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(71) Applicant *(for all designated States except US)*: MIKOH TECHNOLOGY LIMITED [AU/AU]; 93 Braeside Street, Wahroonga, NSW 2076 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : ATHERTON, Peter, Samuel [AU/AU]; 25 Gwyndir Avenue, Turramurra, NSW 2074 (AU).

(74) Agent: SPRUSON & FERGUSON; GPO Box 3898, Sydney, NSW 2001 (AU).

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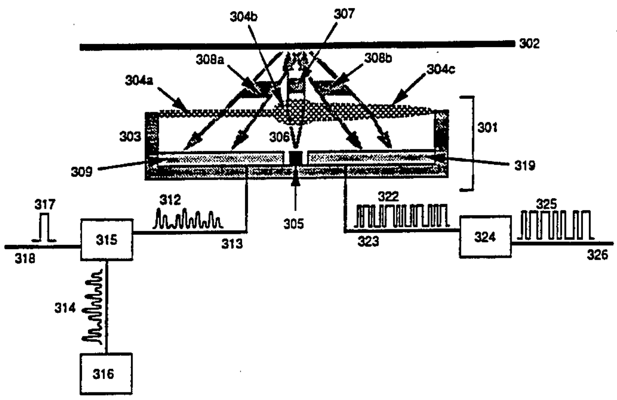

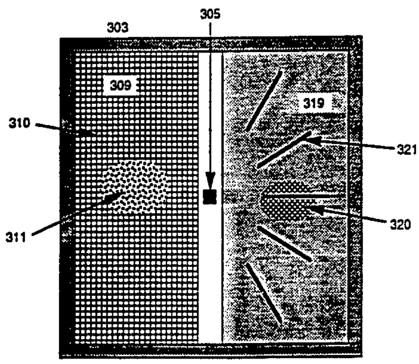

(57) Abstract

A method and apparatus (301) for detecting information stored on an optical memory diffraction surface (101). A reading light beam (102) illuminates the surface (101). At least one diffracted light beam (104) is produced, with the light beam (104) having a predetermined intensity pattern. A sensor (309) is illuminated by a diffracted beam (308) and is used for authentication purposes. A second sensor (319) is illuminated by a second diffracted beam (308), which second beam (308) passes through an optical lens (imaging lens) (304) so that an image is produced on the sensor (319). The sensor (309) produces a signal for authentication purposes which signal can be compared to a "template" signal. The signal generated by the sensor (319) has additional information to that information contained in the signal produced by the sensor (309).

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DIFFRACTION SURFACE DATA DETECTOR

Technical Field

The present invention relates to optical memory technology, and applications thereof to bar codes, data storage cards, such as credit cards and security cards, and methods for the manufacture, reading and modification of the information contained on the cards, or other items such as bank notes, cheques, currency notes, and product labels.

Background of the Invention

Particular attention is drawn to International Patent Application No PCT/AU92/00252.

Disclosed in the above international application are various diffraction surfaces, reading devices and recording devices. However there is not disclosed nor consideration given to the use of intensity patterns in the diffracted beams nor devices to detect such intensity patterns.

Credit card fraud is now becoming a substantial problem due to the ease with which magnetic stripe memories can be modified and copied. This problem also exists in the field of security cards and prepaid card systems. Outside the card industry similar problems exist with documents and products of various types.

Methods have been proposed to overcome the above problems employing holographic patterns and kinegrams.

For example a known kinegram card contains a computer generated holographic pattern extending along one or more tracks across the card. The pattern resembles a conventional hologram but is much brighter and can be made to display a greater degree of movement when viewed at different angles. When the card is used, for example when making a telephone call, it is inserted in a reader slot and the available balance is displayed. After connection, the equipment automatically emits metering pulses. The pulses sequentially decrement the card by destroying each bit by thermal energy. The hologram is read by directing at the pattern light, which is reflected. The angle of reflection is in a direction determined by the hologram. A detector is positioned to be activated by the reflected light.

Swiss Patent 622896 (Application No 2995/78) describes the use of a hologram, in which the reflected light includes a first reflected beam detected by a first sensor, while a second sensor detects scattered light reflected in a second direction. More particularly, the light reflected in the second direction includes a narrow beam and a diverging beam. The narrow beam is blocked so that only the diverging beam is delivered to the second sensor.

Australian Patent Application 19576/83 describes the use of kinegrams for visual verification of the authenticity of the article carrying the kinegram. The kinegram provides diffractive images which move in a predetermined manner with a change in relative orientation. There is no consideration of nor is this particular arrangement adapted to be machine readable.

Similarly Australian Patent Application 44674/85 describes the use of diffractive patterns and the use regarding visual security elements. Similarly Australian Applications 30841/89 and 53729/90 describe techniques for producing visual security images.

European Patent Application 81110234.2 (Publication No 0 060 937) describes the use of optical marks on numerical rollers of a counter mechanism. The optical marks can be a reflective hologram or a refractive grid. A reading beam is directed at each mark and a single beam reflected. Each mark directs the reflected beam at a different angle, with a plurality of detectors being arranged to be illuminated by the appropriate beam.

Swiss Patent Application No 16084/76 (Patent 604279) describes the use of discrete optical marks (which may consist of a diffractive grating or a hologram) which are erased to record information. There is little discussion of reading techniques and the properties of the optical marks.

European Patent Publication 0 015 307 (European Application 79104004.1) describes the use of a stored value card. The card has a series of optical marks arranged in discrete units. The marks are sequentially erased in order to decrease the value of the card.

