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(54) METHOD AND APPARATUS FOR VERIFYING IDENTITY.

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Description

The present invention relates to a method and apparatus for verifying the identity of a person, notably by correlating the minutiae of the finger print of that person with a machine readable identification of the minutiae of that finger print carried by an object presented concurrently with the finger print at a locus or contained in a record available to the locus.

BACKGROUND TO THE INVENTION:

Credit cards and bank cheque cards as currently used by many millions of people carry information relating to the user in machine readable form, usually in the form of one or more magnetic stripes or other recording medium on or in the card carrying binary or other coded information thereon. This provides a simple method for identifying the account to which a transaction relating to that card is to be debitted. However, there is no means contained in the card for verifying that the person presenting the card is the true owner of the card, other than the signature of the card holder. Such a signature can readily be copied with sufficient accuracy to satisfy the cursory inspection usually given to such signatures at the location of use. It is thus possible for a thief to use a stolen card for a period of time as if he were the true owner thereof. Losses due to theft and fraud of credit cards currently runs at many millions of pounds per annum.

Many attempts have been made to personalise credit and other cards so that it is possible to verify that the person presenting the card is the true owner. For example, it has been proposed to incorporate coded information, eg. in binary coded form, about a person's finger print on the card and to compare this information with a corresponding record held in a data base. In one form of such a proposal, as described in European Patent Application No EP 0159037A, data relating to the type, orientation and position of certain minutiae of a person's finger print is recorded on the card or other data record; and this is compared with the corresponding finger print presented by the user. In this proposal, the ridge counts between the minutiae and their adjacent neighbours are counted. As a result, if a minutia cannot be located, for example due to dirt or sweat on the finger being scanned, all data in the record which refers to that minutia either as a reference minutia or in a ridge count from another minutia cannot be used during the verification process.

I have now devised a system by which the identity of a person can be rapidly and accurately verified or related to a document or other thing presented by that person, but which can be adapted for use wherever such relation or verification is required without the need for a complex and costly data base either on site or at a remote location. Furthermore, since the information used in the verification is based on the ridge patterns on the skin of the person, notably the ridge pattern on his finger, the user does not have to carry any PIN number or other aide memoire.

SUMMARY OF THE INVENTION:

Accordingly, the present invention provides a method for verifying the identity of a person or animal relative to a record of minutiae in the ridge pattern of the skin, which record purports to belong to that person or animal, the record including at least four data packages, each data package containing one or more machine readable codings relating to the type, relative orientation and relative location of an individual one of the said minutia, whereby the record contains data relating to at least four of the said minutiae, characterised in that:

A. the said data packages each further include one or more machine readable codings relating to the separate counts of the number of ridges lying between the minutia to which that data package relates and each and every other minutia in said at least four minutiae; and

B. the method comprises in any order, sequentially or concurrently the steps of:

a) observing, in any order, sequentially or concurrently minutiae in the ridge pattern of the skin of the body of the person or animal;

b) selecting individual minutiae from the observed minutiae and assigning, in any order, sequentially or concurrently to each of the selected minutiae a data package comprising one or more machine readable codings relating to the type, relative orientation and relative location of that observed minutia and relating to the separate counts of the number of ridges between that observed minutia and each and every other minutia in the said selected observed minutiae;

c) electing in any order, sequentially or concurrently at least four of the data packages from one of either of the record or the data packages relating to the observed minutiae;

d) comparing in any order, sequentially or concurrently the machine readable codings from the elected data packages with the machine readable codings of the data packages in the other of the record or the data packages relating to the observed minutiae; and

e) establishing the existence or otherwise of substantial identity between at least four of the elected data packages with data packages in the other of the record or the data packages relating to the observed minutiae.

The term data package is used herein for convenience to denote collectively the machine readable code or codings which relate to the type, relative

orientation and relative location of an individual one of the said minutia, and in the case of the method of the invention to the separate counts of the number of ridges lying between the minutia to which that data package relates and each and every other minutia in the selected observed minutiae or the other minutiae in the record.

