

Description

FIELD OF THE INVENTION

The present invention relates to a system for classifying and recording information with respect to gemstones whereby the gemstones may be accurately identified and in a manner to produce a database whereby recovered stolen or missing gemstones may be compared with the database for accurate identification.

BACKGROUND OF THE INVENTION

A number of systems have been proposed for classifying and identifying gemstones to provide what may be referred to as an optical fingerprint of the gemstone. The optical fingerprint is accurate and acceptable by the courts for determining whether a gemstone under consideration is the same gemstone which produced a previously recorded fingerprint.

In theft of gemstones, the most common problem is being able to accurately identify a stolen gemstone as being a particular gemstone which was stolen from a certain owner. This problem is of particular concern to insurance companies, in that gems are often insured and it has been difficult to identify the stolen gemstone even if it is recovered. Insurance companies in the past have also been subject to fraudulent claims. Thus, identification of gemstones and the tracking of gemstones remains a problem.

United States 3,947,120 discloses a particular arrangement for providing an optical fingerprint of a gemstone where a laser beam is focused on a gemstone and the optical response of the gemstone is recorded on a recording medium, preferably a photographic medium. This arrangement provides a fingerprint of the gemstone which is reproducible and has been held by the courts to be sufficient evidence to prove that the gemstone under consideration having a certain optical response is the same as a previously identified gemstone having essentially the same optical response.

Although this patent discloses a particular method for fingerprinting of gemstones, there remains a very significant problem of being able to actually use this information for identification of gemstones which may be known as missing or stolen.

EP-A-0 042 361 discloses a device for producing a reproducible identification pattern of a polished gemstone in which collimated light is directed onto the gemstone and the directions of the refracted and reflected light beams are determined.

SUMMARY OF THE INVENTION

The present invention provides a system for improved recording of gemstone fingerprints and a

method of collecting these recorded fingerprints, classifying of the fingerprints whereby a database is developed which can be effectively searched.

The present invention is also directed to a recovery system whereby gemstones recovered by police or other authorities can be remotely scanned using this technology with the resulting optical response compared to other optical responses on the database for proper identification of the gemstone and a matching with a particular gemstone record, if indeed the stolen gemstone has previously been recorded.

The present invention can have a significant impact with respect to the tracking of gemstones and may also make it substantially more difficult to trade stolen gemstones.

A device for producing a reproducible identification pattern of a polished gemstone according to the present invention comprises light directing means for directing a collimated beam of light onto a gemstone orientated in a particular known manner to produce an optical output of the internal refraction and reflection characteristics of the gemstone and means for recording of a selected portion of the output in a manner to record the relative size and location of the reflected light beams and wherein the recording means automatically adjusts for variations in the intensity of different light beams such that variations in intensity are adjusted for thereby increasing the accuracy of the size measurement.

According to an aspect of the invention, the device for producing reproducible identification pattern of a polished gemstone comprises means for directing a focused beam of light onto a gemstone orientated in a particular known manner to produce an optical response of the internal refraction and reflection characteristics of the gemstone, and means for assessing the relative size and location of a selected portion of the output of the reflected light beams and wherein the means for assessing optically scans the selected portion to produce an electronic record of the optical response of the gemstone.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

Figure 1 is a schematic of the scanning machine of the present invention; and

Figure 2 is a schematic of the overall gemstone recording and recovery system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The scanning machine generally shown as 2 in Figure 1 includes a laser 4 for producing a laser beam 8 which is projected at the gemstone 10. Laser beam 8 passes through a first focusing lens 6, passes

through a central hole in the display screen 16 and passes through a second focusing lens 14 before striking the gemstone 10. The laser beam striking the gemstone 10 which is held in a particular manner, as generally shown and described in United States Patent 3,947,120, produces an optical response 12 which is focused by the second focusing lens 14 onto the display screen 16. A scanner 18 is positioned to one side of the scanning machine out of the direct light transmitting region of the optical response displayed on display screen 16, with the scanner viewing only a selected linear segment of the display screen 16. A track arrangement 20 progressively moves the scanner across the display screen to provide a complete optical record of the optical response shown on the display screen. This controlled movement of the scanner along track 20 is controlled by controller 22. The output from the scanner 18 is recorded in the record storage arrangement 24. Thus, it can be appreciated that a complete record is stored in record storage 24 of the optical response 12 produced by a particular gemstone 10.