Swiss Patent 638632 (Application No 929/79) also describes the use of optical marks on a card. The marks are arranged in a predetermined order and are used for identification purposes.

Swiss Patent Application 6836/81 shows the use of optical marks for the purposes of determining the authenticity of a document. The reading beam changes in wavelength which alters the direction of the refracted beam. A detector is then used to determine this change in direction as a means of determining the authenticity of the document.

European Patent Publication 0 057 271 (European Application No 81109503.3) describes the use of optical markings to produce two refracted narrow light beams. Measurement of the intensity of the light beams is used to verify the authenticity of the document.

European Publication No 0 366 585 (Application No 89108121.8) discloses the use of diffraction gratings arranged in a bar code. However the bars are applied to the carrier in a predetermined order in order to record information.

The above discussed optical diffraction techniques still lend themselves to unauthorised use particularly unauthorised reproduction of the holograms, and/or are not suitable for normal commercial use.

A stored value system is one in which the user purchases a memory device which represents usage of some service or facility up to a certain value. A good example can be found in many telephone systems, where users can purchase a stored value card which allows usage of the telephone system up to a specified value.

A stored value system depends on being able to sell to the user a memory device which can be altered to reflect usage of the system. This memory usually comes in the form of a card, a good example being a telephone card. The requirements on this stored value card are that it should be inexpensive; it must contain a write-once stored value memory so that once the value of the card has been decremented, the decrement is permanent; it should resist copying or fraudulent production; and preferably it should be capable of retaining a large number of the units of value for the system, so that the user does not have to replace the card too frequently.

These requirements together place restrictions on the technologies which can be applied to stored value memories. In general the stored value memories currently in use do not meet all of these requirements. For example, optical memories are used in stored value telephone cards in some countries, but these are generally limited to a relatively small number (several hundred or so) of stored value units, making them unsuitable for a number of other potential applications.

Object of the Invention

It is the object of the present invention to overcome or substantially ameliorate the above disadvantages.

Summary of the Invention

There is disclosed herein a method of detecting information stored on an optical memory diffraction area, said area having a diffraction surface adapted to provide a diffracted beam with an intensity pattern determined by the configuration of the surface, said method including the steps of:

subjecting said surface to a reading beam;

positioning an optical sensor so as to be illuminated by the diffracted beam, said sensor being adapted to detect an intensity pattern in the diffracted beam; and

activating said sensor to produce a signal indicative of said intensity pattern.

There is further disclosed herein a device comprising:

means to receive an item having an optical memory diffraction area, said area having a diffraction surface adapted to provide a diffracted beam with an intensity pattern determined by the configuration of the surface;

light producing means to produce a light beam directed to illuminate said surface so as to produce a diffracted light beam; and

an optical sensor positioned to be illuminated by the diffracted light beam, said optical sensor being adapted to produce a signal indicative of the intensity pattern of the diffracted light beam.

Description of the Preferred Embodiments

Preferred embodiments of the present invention will now be described by way of non-limiting example with reference to the accompanying drawings, where:

Figure 1 is a schematic illustration of the important optical properties of a diffraction surface;

Figure 2 is a schematic illustration of an example of a diffraction surface and a type of diffracted beam Intensity Pattern which may be produced by said diffraction surface; and

Figure 3 is a schematic illustration of a device used to authenticate and read data recorded in or on a diffraction surface.

The following definitions apply to terms used herein.

"Intensity Pattern" means the optical Intensity Pattern, or intensity distribution, of a beam of light as projected onto a surface which intercepts said beam of light. An Intensity Pattern is normally represented graphically as a 3 dimensional plot of optical intensity versus position on said surface. Features of an Intensity Pattern are usually referred to in terms of this 3 dimensional plot.

"Significant Optical Feature" means either a local maximum or a local minimum or a saddle point in an Intensity Pattern, neglecting the local and small scale effects of optical noise on said Intensity Pattern.

"Saddle Point" means a point in an Intensity Pattern which is a local maximum along one axis and a local minimum along an orthogonal axis.

Detailed Description of the Preferred Embodiment

Figure 1 is a schematic illustration of some of the optical properties of a preferred diffraction surface 101. A beam of light 102 is directed to the diffraction surface 101. In this preferred embodiment the beam of light 102 is collimated (i.e. parallel) and monochromatic or approximately monochromatic. The diffraction surface 101 produces from the incident beam of light 102 a pair of conjugate diffracted optical beams 103a and 103b, and possibly other beams also. The directions of the diffracted beams 103a and 103b relative to the incident beam 102 depend on the relative orientation of the incident beam 102 and the diffraction surface 101.

Each of the diffracted beams 103a and 103b has a specified Intensity Pattern (as defined above) resulting from a specified optically diffractive structure incorporated into the diffraction surface 101. In figure 1 the Intensity Patterns of the diffracted beams 103a and 103b are indicated by 104a and 104b respectively. The Intensity Patterns 104a and 104b result from optically diffractive structure incorporated into the diffraction surface 101 either at the surface or at an internal interface.

The diffraction surface 101 is authenticated via machine recognition of one or more of the diffracted beam Intensity Patterns produced by the diffraction surface 101. Hence in figure 1 one or both of the Intensity Patterns 104a and 104b must be machine recognisable and in order to provide secure authentication should preferably differ from the Intensity Patterns produced by conventional diffractive surfaces. The Intensity Patterns of diffracted beams produced by the preferred diffraction surfaces should therefore be other than a single peaked Intensity Pattern.