The method of the invention can be applied to the ridge patterns over a wide range of areas on the body of a person or an animal, for example the ridge patterns on the palm of the hand, on the toes and from the sole or heel of a foot. Thus, the invention can be used to provide means for identifying invalid or paraplegic persons who car not readily provide finger prints, or victims of malformation or accidents who do not possess hands or have lost fingers. However, the invention is of especial application in the use of finger print minutiae to provide a simple and secure method for identifying a person. For convenience, the invention will be described hereinafter in terms of this preferred application.

Since the data required for operation of the method of the invention is usually less than that required in other systems, it is possible to hold all the necessary data in the magnetic strips on a card or in a small memory chip, for example as used in the so called Smart card. There is therefore no need for a separate large data store and the system of the invention readily lends itself to use where on-the-spot identification and/or verification is required, for example at retail store, bank or garage cashpoints. Since no image of the fingerprint can be recovered from the minutiae stored in the record, the psychological objection many users have to the concept of someone else holding their fingerprint record is overcome.

Thus, in a preferred method of the invention, the data packages relating to minutiae on a finger of a person are compared with those in the record purporting to be that of the corresponding finger of the person to determine substantial identity of a number of data packages between the record and the observed finger print minutiae.

The term ridge pattern is used herein to denote the ridges which are present from birth on the skin of the body of the person and remain present throughout the normal life of the person. The term does not include features which are of a transient or temporary nature or features which are introduced after birth. Thus, scars or creases in the skin are not ridges within the present context.

Finger prints are classified by the patterns of the ridges which occur on the skin covering the finger tip. These ridges are not continuous and break, branch or form loops or other interruptions which can readily be identified in a finger print. The most common of these interruptions are shown diagrammatically as A1 to A6 respectively in Figure 1 of the attached drawings. For convenience, the term minutia will be used herein to denote singly and collectively the interruptions A1 to A6 as described above. The method of the invention can be applied using the identification and correlation of all of the above interruptions. However, it will usually be sufficient to identify the interruptions as either ridge ends or ridge bifurcations, the other interruptions being variations of these two basic minutiae. For convenience, the invention will be described hereinafter in terms of the use of this limited identification of the minutiae.

The skin on a finger from its tip to the first joint may carry a number, typically up to 80, of the minutiae. In the method of the invention, a finger print is scanned to detect the minutiae present and to determine the type, the relative position and relative orientation of the detected minutiae and also the number of ridges which occur between each and every one of a selected group of the detected minutiae.

The term "coincident sequence" for a group of finger print minutiae is defined herein as being:

1. identity of the type of the finger print minutia;
2. the relative location of that minutia to the other minutia in the group;
3. the orientation of that minutia relative to the other minutiae in the group; and
4. the count of the ridges lying between any one minutiae each and every other minutiae in the group.

For a coincident sequence to exist there must be at least four minutiae in the group being inspected; and preferably at least one minutia in that group is different from the other minutiae in the group. Whilst the method of the invention can be applied to the location of four minutiae in the same coincident sequence in both of the record and the observed finger print, it will be appreciated that the higher the number of coincident sequences required, the more positive will be the verification of identity and the smaller the error rate in making a positive identification. It is therefore preferred that from six to twenty, notably from eight to seventeen, minutiae in the same coincident sequence in each of the recorded and the observed minutiae should be required in making a positive identification using the method of the invention.

Thus, from a preferred aspect, the present invention provides a method for verifying the identity of a person relative to a record of minutiae in the ridge pattern of a friction skin surface purporting to belong to that person, which method is characterised in that the record carries information in machine readable form relating to the type, relative location and relative orientation of at least six minutiae and to the ridge counts between each minutia and every other minutiae in the record; and in that the method comprises observing the type, relative location and relative orientation of minutiae and the ridge counts between each and every one of those observed minutiae on a finger of that person presented at the

site of such identification; and comparing the observed minutiae data with the said record information.