The scanner is a charged coupled device which can accurately receive the signal from a particular segment of the display screen 16. By mechanically moving the scanner across the display screen along track 20, a complete assessment of the optical response is compiled. This mechanical moving of the scanner 18 greatly reduces the cost of the scanner, whereas a scanner which would view the entire screen would be many times more expensive and thus would render the site machine excessively expensive for the average jeweller to maintain within his own premises. The jeweller who would have this machine in his shop upon selling of the gemstone would key in particular information with respect to the owner of the gemstone, the address, the particular cut, colour, weight and other characteristics of the gemstone which he can accurately determine, and combine this information with the optical response of the particular gemstone. A modem 28 is provided for sending of the record storage 24 to a central database 40 shown in Figure 2 where the optical response will subsequently be classified in a manner that it may be accurately searched. Associated with the scanning machine 2 is a certificate printer 30 which will provide a hard copy of the optical response 12 of the particular gemstone as well as providing the other information entered at the keyboard. The scanner 18 includes means for automatically adjusting for different light intensities as it scans a particular segment. The purpose of the scanner is to accurately determine the size and location of the individual beams that are found in the optical response. This is contrast to a photographic record where the intensity of these beams is inherently recorded on the photographic material and can inaccurately influence the size of the beam due to the effect of a very high or low intensity. Therefore, the

scanner 18 automatically adjusts for variations in the intensity of the different light beams to provide a more accurate assessment of the size and location of the light beams produced in the optical response 12. The progressive scanning of the optical response lends itself to this correction for intensity. It can be appreciated that a scanner capable of reading the entire screen is also possible and can adjust for varying intensity.

Preferably, the record storage 24 includes data compression capability as the optical record is particularly appropriate for data compression as the size and location of the hot spots are of prime importance. Data compression can take many forms including run length encoding.

The overall system is generally shown in Figure 2 and comprises a central database 40 which includes a classification section 42 and a databank 44 of classified gemstones. This databank 44 has associated therewith a sub group 46 of gemstones indicated as being stolen or missing by the particular insurance company or the owner.

Recovered gemstones are optically scanned by a particular site machine at a police station, such as 50, and the optical response of these gemstones are compared with the sub group 46 of the gemstones stolen or missing as identified by the particular owners. In this way, police departments in far varying jurisdictions can compare the gemstones recovered from thieves or suspected of being stolen with a database of gemstones which have previously been identified as being stolen or missing.

The classification of the gemstones carried out at 42 in Figure 2 relies on a polar coordinate system for identifying the largest area light beams of the optical response identified as large circles on the hard copy of the optical response. The largest area light beam is identified as a number 1 light beam and the remaining light beams are progressively identified by size. The largest light beam is considered to be at a zero angle and all other light beams are plotted relative to this major light beam. The distance from the center point is also measured to provide an accurate location identification.

This particular classification arrangement renders it quite convenient to search, as the optical response of the suspected stolen gemstone is classified and the various light beams thereof are again plotted in this manner. Software accurately compares this response with known responses based upon the particular angles of the light beams and then varying of the particular light beams which are considered the dominant light beams. This can be carried out in software and is very efficient and may result in several searches or several permutations of the actual optical response. After a number of possible matches have been identified, then further comparison can be made with respect to the distance from the center as

well as the much more detailed response characteristics. Based upon a comparison of the recorded optical responses, the expert can then provide his opinion whether it is an identical match or not.

As can be appreciated, the system operates most efficiently if jewellers throughout the country or throughout the territory all have these individual site machines and upon the sale of a gemstone, make an accurate optical fingerprint of the gemstone using the site machine to evaluate the gemstone. This record is then recorded in a central databank of gemstones and is preferably forwarded electronically to the databank. Compression of the optical response characteristics of a particular gemstone can be accomplished using standard techniques. The actual recording is preferably based on the size and location of these light spots resulting from the particular light beams produced in the optical response. Run length encoding is particularly suitable for compression of this data.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that variations may be made thereto without departing from the the invention whose scope is defined by the appended claims.

