in the image data can be removed using the techniques disclosed herein. Also disclosed in this portfolio is a projector for displaying better quality images using modulation. This projector includes an arrangement of optical components (e.g. mirrors) that selectively reflect light bands of different colors from the image data allowing a better image to be displayed. A high resolution image can be displayed by adjusting the angle between the mirrors of the projector.

Priority Date: 08-07-02

Forward Citing Companies: Hewlett-Packard, Sharp, Texas Instruments, Intel, NEC, Samsung, AU Optronics, LG, Konica Minolta, Casio

Representative Claim: US 6,963,319 – Claim #1
A method of displaying an image, the method comprising: receiving image data for the image; buffering the image data for the image, including creating a frame of the image; defining a first sub-frame and at least a second sub-frame for the frame of the image; and displaying the first sub-frame and the second sub-frame, including synchronizing shifting a displayed image of the second sub-frame with displaying the second sub-frame, wherein displaying the first sub-frame and the second sub-frame includes modulating light with a light modulator and producing a first displayed image portion with the first sub-frame and a second displayed image portion with the second sub-frame, wherein displaying the first sub-frame and the second sub-frame further

TECHNOLOGY
DISPLAY SYSTEMS / PROJECTORS

NOVELTY
EFFICIENT AND EFFECTIVE METHOD OF INCREASING IMAGE RESOLUTION IN DIGITAL PROJECTION DISPLAYS WITHOUT INCREASING THE NUMBER OF PIXELS IN THE SPATIAL LIGHT MODULATOR

IMPORTANCE
KEY IP FOR MANUFACTURERS OF PROJECTORS AND OTHER DISPLAY DEVICES

NUMBER OF ASSETS
27

US PATENTS (27)

6,963,319	7,317,465
6,972,913	7,358,930
6,984,040	7,453,449
7,023,449	7,463,272
7,030,894	7,474,319
7,034,811	7,551,154
7,044,606	7,557,819
7,052,142	7,657,118
7,086,736	7,668,398
7,098,936	7,670,005
7,154,508	7,675,510
7,172,288	7,676,113
7,190,380	7,679,613
7,289,114	

includes projecting the first displayed image portion and the second displayed image portion with projection optics, and wherein shifting the displayed image of the second sub-frame includes positioning an optical element in an optical path at least one of before and after the projection optics and moving the optical element between a first position and at least a second position.

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ICAP PATENT BROKERAGE

Imaging & Pattern Matching Techniques

Kui Ming Chui

(1) In medicine, imaging techniques such as X-ray (or CR), Magnetic Resonance (MR), Computer Tomography (CT), or Positron Emission Tomography/Nuclear Medicine (PET/NM) involve scanning an object to prepare an image. However, a faithful reproduction of an object's image may not be obtained due to the Penumbra Spread caused by the various limiting factors such as finite size of the energy source, detector size, sampling frequency, display density, software filter function and partial-volume effects experienced with some imagers. Instead, a smeared-out image, or Point-Spread Function (PSF), is observed. The smearing effect becomes even more intense as the adjacent discontinuities or contrast profiles get closer to each other.

(2) Images of real objects are commonly captured by electronic devices for medical purposes (for example, to diagnose or examine a disease) and for security reasons (to identify an authorized user). In such applications, a master image is often compared against a captured image to determine the level of similarities or differences between the images: Pattern Matching. Pattern matching techniques are used in critical applications such as fingerprinting, the use of specific instances of skin impressions left by a finger (or another part of a human hand or foot), to accurately identify a person.

Value Proposition: Two main technologies are described by this portfolio: image enhancement and pattern matching.

(1) An image enhancement technique that can be used for medical imaging such as X-ray (or CR), MR, CT, or PET/NM. The technique involves applying a de-convolution process to an image of a scanned object for calculating a Point-or-Line Spread Function (PSF). This PSF is used to find the discontinuity in a scanned image. Further, the PSF is correlated with the image domain results for enhancing the spatial resolution of the image. This enhancement may involve transferring sub-pixels from one side of the location of the discontinuities to the other. The de-convolution process can also be performed using a least-squares fitting technique. Therefore, this technology reduces the smearing effect displayed in the images (Ref. 3).

(2) A method and a system for pattern matching used in applications such as fingerprinting or identification using other anatomical feature. The technique describes the use of a de-convolution process on images from a two-dimensional scanned patterns for the creation of skeleton representations. Such representations are then compared against a master pattern for accurate identification. The comparison can be done between the skeletons, or it can also include matching between a density pattern derived from the skeleton representation of the scanned pattern and a reference or master density pattern.