In a further embodiment, the invention also provides a method for verifying the identity of a person or relating the identity of that person to a document or other thing presented by that person at a locus or held in a record available to the locus, which method comprises scanning the finger of the person at the locus to provide machine readable codings relating to coincident sequence data of selected observed minutiae, that is the type, relative location and relative orientation of each of the selected minutiae in the finger print of that person and the separate counts of the number of ridges between a minutia and each and every one of the selected minutiae; comparing the said machine readable codings with a machine readable record of the co-incident sequence data for minutiae from a finger print purporting to be that of that person which has been obtained beforehand and which is presented to the locus concurrently with the finger of the person either on the document or other thing or from a separate record so that the existence of identity of part of all of the coincident sequences of the observed minutiae of the presented finger and the record can be established.

Preferably, the coincident sequence contains at least 8 minutiae to ensure that a unique correlation between the finger print and the record is achieved.

The method of the invention can be applied to a wide range of types of record which are to be compared with the actual finger print of the presenter.

Thus, the invention can be applied to a plastics or similar card for use in financial transactions, to a cheque, to pages of an identity document or passport which are presented by the user for verification or to identify the presenter to another. Alternatively, the record can be held in part of a mechanism which is to be actuated once the identity of the person has been verified. For example, the invention finds use in providing security locks for hotel bedrooms, offices or other locations where it is desired that only certain people should have access. In these cases, the record of the finger print can be located in the lock mechanism so as to permit only accepted people to operate the lock mechanism. Alternatively, the mechanism can be linked to a remote memory/programming centre where data relating to the finger print minutiae of the user is encoded and stored for future use at the mechanism. For example, the data relating to the minutiae can be encoded at the reception desk of a hotel when the user registers and that information used to encode the lock for his room. The lock mechanism has a scanner unit which observes the minutiae of a finger presented to it, transmits those to the memory/programming centre for verification and releases the lock once verification has been achieved; or refers to its own encoded memory for the verification.

For convenience, the present invention will be described hereinafter in terms of the use of a plastics card or the like to provide the record for comparison with the actual finger print minutiae of the presenter in situ at the location where verification is to take place.

For the method of the invention, the record of the coincident sequences for the minutiae of the user's finger print is first obtained in a machine readable form for inclusion in the record to be read at the locus at which the user is to present himself. This is usually done by scanning the designated finger of the person. The scanning can be carried out using a number of techniques, eg. optically using high intensity illumination and an array of photosensitive diodes as a camera to record the image, or some other optical scanning device such as a laser scanner, to provide an image which can be processed electronically. The scanning device is coupled to an image processor, typically incorporating one or more microprocessors and programmed to scan the image observed to identify the finger print minutiae, to assign them a binary code identifying their type, and identifying their position and orientation relative to other minutiae observed. The processor will also observe the ridge count between each and every one of the minutiae observed to build up the record of the coincident sequences within the record.

The record can be built up in a series of stages, as when the image processor tracks the line of each ridge observed by the scanning means to locate any minutiae along that ridge. Alternatively, the scanner can merely locate the minutiae and ascribe the relevant binary codings to them for type, orientation and location; and subsequently establish a ridge count between the located minutiae. For the purposes of the record, it is not necessary that all the finger print be scanned and all minutiae be identified and coded. However, it is preferred that at least 10, and preferably 20 to 40, of the available minutiae be identified and encoded for the record to provide a sufficiently large record from which to compensate for dirt or blemishes in the finger print which is subsequently scanned or for malfunctions in the apparatus to ensure that sufficient valid minutiae can be available for comparison purposes during the verification process.