Claims

1. A device (2) for producing a reproducible identification pattern of a polished gemstone comprising
 light directing means (4,8) for directing a collimated beam of light onto a gemstone (10) orientated in a particular known manner to produce an optical output (12) of the internal refraction and reflection characteristics of the gem stone (10), characterized by
 means for recording (16,18,20,22) of a selected portion of the output in a manner to record the relative size and location of the reflected light beams,
 and wherein said recording means (16,18,20,22) automatically adjusts for variations in the intensity of different light beams.
2. A device as claimed in claim 1 wherein said recording means (16,18,20,22) includes means for applying data compression techniques to the optical output of the reflected light beams.
3. A device as claimed in any preceding claim wherein said recording means (16,18,20,22) produces an electronic record of the optical response of the gemstone (10) and said device (2) includes means for transmitting (20) said electronic record to a remote computer.
4. A device as claimed in claim 3 wherein said recording means (16,18,20,22) optically scans segments of said optical output which segments collectively represent said optical output of said gemstone.
5. A device as claimed in any preceding claim with a central recording means (40) for electronically receiving and recording optical outputs of gemstones in a searchable database where said optical output (12) is classified in a manner to allow accurate comparison of a given optical output with optical outputs of gemstones classified and recorded in said database.
6. A device as claimed in claim 5 wherein classification of the optical outputs (12) for recording in said database (40) includes classifying according to the size of areas of high illumination and assigning polar coordinates to the areas of high illumination.
7. A device as claimed in claim 5 wherein said database of classified optical outputs of gemstones is divided into a separate group of gemstones which have been identified as being stolen or missing, and wherein optical outputs of recovered gemstones are compared to said separate group of stolen or missing gemstones.
8. A method for producing a reproducible identification pattern of a polished gemstone comprising
 directing a focused beam of light onto a gemstone orientated in a particular known manner to produce an optical output of the internal refraction and reflection characteristics of the gemstone, and
 recording a selected portion of the optical output in a manner to record the relative size and location of the reflected light beams while adjusting for variations in the intensity of different light beams.
9. A method as claimed in claim 8 including transmitting the recorded selected portion to a remote database which stores the selected portion in a manner to allow automated searching of said database to determine if a given optical output of a gemstone matches a gemstone previously recorded in said database.
10. A method as claimed in claim 9 including classifying, prior to recording in said database, the recorded selected portions of each optical output according to the size of areas of high illumination and assigning polar coordinates to the areas of high illumination to simplify searching of said database.

well as the much more detailed response characteristics. Based upon a comparison of the recorded optical responses, the expert can then provide his opinion whether it is an identical match or not.

As can be appreciated, the system operates most efficiently if jewellers throughout the country or throughout the territory all have these individual site machines and upon the sale of a gemstone, make an accurate optical fingerprint of the gemstone using the site machine to evaluate the gemstone. This record is then recorded in a central databank of gemstones and is preferably forwarded electronically to the databank. Compression of the optical response characteristics of a particular gemstone can be accomplished using standard techniques. The actual recording is preferably based on the size and location of these light spots resulting from the particular light beams produced in the optical response. Run length encoding is particularly suitable for compression of this data.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that variations may be made thereto without departing from the the invention whose scope is defined by the appended claims.

Claims

1. A device (2) for producing a reproducible identification pattern of a polished gemstone comprising
light directing means (4,8) for directing a collimated beam of light onto a gemstone (10) orientated in a particular known manner to produce an optical output (12) of the internal refraction and reflection characteristics of the gem stone (10), characterized by
means for recording (16,18,20,22) of a selected portion of the output in a manner to record the relative size and location of the reflected light beams,
and wherein said recording means (16,18,20,22) automatically adjusts for variations in the intensity of different light beams.
2. A device as claimed in claim 1 wherein said recording means (16,18,20,22) includes means for applying data compression techniques to the optical output of the reflected light beams.
3. A device as claimed in any preceding claim wherein said recording means (16,18,20,22) produces an electronic record of the optical response of the gemstone (10) and said device (2) includes means for transmitting (20) said electronic record to a remote computer.
4. A device as claimed in claim 3 wherein said recording means (16,18,20,22) optically scans segments of said optical output which segments collectively represent said optical output of said gemstone.
5. A device as claimed in any preceding claim with a central recording means (40) for electronically receiving and recording optical outputs of gemstones in a searchable database where said optical output (12) is classified in a manner to allow accurate comparison of a given optical output with optical outputs of gemstones classified and recorded in said database.
6. A device as claimed in claim 5 wherein classification of the optical outputs (12) for recording in said database (40) includes classifying according to the size of areas of high illumination and assigning polar coordinates to the areas of high illumination.
7. A device as claimed in claim 5 wherein said database of classified optical outputs of gemstones is divided into a separate group of gemstones which have been identified as being stolen or missing, and wherein optical outputs of recovered gemstones are compared to said separate group of stolen or missing gemstones.
8. A method for producing a reproducible identification pattern of a polished gemstone comprising
directing a focused beam of light onto a gemstone orientated in a particular known manner to produce an optical output of the internal refraction and reflection characteristics of the gemstone, and
recording a selected portion of the optical output in a manner to record the relative size and location of the reflected light beams while adjusting for variations in the intensity of different light beams.
9. A method as claimed in claim 8 including transmitting the recorded selected portion to a remote database which stores the selected portion in a manner to allow automated searching of said database to determine if a given optical output of a gemstone matches a gemstone previously recorded in said database.
10. A method as claimed in claim 9 including classifying, prior to recording in said database, the recorded selected portions of each optical output according to the size of areas of high illumination and assigning polar coordinates to the areas of high illumination to simplify searching of said database.