In general the diffracted beam Intensity Patterns produced by the preferred diffraction surfaces will have more than one Significant Optical Feature (as defined above). Hence for example a diffraction surface may produce diffracted beam Intensity Patterns in the form of a number of bright peaks or bright bands or in the form of bright lines which form one or more closed loops or in the form of other complex shapes and patterns.

The essential point is that the diffracted beam Intensity Patterns must be machine recognisable and must be different from the diffracted beam Intensity Patterns produced by conventional diffractive surfaces.

It should be appreciated that a diffraction surface may be designed to produce a different number of diffracted beams from that illustrated in figure 1 and that the different diffracted beams may have different Intensity Patterns.

It should be appreciated that the diffraction surface 101 may be designed such that the Intensity Pattern, and/or other properties such as direction, of a diffracted beam may vary as the region of the diffraction surface 101 illuminated by the optical beam 102 varies. For example, as the incident beam 102 is moved along the diffraction surface 101 the Intensity Pattern 104a or 104b may change in a continuous or discontinuous manner in terms of size, shape, orientation or character to produce an "animation" effect which may add to the security provided through the use of the diffraction surface 101.

It should be appreciated that the diffractive properties of the diffraction surface 101 depend on the structure incorporated into the surface 101. The diffraction surface 101 includes a specified "groove" or "line" pattern either at the surface or internally. Said grooves when viewed from above the surface 101 may be straight or curved and in general will have variable spacings in order to achieve the required diffracted beam Intensity Patterns. Furthermore the cross sectional shapes and depths of said grooves in the diffraction surface 101 may also be specified in order to determine the properties of the diffracted beam Intensity Patterns such as the pattern shape or the intensity gradations within said patterns. In this case said grooves act as a so-called "phase grating".

By way of example, figure 2 is an illustration of a preferred embodiment of a diffraction surface along with the diffracted beam Intensity Pattern produced from said surface.

Figure 2(a) is an illustration of the diffraction surface 201 as viewed from above the surface. The surface includes a number of lines or grooves 202 which are curved and have variable spacing across said surface 201. The diffraction surface 201 is designed to produce a number of diffracted beams, of the type described in relation to figure 1. The pattern of the grooves 202 in the surface 201 is designed so as to produce diffracted beams with specified Intensity Patterns which can be machine recognised in order to authenticate the diffraction surface 201. Figure 2(b) illustrates the type of diffracted beam Intensity Patterns produced by a surface of the type illustrated in figure 2(a) when illuminated by a single collimated monochromatic incident optical beam. In figure 2 the optical intensity I of the diffracted light is plotted against position (X,Y) in the plane of the surface intercepting the diffracted light. The contours in figure 2(b) are lines of constant optical intensity which therefore form an Intensity Pattern of the diffracted beams produced by a diffraction surface of the type illustrated in figure 2(a). It can be seen from figure 2(b) that in this case a number of distinct "ridges" occur in the Intensity Pattern. The central peak 203 in figure 2(b) corresponds to specular reflection of the incident beam of light. The diffracted beam Intensity Pattern illustrated in figure 2(b) can be machine recognised using an optical detector array as described herein. It should be appreciated, however, that the diffraction surface illustrated in figure 2(a) may be authenticated via machine recognition of only part of the overall, or total, diffracted beam Intensity Pattern illustrated in figure 2(b). For example, only one of the abovementioned "ridges" in the Intensity Pattern illustrated in figure 2(b) may be machine recognised during the authentication process.

Figure 3 is a schematic illustration of a preferred embodiment of a device 301 used in reading and authenticating a diffraction surface 302. Also illustrated in figure 3 is some of the electronics associated with operating the device 301. Figure 3(a) illustrates the device 301 in side cutaway view, while figure 3(b) illustrates a front view of the device 301, omitting some of the components.

The diffraction surface 302 is positioned by some means relative to the device 301. The device 301 has an outer package 303. The device 301 also has a front window 304 made up of 3 regions 304a, 304b and 304c, each of said regions performing a different function in this preferred embodiment. The window 304 may be made from a single piece of material or may be made up of several different pieces.

It should be noted that for clarity figure 3(b) illustrates a front view of part of the device 301 only. Specifically, figure 3(b) does not include the window 304 and also does not include the electronics associated with operation of the device 301 as shown in figure 3(a).

The device 301 includes a laser diode light source 305 which produces a beam of light 306. The light beam 306 is usually an asymmetrically divergent light beam. The section 304b of the window 304 is an optical lens arrangement designed to produce from the light beam 306 a collimated (i.e. parallel) reading light beam 307. The section 304b of the window 304 may be a single component lens or may consist of a number of lens components.

The reading light beam 307 is directed to the diffraction surface 302. In this preferred embodiment the diffraction surface 302 produces from the reading light beam 307 a conjugate pair of diffracted light beams 308a and 308b. Other light beams may also be produced from the reading light beam 307 by the surface 302, but will not be considered in the present description. The diffracted beams 308a and 308b will generally be divergent, although some diffraction surfaces may be designed to produce convergent beams 308a and 308b.

As described herein, the diffracted beams produced by the diffraction surface 302 have characteristic and machine readable Intensity Patterns which patterns result from the diffractive structure incorporated into the diffraction surface 302.

The diffracted beam 308a passes through the section 304a of the window 304 and onto an optical sensor 309. The section 304a of the window 304 should ideally cause no distortion of the beam 308a. In figure 1 the section 304a of the window 304 is thin and planar and therefore does not significantly distort the beam 308a.