The record of the finger print data is preserved in any suitable form which can be readily stored and/or carried and presented by the user. Thus, the information can be stored as a series of electronic signals on a magnetic recording medium, as signals within a read only memory chip, which can be programmable, or as signals in an optically scanned medium carried on or in the card, eg. in holographic form or as a laser readable strip on the card. For convenience, the invention will be described hereinafter in terms of binary coded signals recorded on a magnetic

medium, notably in the form of a strip of magnetic medium carrying the record thereon and integrated with the card.

In addition to the information about the minutiae of the finger print of the person, the record may also contain information about the person, eg. his name and address, bank account number and so on. If desired, the record can be formed in two or more sections, eg. with two separate magnetic strip areas on a card, so that the finger print information can be scanned separately from the other data.

The record can be taken from any finger of the person, for example from the small finger of the left hand for one person, whilst another person can use the print from the middle finger of his right hand for creating the record. It will also be appreciated that the record can carry information relating to more than one finger of the person so that he can select the alternative information if one of his fingers should not be available for scanning at the verification locus, as when the finger is bandaged.

As indicated above, the apparatus for scanning the finger print to prepare the record can be selected from a wide range of suitable apparatus and many forms of such apparatus are available commercially, for example as the finger print scanners in those methods which use only the spatial configuration of the finger print minutiae. Thus, the apparatus will typically comprise a finger rest having a translucent section through which the ridge pattern on the finger can be observed. The rest typically comprises a generally circular cross-section channel into which the user places his selected finger. The channel preferably has an end stop to limit the extent of penetration of the finger axially along the channel so that approximately the same area of the finger will be scanned for each user.

The ridge pattern on the finger in the channel is observed by a suitable sensor, eg. a camera or scanner, notably a photosensitive diode array. This can scan the ridge pattern from a fixed point or, more preferably, can traverse around the axis of the finger to scan the ridge pattern from a range of angles. Alternatively, the minutiae of the finger print can be sensed using a pressure sensitive pad.

The data provided from the sensor is processed to provided the necessary binary coding of the minutiae and the ridge counts between them. This is achieved in known manner using conventional electronics circuitry and computer components, eg. to convert an initial visual image to suitable electronic signals for retention in the recording medium. Typically, the circuitry will cause the ridge pattern to be scanned to identify the desired minutiae, which may be stored in a read only memory for ease of identification, with the ridge count between each and every minutiae being computed as each new minutia is located. Alternatively, information for each minutia located can be encoded directly into the record to build up topographical information on the ridge minutiae. The ridge counts between each and every one of a selected group of the recorded minutiae can then be made as a second function once the data on the minutiae has been captured and encoded. The encoding is preferably done using an n-tuple algorithm or other system using conventional computer techniques.

The coding of the ridge minutiae and the ridge count between them is stored on the recording medium of the card using the card encoding equipment presently available commercially for this purpose. Thus, a magnetic stripe on a plastics card can have the binary coded information recorded on it as if that information were conventional account information as currently recorded on the magnetic stripe on the card.

As indicated above, it is not necessary for the full information about all minutiae on the finger to be encoded and recorded. In a preferred embodiment of the invention, establishing identity between coincident sequences in two to four sets each of four minutiae from the record and the observed finger will give satisfactory results for most applications. Thus, it is necessary to ensure that at least eight minutiae and their ridge counts are recorded on the card. This will, however, provide no margin of error in case the person's finger print should be damaged or masked by dirt, or allow for any malfunctions in scanning the presenter's finger when verification is carried out. It will therefore usually be desired to encode data for at least 10, and usually 20 to 40, of the minutiae present on the finger print being scanned.

The above method provides the data upon the card which forms the record against which the user will subsequently have to verify his finger print minutiae at the verification location. At this location, the finger print of the presenter will be scanned using a similar technique to that outlined above for preparing the encoded data for recording on the card. The data from this scanner is compared with the data held in the record to establish whether or not there is identity between a sufficient number of coincident sequences in the record and the finger being scanned to show that the two are from the same person. As indicated above, it is preferred that there should be at least 8 minutiae from each of the record and the scanned finger which are in coincident sequence with one another.