Patentansprüche

1. Vorrichtung (2) zur Erzeugung eines reproduzierbaren Identifikationsmusters eines geschliffenen Edelsteines, welche eine Lichtsendeinrichtung (4, 8) zum Richten eines kollimierten Lichtstrahles auf einen Edelstein (10) aufweist, welcher in einer speziellen bekannten Weise orientiert ist, um einen optischen Ausgang (12) der inneren Brechungs- und Reflexionscharakteristiken des Edelsteines (10) zu erzeugen, gekennzeichnet durch eine Aufzeichnungseinrichtung (16, 18, 20, 22) zum Aufzeichnen eines ausgewählten Anteiles des Ausgangs in einer Weise, daß die relative Größe und Lage der reflektierten Lichtstrahlen aufgezeichnet wird, und wobei diese Aufzeichnungseinrichtung (16, 18, 20, 22) automatisch Variationen in der Intensität der verschiedenen Lichtstrahlen reguliert. 5
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2. Vorrichtung nach Anspruch 1, wobei die Aufzeichnungseinrichtung (16, 18, 20, 22) eine Einrichtung einschließt, um Datenkomprimierungstechniken für den optischen Ausgang der reflektierten Lichtstrahlen anzuwenden. 25
3. Vorrichtung nach irgendeinem vorangegangenen Anspruch, wobei die Aufzeichnungsvorrichtung (16, 18, 20, 22) eine elektronische Aufzeichnung der optischen Antwort des Edelsteines (10) liefert und diese Vorrichtung (2) Mittel (20) einschließt, um diese elektronische Aufzeichnung an eine entfernte Datenverarbeitungsanlage zu senden. 30
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4. Vorrichtung nach Anspruch 3, wobei diese Aufzeichnungsmittel (16, 18, 20, 22) Segmente des optischen Ausgangs optisch abtastet, wobei die Segmente zusammen den optischen Ausgang des erwähnten Edelsteines repräsentieren. 40
5. Vorrichtung nach irgendeinem der vorangegangenen Ansprüche mit einer zentralen Aufzeichnungseinrichtung (40), um optische Ausgänge von Edelsteinen in einer abfragbaren Datenbank elektronisch zu empfangen und aufzuzeichnen, in der dieser optische Ausgang (12) derart klassifiziert wird, daß ein genauer Vergleich eines gegebenen optischen Ausgangs mit optischen Ausgängen von Edelsteinen, die in dieser Datenbank klassifiziert und aufgezeichnet sind, ermöglicht ist. 45
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6. Vorrichtung nach Anspruch 5, wobei die Klassifizierung der optischen Ausgänge (12) zur Aufzeichnung in der Datenbank (40) eine Klassifizie-

rung nach der Größe der Flächen von hoher Beleuchtung und eine Zuordnung von polaren Koordinaten zu den Flächen von hoher Beleuchtung einschließt.

7. Vorrichtung nach Anspruch 5, wobei die Datenbank für die klassifizierten optischen Ausgänge der Edelsteine in eine besondere Gruppe von Edelsteinen aufgeteilt ist, welche als gestohlen oder verloren identifiziert sind, und wobei optische Ausgänge von wiedergefundenen Edelsteinen mit der gesonderten Gruppe von gestohlenen oder vermißten Edelsteinen verglichen werden.
8. Verfahren zur Erzeugung eines reproduzierbaren Identifikationsmusters eines geschliffenen Edelsteines mit den Verfahrensschritten,
 - Richten eines fokussierten Lichtstrahles auf einen Edelstein, der in einer speziellen bekannten Weise orientiert ist, um einen optischen Ausgang der inneren Brechungs- und Reflexionscharakteristiken des Edelsteines zu erzeugen, und
 - Aufzeichnen eines ausgewählten Anteils des optischen Ausgangs derart, daß die relative Größe und Lage der reflektierten Lichtstrahlen unter Regulierung von Variationen in der Intensität der verschiedenen Lichtstrahlen aufgezeichnet werden.
9. Verfahren nach Anspruch 8 mit dem Verfahrensschritt,
 - Senden des aufgezeichneten ausgewählten Anteils an eine entfernte Datenbank, welche den ausgewählten Anteil in einer Weise speichert, daß ein automatisches Abfragen dieser Datenbank möglich ist, um zu bestimmen, ob ein gegebener optischer Ausgang eines Edelsteines mit einem zuvor in dieser Datenbasis aufgezeichneten Edelstein übereinstimmt.
10. Verfahren nach Anspruch 9 mit den Verfahrensschritten,
 - Klassifizieren, vor dem Aufzeichnen in der Datenbank, des aufgezeichneten ausgewählten Anteils eines jeden optischen Ausgangs nach der Größe der Flächen hoher Beleuchtung und Zuordnen von polaren Koordinaten zu den Flächen hoher Beleuchtung, um das Abfragen der Datenbank zu vereinfachen.