The optical sensor 309 is an array of separate optical detection regions 310 enabling a measurement of the optical Intensity Pattern 311 of the diffracted beam 308a at the optical sensor 309 in order to authenticate the diffraction surface 302.

The optical detector array 309 may be configured in one of a number of different ways. In figure 3, the optical detector array 309 is made up of a number of optical detection regions 310 each of which measures incident optical intensity. The optical detector array therefore enables a measurement of the Intensity Pattern of the diffracted beam 308a by measuring the optical intensity of the diffracted beam 308a at a number of different points corresponding to the optical detectors 310. The optical detector array 309 provides electronic signals 312 at the output 313 which electronic signals 312 are representative of the outputs of the optical detectors 310 making up the optical detector array 309, and therefore representative of the optical Intensity Pattern of the beam 308a at the optical detector array 309.

The electronic signals 312 representing the Intensity Pattern of the beam 308a are compared with a specified set of values 314 in an electronic device 315. The set of values 314 is stored in an electronic memory 316 and represents an authentic or "template" optical Intensity Pattern. The electronic device 315 therefore compares the measured optical Intensity Pattern, as represented by the signals 312, with a "template" optical Intensity Pattern, as represented by the signals 314, in order to determine whether or not the measured optical Intensity Pattern matches the template to within reasonable error.

The comparison device 315 produces an output signal 317 at the output 318 to indicate whether or not the measured and template optical Intensity Patterns match, to within reasonable error.

The measured optical Intensity Pattern results from the diffractive structure incorporated into the diffraction surface 302. The template Intensity Pattern corresponds to an authentic diffraction surface. Hence matching of the signals 312 representing the measured optical Intensity Pattern and the signals 314 representing the template optical Intensity Pattern is an indication that the diffraction surface 302 is authentic, whereas non-matching is an indication that the surface 302 is not authentic.

Different diffraction surfaces, with different diffracted beam Intensity Patterns, can be produced and used in different applications. Each of the different diffraction surfaces has a corresponding "template" optical Intensity Pattern 314 to be stored in the memory device 316. Therefore each diffraction surface reader device will store template optical Intensity Pattern values 314 corresponding to the type or types of diffraction surface for which the reader is intended. It should be appreciated that a diffraction reader 301 may store more than one "template" optical Intensity Pattern, thereby enabling the reader to be used with any of the corresponding types of the diffraction surface.

The diffracted beam 308b, which in this preferred embodiment is conjugate to the diffracted beam 308a, passes through the section 304c of the window 304 and onto an optical sensor 319 which differs in design and function from the optical sensor 309. The section 304c of the window 304 is an optical lens or combination of optical lenses which acts to image the area of the diffraction surface 302 illuminated by the reading beam 307 onto the surface of the optical sensor 319, thereby producing an image 320. In some designs the image 320 formed at the optical sensor 319 may be magnified or minified relative to the illuminated area at the diffraction surface 302. Hence the image 320 produced at the optical sensor 319 will not be the diffracted beam Intensity Pattern, as is the case with the diffracted beam 308a and optical sensor 309, but will instead be an image of any pattern recorded in the diffraction surface 302.

The purpose of the optical sensor 319 is to read any information recorded as a pattern on or in the diffraction surface 302. The optical sensor 319 includes one or more optical detection regions 321 each configured according to the type of pattern anticipated at the optical sensor 319. More than one optical detection region 321 may be included on the optical sensor 319 since the position of the image 320 on the optical sensor 319 will depend on the relative orientation of the device 301 and the diffraction surface 302, and hence the inclusion of a number of optical detection regions 321 will help ensure that the image 320 is detected regardless of its position on the optical sensor 319.

In one preferred embodiment the diffraction surface 302 may have a bar code data sequence recorded on it in some manner, in which case each optical detection region 321 will preferably be a single optical detector which may have an active detection area shaped either as a spot or as a narrow slit (as illustrated in figure 3) parallel to the anticipated direction of the bars in the bar code image 320 formed at the optical sensor 319, the diameter of said spot or the width of said slit geometry governing the resolution of the bar code reading operation at the optical sensor 319.

In another preferred embodiment the diffraction surface 302 may have a two dimensional array of pixels recorded on or in it in some manner so as to represent information in a machine readable form, in which case each optical detection region 321 may preferably be a linear or two dimensional array of optical detector elements with the long axis of said array positioned parallel to the anticipated direction of one of the axes in the two dimensional array image 320 produced at the optical sensor 319.

Regardless of the type of pattern recorded in the diffraction surface 302, relative movement of the reading beam 307 and diffraction surface 302 will cause a change in the region of the diffraction surface 302 illuminated by the reading beam 307 and hence will result in movement of the pattern in the image 320 on the surface of the optical sensor 319. By the process of relative movement of the reading beam 307 and diffraction surface 302 information recorded as a pattern in the diffraction surface 302 can be detected by one or more of the optical detection regions 321 on the surface 319.

The optical detection regions 321 produce electronic signals 322 at the output 323 which electronic signals 322 are representative of the optical signals at the optical detection regions 321. For example, in one preferred embodiment the signals 322 may be made up of the outputs of the optical detectors 321 interleaved together. The electronic signals 322 are fed to an electronic device 324 which processes the signals 322 to produce an output signal 325 at the output 326 which signal 325 is representative of the data read from the diffraction surface 302. In one preferred embodiment the electronic device 324 may select and process from the outputs of the optical detection regions 321 that output which has the greatest signal to noise ratio.