The comparison between the record and the finger being scanned need not be carried out in a specified sequence, but can randomly locate minutiae common to the record and the scanned finger and then check whether those minutiae are in coincident sequence with minutiae already identified as in coincident sequence so as progressively to build up the desired total of minutiae in coincident sequ-

ence. Alternatively, the comparison can be carried out in two stages. Firstly to establish identity of type, relative location and preferably relative orientation for at least 8 minutiae between the record and the finger being scanned. Where it is required that 8 minutiae are to be in coincident sequence, it will be preferred to identify 16 or more minutiae in this stage to provide a margin in case of dirt or damage to ridges preventing an accurate ridge count to be taken for some of the minutiae identified. From the minutiae that have been identified as the same for each of the record and the scanned finger, two or four sets of three or four minutiae each are selected from each of the record and the scanned finger, preferably one set from each quadrant of the finger print pattern. Ridge counts are then done for the minutiae of the finger being scanned between each and every minutia within those sets and compared with the ridge counts for the record or vice versa. The ridge counts are preferably done firstly within each set and then from one set to another. In this way, the verification of the match between the record and the finger being scanned is carried out progressively and if there is a failure to achieve coincident sequencing due to dirt or a blemish on the finger being scanned, the match can be aborted at an early stage and a fresh match sequence initiated.

The reading of the record on the card and the scanning of the finger can be carried out in either order or simultaneously and the term concurrently is used herein to denote both consecutive and simultaneous operation.

The data encoded onto the record and as handled during the scanning and comparison of the minutiae at the verification stage can be simple binary code information. However, in order to reduce the risk that unauthorised versions of the record might be made and/or forged versions of the card made, it is preferred to further encode the information to make it difficult for unauthorised use of the card encoder or the finger print scanner.

As indicated above, the scanning of the finger and the processing of the data therefrom to provide information on the coincident sequences in the minutiae observed during the scanning can be carried out using conventional equipment, which can embody many of the features described above for the preparation of the record. The comparison of the record with the information from the scanning of the finger can be done using conventional computer techniques once the coincident sequences have been identified. Thus, the apparatus for use in the method of the invention will typically comprise a means for scanning a finger of a person to provide signals defining the type, relative location and relative orientation of minutiae of the ridge pattern of that finger and to identify the presence of ridges between each and every one of the minutiae located; means for receiving signals from a record purporting to contain information on minutiae corresponding to those located on the scanned finger; and means for identifying coincident sequences in that record and the minutiae located on the scanned finger: and means for comparing the coincident sequences to establish identity therebetween.

From a preferred aspect, the invention provides apparatus for verifying the identity of a person using the method of the invention which apparatus comprises: a means for scanning a finger of a person to observe minutiae in the ridge pattern of the skin of the finger; a signal generating apparatus operatively associated with the scanning means and programmed to generate machine readable codings identifying the type, relative location and relative orientation of at least four of the observed minutiae of the ridge pattern of that finger and the count of the number of ridges between each and every one of the said at least four observed minutiae; means for scanning a record containing machine readable codings which identify the type, relative location, relative orientation and ridge counts for a ridge pattern purporting to correspond to that observed during the scanning operation; signal processing means for receiving the signals from the record scanning operation and from the finger scanning operation signal generation means, which processing means is programmed to process the record and scanned signals so as to establish identity or otherwise between the type, relative location, relative orientation and ridge counts of at least four of the minutiae in the record and the observed minutiae.