Revendications

1. Dispositif (2), destiné à produire un motif reproductible d'identification d'une pierre précieuse polie, comprenant des moyens d'orientation de



- lumière (4, 8) servant à diriger un faisceau de lumière, rendu parallèle, sur une pierre précieuse (10) orientée d'une manière particulière connue, en vue de produire une réponse optique (12) des caractéristiques de réfraction interne et de réflexion de la pierre précieuse (10), caractérisé par des moyens (16, 18, 20, 22) servant à enregistrer une partie sélectionnée de la réponse de manière à enregistrer les dimensions et l'emplacement relatifs des faisceaux de lumière réfléchis, ces moyens d'enregistrement (16, 18, 20, 22) s'adaptant automatiquement à des variations se présentant dans l'intensité de différents faisceaux de lumière.
2. Dispositif selon la revendication 1, dans lequel les moyens d'enregistrement (16, 18, 20, 22) comprennent des moyens servant à appliquer des techniques de compression de données à la réponse optique des faisceaux de lumière réfléchis.
 3. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les moyens d'enregistrement (16, 18, 20, 22) produisent un enregistrement électronique de la réponse optique de la pierre précieuse (10), tandis que le dispositif (2) comprend des moyens (20) servant à transmettre ledit enregistrement électronique à un ordinateur situé à distance.
 4. Dispositif selon la revendication 3, dans lequel les moyens d'enregistrement (16, 18, 20, 22) balayent optiquement des segments de ladite réponse optique, lesquels segments représentent ensemble cette réponse optique de la pierre précieuse.
 5. Dispositif selon l'une quelconque des revendications précédentes, comprenant des moyens d'enregistrement central (40) qui, par voie électronique, servent à recevoir des réponses optiques de pierres précieuses et à les enregistrer dans une base de données consultable dans laquelle ladite réponse optique (12) est soumise à un classement, d'une manière permettant une comparaison précise d'une réponse optique donnée avec des réponses optiques de pierres précieuses ayant fait l'objet d'un classement et enregistrées dans la base de données.
 6. Dispositif selon la revendication 5, dans lequel le classement des réponses optiques (12) servant à l'enregistrement dans la base de données (40) consiste à procéder à un classement en fonction des dimensions de zones de brillance élevée et à assigner des coordonnées polaires aux zones de brillance élevée.
 7. Dispositif selon la revendication 5, dans lequel la base de données constituée par les réponses optiques classées de pierres précieuses est divisée en un groupe séparé de pierres précieuses qui ont été identifiées comme étant volées ou manquantes et dans lequel les réponses optiques de pierres précieuses récupérées sont comparées audit groupe séparé de pierres précieuses volées ou manquantes.
 8. Procédé, permettant de produire un motif reproductible d'identification d'une pierre précieuse polie, consistant à diriger un faisceau de lumière, rendu parallèle, sur une pierre précieuse orientée d'une manière particulière connue, en vue de produire une réponse optique des caractéristiques de réfraction interne et de réflexion de la pierre précieuse, et à enregistrer une partie sélectionnée de la réponse optique, de manière à enregistrer les dimensions et l'emplacement relatifs des faisceaux de lumière réfléchis, tout en procédant à une adaptation tenant compte des variations se présentant dans l'intensité de différents faisceaux de lumière.
 9. Procédé selon la revendication 8, consistant en outre à transmettre la partie sélectionnée enregistrée à une base de données située à distance qui range en mémoire cette partie sélectionnée, de manière à permettre une consultation automatisée de la base de données en vue de déterminer si une réponse optique donnée d'une pierre précieuse coïncide avec une pierre précieuse précédemment enregistrée dans ladite base de données.
 10. Procédé selon la revendication 9, consistant en outre à procéder, préalablement à l'enregistrement dans la base de données, à un classement des parties sélectionnées enregistrées de chaque réponse optique, en fonction des dimensions des zones de brillance élevée, et à assigner des coordonnées polaires aux zones de brillance élevée afin de simplifier la consultation de la base de données.