The position of the optical Intensity Pattern 311 of the diffracted beam 308a on the optical detector array 309 will vary depending on the relative orientation of the reading device 301 and diffraction surface 302. However, it is intended that authentication of the diffraction surface 302 via comparison of the Intensity Pattern 311 with a "template" Intensity Pattern stored in the memory device 316 be possible regardless of the position of the Intensity Pattern 311 on the optical detector array 309, provided that the required diffracted beam Intensity Patterns do fall on the optical detector array 309.

In order to improve the efficiency of the electronic comparison device 315 it may be advantageous for the device 315 to be able to determine the timing of the portion of the signal 312 representing the Intensity Pattern 311. This can be achieved in one of a number of ways, for example in one preferred embodiment this could be achieved by deliberately including in the optical Intensity Pattern 311 an optical feature which acts as a "start" signal for the electronic comparison device 315.

It should be appreciated that numerous variations are possible on the techniques and devices described herein. Some of the possible variations are described below.

In figure 3 the optical detection elements 310 making up the optical detector array 309 are arranged in a Cartesian layout i.e. square or rectangular. However, it should be appreciated that the optical detection elements 310 could instead be arranged in a different manner. For example the optical detection elements 310 could be arranged in a radial/circumferential layout.

In some applications it will be necessary to authenticate a diffraction surface without reading any information recorded in the surface. In such applications a simplified version of the device shown in figure 3 could be used, where said simplified device would not include the optical sensor 319 or the electronic device 324, and where the remaining components may in some embodiments be re-arranged while still performing similar functions.

The optical detection regions 321 may be overlaid with masks in order to achieve the appropriate active optical detection area and spatial filtering of the incident optical beam.

Measurement and comparison of the optical Intensity Pattern 311 of the diffracted beam 308a may not be required at all points on the diffraction surface 302 in order to authenticate the surface 302. Instead, confirmation of the Intensity Pattern 311 of the diffracted beam 308a may only be required at a predetermined number (or more) of points or at a number of predetermined locations on the diffraction surface 302 in order to authenticate the diffraction surface 302.

It may be an advantage not to operate the device 301 continuously during authentication and reading of a diffraction surface. For example, it may be an advantage not to measure continuously the optical Intensity Pattern 311 of the diffracted beam 308a, but instead to take "snapshots" of the Intensity Pattern 311. This could be done using one of a number of techniques. In one preferred embodiment the laser diode 305 may be pulsed between lower and upper power output levels at an appropriate repetition rate and with an appropriate duty cycle to obtain the required "snapshots" of the Intensity Pattern 311 from the optical detector array 309. Pulsing the laser diode 305 has the advantage of reducing the thermal energy generated by the laser diode and hence reducing the heat dissipation requirement for the reader device. Pulsing of the laser diode, if carried out, would need to be done under conditions which do not impede reading by the optical sensor 319 of information recorded in the diffraction surface 302. In another preferred embodiment, said "snapshots" could be obtained by electronically "shuttering" the optical detector array 309.

The device 301 as illustrated in figure 3 uses a single light source to generate a single optical reading beam 307 directed to the diffraction surface 302. It should be appreciated that multiple optical reading beams, at the same or different wavelengths, generated by one or more optical sources, could be used in the reading device 301 instead of the single optical reading beam 307 illustrated in figure 3. In this case each optical reading beam produces a pair of diffracted beams 308a and 308b as illustrated in figure 3. Said multiple optical reading beams could be directed all to the same point or to different points on the diffraction surface 302 and may be incident on the diffraction surface at the same or different angles.

In one preferred embodiment a number of optical reading beams, all of the same wavelength, generated by one or more optical sources, may be incident on the same region of the diffraction surface 302 from different directions. An advantage of using multiple optical reading beams in this manner is that multiple diffracted beams will be produced in different directions, one of type 308a and one of type 308b for each incident optical reading beam, thereby increasing the probability that for a given relative orientation of the device 301 and diffraction surface 302 at least one diffracted beam of the type 308a and at least one diffracted beam of the type 308b will fall on the optical sensors 309 and 319 respectively thereby enabling the reader device to operate over a greater range of relative orientations of the device 301 and diffraction surface 302.

The diffraction surface 302 illustrated in figure 3 produces only a single pair of conjugate diffracted beams - namely the beams 308a and 308b. It should be appreciated that other diffraction surfaces may be designed to produce more than these two diffracted beams and consequently that more than one diffracted beam Intensity Pattern 311 may occur at the optical detector array 309. Authentication of such a diffraction surface may require confirmation (via the comparison device 315 as described herein) of only one of said diffracted beam Intensity Patterns at the optical detector array 309, or may instead require confirmation of a number of said diffracted beam Intensity Patterns at the optical detector array 309. The memory device 316 will be required to store "template" Intensity Patterns for those optical Intensity Patterns which require confirmation, which may mean that the memory device 316 must be capable of storing more than one "template" Intensity Pattern.

The above descriptions are in terms of reflective surfaces. It should be appreciated however that the same principles can be applied to transmissive surfaces in which case the device illustrated in Figure 3 will have the light source and optical sensors on opposite sides of the diffraction surface.

CLAIMS:

1. A method of detecting information stored on an optical memory diffraction area, said area having a diffraction surface adapted to provide a diffracted beam with an intensity pattern determined by the configuration of the surface, said method including the steps of:

subjecting said surface to a reading beam;

positioning an optical sensor so as to be illuminated by the diffracted beam, said sensor being adapted to detect an intensity pattern in the diffracted beam; and

activating said sensor to produce a signal indicative of said intensity pattern.