From a particularly preferred aspect, the invention further provides apparatus which comprises:

a. a means for scanning a finger presented to it by a person at the locus at which an operation is to be carried out so as to generate signals in machine readable form identifying the type, relative location and relative orientation of minutiae in the ridge pattern of the finger print and identifying the number of ridges in the ridge pattern between each and every one of a selected group of the minutiae located during the scanning operation;

b. means for receiving a card or other means carrying a record of machine readable signals relating to the type, relative location, relative orientation and ridge counts of minutiae purporting to be those of the finger print of that person and for scanning that record so as to generate a series of record signals;

c. means for receiving the machine readable signals from the scanning of the finger and of the record and for comparing the signals, which means is programmed to detect the presence of minutiae in both the record and those selected from the observed minutiae which are of the same type, have the same relative location and relative orientation and between each of which

there are the same individual ridge counts; and

d. means for generating a signal to initiate the operation to be carried out when a required minimum number of the minutiae from the record and those observed have been detected as having the identity of type, relative location, relative orientation and ridge counts.

The method and apparatus of the invention find widespread use wherever it is desired to verify the identity of a person to permit some operation to be carried out. Since the user presents a unique identifier to the apparatus (his actual finger print) and this is verified against a record of that identifier at the location of verification, not only does the method provide a high degree of security, but this is achieved by a simple means not requiring large data stores or visual inspection.

The invention finds use in reducing fraudulent and unauthorised use of credit and other cards to achieve goods and/or finance; to provide a personalised "key" to gain access to a location or to actuate a mechanism such as a car ignition switch or to unlock a door to a room; to provide a simple means for establishing that the carrier of a passport is the person referred to therein, thus facilitating immigration and other identity checks at frontiers or elsewhere.

The invention can be implemented by supplying the necessary finger and card scanning apparatus in place of the conventional card accepting apparatus used at present. However, some present apparatus already incorporates card scanning means, for example cash dispensers in banks or hotel card key systems. In this case that apparatus can be modified to operate the method of the invention by providing a finger scanning apparatus and comparator means and linking those into the existing apparatus. Since the verification can be carried out without the need for any separate data record, the invention can be used in almost any location and is not limited to use at those locations having access to information networks or data bases as with some current proposals.

DESCRIPTION OF THE DRAWINGS:

Apparatus for use in the present invention will now be described by way of example with respect to the accompanying drawings in which Figure 1 is a diagrammatic representation of six minutiae used in classifying a finger print, together with examples of binary coding which can be used to describe such minutiae; Figure 2 is a schematic representation of an apparatus according to the invention; and Figure 3 shows two finger print ridge patterns identifying some of the minutiae from Figure 1 thereon.

The apparatus for use in the invention comprises a device (1) with a read only memory (ROM) for scanning the finger of a person at the verification site. The ROM has programmed therein an image of each of the six ridge minutiae shown in Figure 1, together with an image of a typical ridge. The scanning device and ROM (1) combination are controlled by a processor (2). For the purpose of scanning a finger for the first time, the processor (2) will instruct the device (1) to scan the finger and, by plotting the coordinates of the scanner at any instant during the scan, will when the ROM recognises one of the six ridge minutiae assign a unique binary character combination for the recognised ridge minutia, its direction and its coordinates.

On recognising a second ridge minutia, the processor (2), via the device (1), will have information as to the number of ridges between the first recognised ridge minutia and the second recognised ridge minutia. The scanning process continues in this fashion until there is stored in the processor (2) a plurality of binary character combinations representing the observed fingerprint minutiae. Thus a digital record of the fingerprint minutiae, their direction and relationship to each other (coincident sequence) is generated. Typically, anything from 40 to 80 recognisable ridge minutiae will be stored in the processor (2).

To generate a strip material, the processor (2) transfers, in a known fashion, the binary character combinations onto the strip material. Other information relating to the holder of the finger scanned by the device (1) may also be encoded onto the strip material.

The strip material may already be, or subsequently be, laminated with and/or attached to an identity card as hereinbefore referred to, to produce an identity card.