Priority Date: 10-15-1998

Forward Citing Companies: Cedara Software Corp, Kabushiki Kaisha Toshiba, Toshiba Medical Systems Corporation, Accuimage Diagnostics Corp, General Electric Company, Varian Medical Systems Inc, Scimed Life Systems Inc, Contextvision Ab.

Representative Claims:

(1). US 6,928,182 – Claim #1
An imaging method for enhancing spatial resolution within an image domain of an image edge-response function of a scanned object-discontinuity, the method comprising the steps of: carrying out a de-convolution process on the image edge-response function to derive from the image edge-response function a spread profile of the respective point-spread function or line-spread function of the image edge-response

TECHNOLOGY
(1) IMAGING, AND
(2) PATTERN MATCHING

NOVELTY
(1) ENHANCEMENT IMAGING ALGORITHMS FOR MEDICAL DEVICES & FOR INDUSTRIAL APPLICATIONS, AND (2) SECURED 2-D FINGERPRINT MATCHING

IMPORTANCE
STRATEGIC PORTFOLIO FOR COMPANIES DEVELOPING IMAGING DEVICES INCLUDING SECURITY, INDUSTRIAL, AND MEDICAL APPLICATIONS

NUMBER OF ASSETS
12

PATENTS (8)
US 6,928,182
AU 768756
CA 2346852
DE 69922983
EP 1121663
GB 2346028
GB 2419214
JP 4309062

APPLICATIONS (4)
US 11/665,283
NZ 511458
PCT/GB2005/003986
PCT/GB99/03417

function, the de-convolution process being carried out with sub-pixel sampling of the image-edge response function; correlating the spread profile with a profile of the image edge-response function; identifying within the image domain the location of the object-discontinuity, the location of the object-discontinuity being identified within the image domain by a mid-point of a full-width half-maximum of the spread profile; and redistributing sub-pixels of the profile of the edge-response function to enhance the spatial resolution of the object-discontinuity within the image domain, the sub-pixels being redistributed between two opposite sides of the identified location of the object-discontinuity in the image domain, by transferring sub-pixels on one of the two sides to the other of the two side of the identified location. Publications of the principle of the subject, its developed products, and their examples in applications are listed in Refs. 1 & 3.

Practical achievements:

(a) Position at the object-discontinuity was pin-pointed by the de-convolution technique to the sub-pixel accuracy,
(b) Enhancement of the edge-profile (at the object-discontinuity) was achieved without any trade-off loss in the form of noise increase,
(c) A definitive method of accurate measurements has been found for works in Quantitative Radiology, and,
(d) Software algorithm products, IETech-MED in medical applications for various imaging modalities, and IETech-NDT in industrial applications of Non-Destructive Testing and Enhanced 3D Finite Element Analysis have been accomplished.

Priority Date: 10-15-2004

(2). GB 2,419,214 & (Pending US Patent Application 11/665,283) – Claim #1
A method for pattern matching wherein image edge-response functions of a scanned pattern are each submitted to a de-convolution process to determine from the mid-point of the full-width-half-maximum of the derived line spread function the true location in the image domain of the respective edge, and the true-edge locations are linked to one another with reference to the sense with which density or intensity of the scanned pattern changes in the scan-sweep through them so as to derive a skeleton representation of the scanned pattern, and wherein the skeleton representation is utilized in a 2D matching comparison with a reference or master pattern. The developed product is described in Ref. 2.

Practical achievements:

(a) E-lock & key for e-gadgets such as mobile phone, iPad, counter check-in credit card reader, ATM machine, mobile or Internet banking, fingerprint reader for immigration control, etc...in security applications.
(b) Fingerprint matching algorithm, IETech-FPM, to ensure 100% matching efficiency (i.e. 0% false matching & 100% true matching) via a sensor has been successfully written and tested to work), and,
(c) Sub-second processing time may be achieved via the Parallel Processing mode.

References to Principles, Products Developed, and their Applications:

(1) US 6,928,182 alone led to the developments of products, IETech-MED, and IETech-NDT in: http://www.iet.org.uk
(2) US 6,928,182 & GB 2,419,214 (& Pending US Patent Application 11/665,283) together led to the development of IETech-FPM in: http://www.iet.org.uk
(3) Home page, examples, and Publications #1-25 in: http://www.iet.org.uk

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