2. The method of claim 1, wherein said reading light beam is collimated and approximately monochromatic.

3. The method of claim 1 or 2, wherein at least two diffracted beams are produced by said reading beam.

4. The method of claim 3, wherein there are two diffracted beams, which diffracted beams are a conjugate pair of diffracted beams.

5. The method of claim 3 or 4, wherein one of the diffracted beams diverges relative to another of the diffracted beams.

6. The method of claim 3 or 4, wherein one of the diffracted beams converges relative to another of the diffracted beams.

7. The method of claims 3, 4, 5 or 6, wherein said optical sensor includes a first optical sensor and a second optical sensor, each optical sensor being positioned to be illuminated by a respective one of the diffracted beams, with the optical sensors each being adapted to produce a signal indicative of the intensity pattern of its associated diffracted beam.

8. The method of any one of claims 1 to 7, adapted to determine the authenticity of said area, the method including the further step of electronically determining whether said signal or one of said signals represents a signal produced by an authentic surface.

9. The method of claim 7 or 8, wherein the diffracted beams or one of said diffracted beams passes through an optical lens to form an image on its respective optical sensor.

10. The method of any one of claims 1 to 8, further including the step of causing movement between said surface and said reading beam.

11. The method of claim 9, wherein the optical sensor/s are operated to produce a signal or signals intermittently.

12. The method of claim 9, wherein said optical sensor/s produce a signal or signals which are continuous.

13. The method of any one of claims 1 to 11, wherein said reading light beam is produced by a laser diode light source.

14. The method of any one of claims 1 to 13, wherein said reading beam is

pulsed.

15. The method of any one of claims 3 to 7, or 8 to 14 when appended to claim 3, wherein two of the diffracted beams have the same intensity pattern.

16. The method of any one of claims 3 to 7, or 8 to 14 when appended to claim 3, wherein two of the diffracted beams have different intensity patterns.

17. The method of any one of claims 1 to 16, wherein there are at least two reading beams.

18. The method of any one of claims 7, or 8 to 17 when appended to claim 7, wherein said diffraction surface has stored first information used for authentication purposes and second stored information additional to said first information, said method including the further step of electronically determining whether the signal of the sensor illuminated by said first beam is a signal that would be produced by an authentic surface.

19. The method of claim 18, wherein said second beam passes through an optical lens to form an image on its respective sensor, said image being indicative of said second information, and said respective sensor produces a signal indicative of said second information.

20. The method of claim 18 or 19, wherein said first information is recorded on said surface by a first diffraction surface configuration, and said second information is recorded on said surface by a second surface configuration superimposed on said first configuration.

21. The method of claim 20, wherein said second configuration is a deformation of said first configuration.

22. The method of claim 20, wherein said second configuration is a further diffraction surface configuration.

23. The method of any one of claims 18 to 22, wherein said second optical sensor is adapted to produce a continuous signal.

24. The method of any one of claims 18 to 22, wherein said second optical sensor is adapted to produce a signal intermittently.

25. A data detection device comprising:

means to receive an item having an optical memory diffraction area, said area having a diffraction surface adapted to provide a diffracted beam with an intensity pattern determined by the configuration of the surface;

light producing means to produce a light beam directed to illuminate said surface so as to produce a diffracted light beam; and

an optical sensor positioned to be illuminated by the diffracted light beam, said optical sensor being adapted to produce a signal indicative of the intensity pattern of the diffracted light beam.

26. The device of claim 25, wherein said light means produces a collimated and approximately monochromatic reading light beam.

27. The device of claim 25 or 26, wherein said sensor includes a first and a second sensor, the sensors being adapted to be illuminated by a pair of diffracted light beams, said sensors each being adapted to produce a signal indicative of the intensity pattern of a respective one of the diffracted beams.

28. The device of claim 27, wherein said beams are a conjugate pair of beams.

29. The device of claim 27, 28, 29 or 30, wherein said light means is a laser diode light source.

30. The device of claim 27, 28 or 29, further including an optical lens through which at least one of the diffracted light beams passes to produce an image on the associated sensor.

31. The device of claim 27, 28, 30, or claim 29 when appended to claim 27 or 28, wherein said second sensor is adapted to produce a continuous signal.

32. The device of claim 27, 28, 30, or claim 29 when appended to claim 27 or 28, wherein said second optical sensor is adapted to produce an intermittent signal.

33. The device of any one of claims 25 to 32, further including means to cause relative movement between said surface and said reading light beam.

34. The device of any one of claims 25 to 33, wherein said light means is adapted to cause pulsing of said reading light.

35. The device of any one of claims 25 to 34, wherein said device includes electronic comparison means to receive said signal or one of said signals, said comparison means being adapted to determine whether said signal or signals represent a signal or signals produced from an authentic surface.

36. The device of any one of claims 25 to 35, wherein said light producing means produces two or more light beams directed to illuminate said surface.

37. The method of any one of claims 1 to 24 wherein the or one of the sensors is illuminated by two or more diffracted light beams.

38. The method of claim 10, wherein the intensity pattern, the diffracted beam or one of the diffracted beams alters with movement of the reading beam with respect to said surface.