At the site of use, the identity card is inserted into a card or strip material reading device, via a card input (not shown), the information on the strip material being read by a second ROM. A finger of the user of the identity card is scanned by the device (1). The processor (2) will generate binary character combinations for the ridge minutiae types, their direction and their coordinates and compare the combinations thus generated with the binary minutiae data on the strip material. If sufficient ridge minutiae in the same coincident sequence that are found on the finger being scanned are also read from the strip material, then a positive correlation will result.

Depending on the type of correlation resulting from the comparison between the minutiae data found on the strip material and those scanned by the scanner, a signal is sent from processor (2), for example, to one of three different indicators via a circuit (not shown) for converting the signal received from the processor (2) into another signal to light one of three indicators or display a signal on a suitable display (not shown). If the correlation is positive, then one of the indicators (for example) is lit. The lighted indicator may bear a legend or a colour to indicate to the recipient of the identity card that the presenter is the authorised user and permit a transaction to take

place. The other two indicators may serve to indicate a negative or no correlation result. In the case of a negative correlation, no transaction takes place and one of the indicators is lit which indicates to the recipient that the presenter in not the authorised user of the card. In this instance, the unit can, if required, retain the card. In the case of no correlation the third indicator is lit and the user of the card may be requested to try again. A no correlation result may be obtained, for example, through a malfunction of the device, through a blurring of the scan because the finger is excessively dirty or the scanning surface plate or glass is dirty, or through damage to the identity card's memory device.

Claims

1. A method for verifying the identity of a person or animal relative to a record of minutiae in the ridge pattern of the skin of a person or animal, which record purports to belong to that person or animal, the record including at least four data packages, each data package containing one or more machine readable codings relating to the type, relative orientation and relative location of an individual one of the said minutiae, whereby the record contains data relating to at least four of the said minutiae, characterised in that:

A. the said data packages each further include one or more machine readable codings relating to the separate counts of the number of ridges lying between the minutia to which that data package relates and each and every other minutia in said at least four minutiae; and

B. the method comprises in any order, sequentially or concurrently the steps of:

a) observing, in any order, sequentially or concurrently minutiae in the ridge pattern of the skin of the body of the person or animal;

b) selecting individual minutiae from the observed minutiae and assigning, in any order, sequentially or concurrently to each of the selected minutiae a data package comprising one or more machine readable codings relating to the type, relative orientation and relative location of that observed minutia and relating to the separate counts of the number of ridges between that observed minutia and each and every other minutia in the said selected observed minutiae;

c) electing in any order, sequentially or concurrently at least four of the data packages from one of either of the record or the data packages relating to the observed minutiae;

d) comparing in any order, sequentially or concurrently the machine readable codings from the elected data packages with the machine readable codings of the data packages in the other of the record or the data packages relating to the observed minutiae; and

e) establishing the existence or otherwise of substantial identity between at least four of the elected data packages with data packages in the other of the record or the data packages relating to the observed minutiae.

2. A method as claimed in claim 1, characterised in that the minutiae are the minutiae of the finger print of a person.

3. A method as claimed in claim 1, characterised in that the comparison in step d is done between the data packages relating to at least six minutiae in the ridge pattern of the skin of the body of the person or animal.

4. A method as claimed in claim 1, characterised in that the comparison between the machine readable codings for the minutiae in the record and those for the observed minutiae is carried out by identifying minutiae which occur in both the recorded and observed minutiae as having substantially the same type, relative location and relative orientation; and the counts of the number of ridges between minutiae are done between those identified minutiae.

5. A method as claimed in claim 1, characterised in that the record is held in the form of binary coded information in a memory medium carried by a plastics card.

6. A method for verifying the identity of a person relative to a record of minutiae in the ridge pattern of a friction skin surface purporting to belong to that person, which method is characterised in that the record carries information in machine readable form relating to the type, relative location and relative orientation of at least six minutiae and to the ridge counts between each minutia and every other minutiae in the record; and in that the method comprises observing the type, relative location and relative orientation of minutiae and the ridge sounts between each and every one of those observed minutiae on a finger of that person presented at the site of such identification; and comparing the observed minutiae data with the said record information.