39. A method of data detection substantially as hereinbefore described with reference to the accompanying drawings.

40. A data detection device substantially as hereinbefore described with reference to the accompanying drawings.

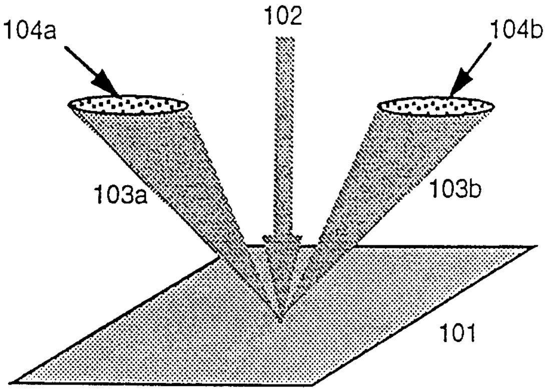

FIGURE 1

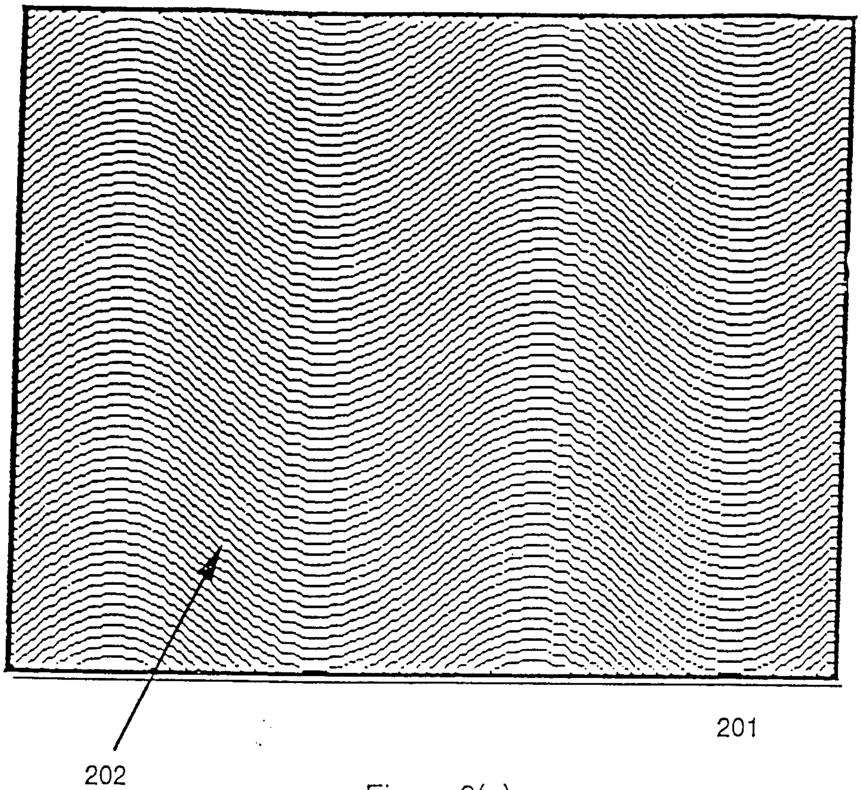

Figure 2(a)

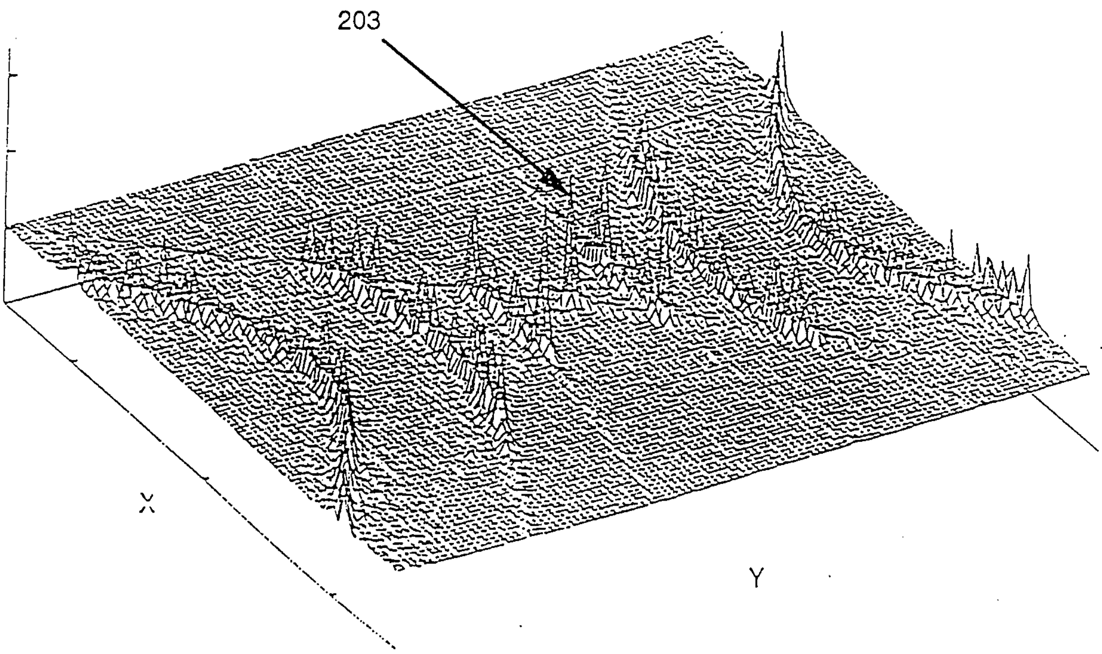

Figure 2(b)

FIGURE 2

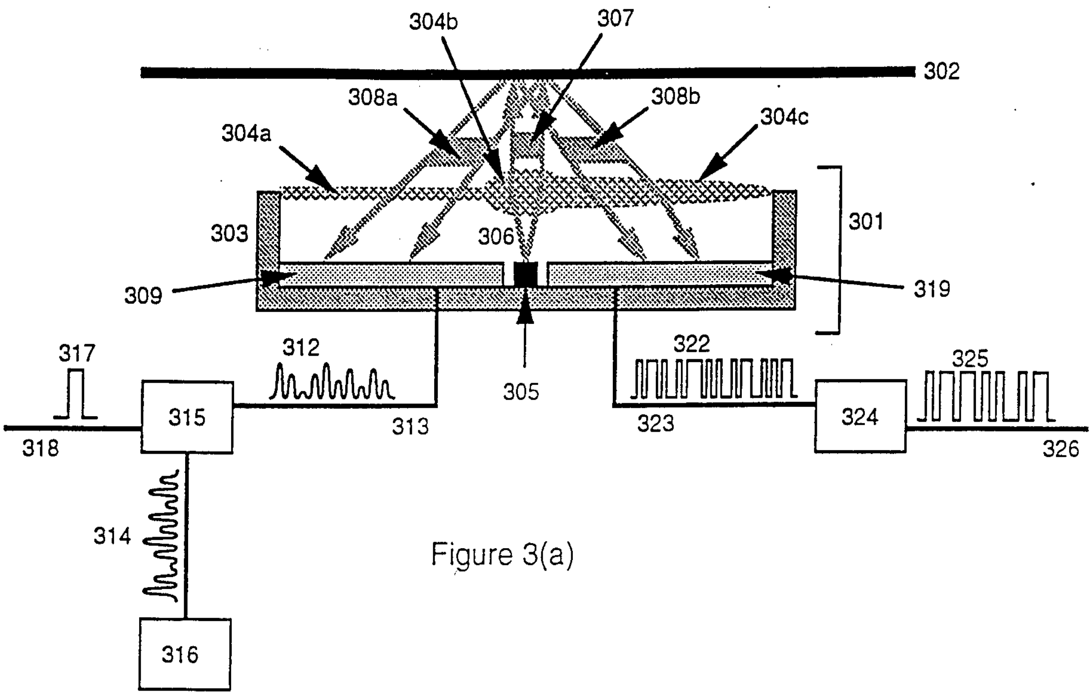

Figure 3(a)

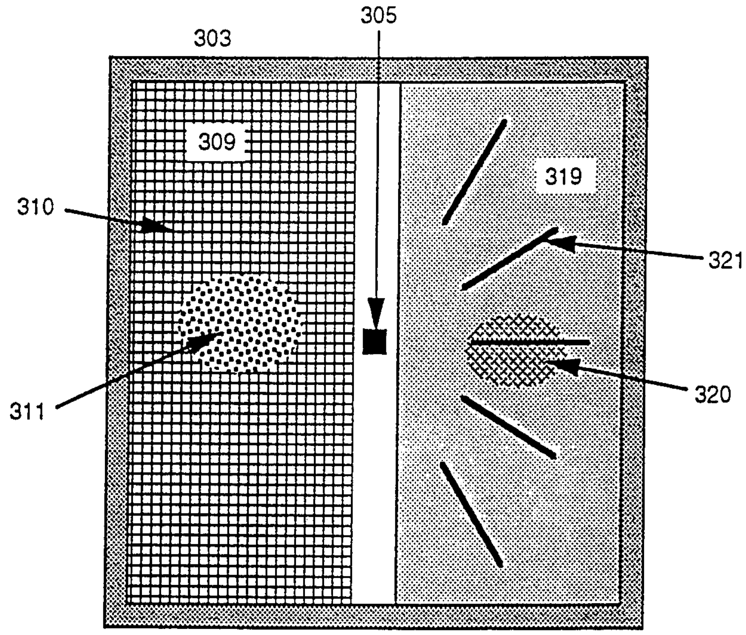

Figure 3(b)

FIGURE 3

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.^{5} G06K 7/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC G06K 7/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU:IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

JAPIO: hologram is interference or diffract or grating

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	US,A, 4204638 (LAUDE) 27 May 1980 (27.05.80) whole document	1-40
P,A	WO,A, 93/12506 (CONTROL MODULE INC.) 24 June 1993 (24.06.93)	1-40
A	EP,A2, 412316 (NHK SPRING CO. LTD.) 13 February 1991 (13.02.91)	1-40
A	US,A, 4641017 (LOPATA) 3 February 1987 (03.02.87)	1-40

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 December 1993 (07.12.93)	8 DEC 1993 (8.12.93)
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. 06 2853929	Authorized officer John Thomson J W Thomson Telephone No. (06) 2832214

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
A	US,A, 4108367 (HANNAN) 22 August 1978 (22.08.78)	1-40
A	US,A, 4034211 (HORST ET. AL) 5 July 1977 (05.07.77)	1-40
A	US,A, 4023010 (HORST ET. AL) 10 May 1977 (10.05.77)	1-40

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4204638	DE	2907389	FR	2418955	JP	54118146
WO	9312506	AU	32327/93				
EP	412316	JP	3071383	US	5200794	JP	3071384
		JP	3071385	JP	3071386	JP	3169695
US	4641017						
US	4108367	JP	53106550				
US	4034211	CA	1080354	DE	2627417	FR	2316667
		GB	1520594	JP	52002358		
US	4023010	CA	1080523	DE	2639464	FR	2323193
		GB	1521849	JP	52041542		

END OF ANNEX