7. A method for preparing a record for use in the method of claim 1, characterised in that the ridge pattern of a friction skin surface of a person or animal is observed to provide machine readable codings of the type, relative location, relative orientation and the ridge counts between each and every one of the observed minutiae in at least part of said ridge pattern; and storing said machine readable codings in a storage medium to provide the said record.

8. Apparatus for use in the method of any one of claims 1 to 6, which apparatus is characterised in that it comprises: a means for scanning a finger of a person to observe minutiae in the ridge pattern of the skin of the finger; a signal generating apparatus operatively associated with the scanning means and prog-

rammed to generate machine readable codings identifying the type, relative location and relative orientation of at least four of the observed minutiae of the ridge pattern of that finger and the count of the number of ridges between each and every one of the said at least four observed minutiae; means for scanning a record containing machine readable codings which identify the type, relative location, relative orientation and ridge counts for a ridge pattern purporting to correspond to that observed during the scanning operation; signal processing means for receiving the signals from the record scanning operation and from the finger scanning operation signal generation means, which processing means is programmed to process the record and scanned signals so as to establish identity or otherwise between the type, relative location, relative orientation and ridge counts of at least four of the minutiae in the record and the observed minutiae.

9. Apparatus according to claim 8, characterised in that it comprises:

a. a means for scanning a finger presented to it by a person at the locus at which an operation is to be carried out so as to generate signals in machine readable form identifying the type, relative location and relative orientation of minutiae in the ridge pattern of the finger print and identifying the number of ridges in the ridge pattern between each and every one of a selected group of the minutiae located during the scanning operation;

b. means for receiving a card or other means carrying a record of machine readable signals relating to the type, relative location, relative orientation and ridge counts of minutiae purporting to be those of the finger print of that person and for scanning the signals of that record so as to generate a series of record signals;

c. means for receiving the machine readable signals from the scanning of the finger and of the record and for comparing the signals, which means is programmed to detect the presence of minutiae in both the record and those selected from the observed minutiae which are of the same type, have the same relative location and relative orientation and between each of which there are the same individual ridge counts; and

d. means for generating a signal to initiate the operation to be carried out when a required minimum number of the minutiae from the record and those observed have been detected as having the identity of type, relative location, relative orientation and ridge counts.

Patentansprüche

1. Verfahren zur Feststellung der Identität einer Person oder eines Tieres unter Bezug auf eine Aufzeichnung von Einzelheiten des Linienmusters der Haut einer Person oder eines Tieres, welche Aufzeichnung besagt, zu dieser Person oder diesem Tier zu gehören, wobei die Aufzeichnung wenigstens vier Datengruppen enthält, jede dieser Datengruppen einen oder mehrere maschinenlesbare Codes bezüglich des Typs, der relativen Orientierung und relativen Lage einer einzelnen der besagten Einzelweiten, wobei die Aufzeichnung Informationen enthält, die sich auf wenigstens vier der besagten Einzelheiten beziehen, dadurch gekennzeichnet, daß:

A. jede der besagten Datengruppen außerdem einen oder mehrere maschinenlesbare Codes im Hinblick auf die einzelnen Anzahlen der Rillen enthält, die zwischen der Einzelheit zu der die Datengruppe gehört, und jeder anderen Einzelheit der wenigstens vier besagten Einzelheiten liegen; und

B. das Verfahren in beliebiger Reihenfolge, aufeinanderfolgend oder gleichzeitig, die Schritte umfaßt:

a) Beobachtung von Einzelheiten des Linienmusters der Haut des Körpers einer Person oder eines Tieres in beliebiger Reihenfolge, aufeinanderfolgend oder gleichzeitig;

b) Selektieren individueller Einzelheiten aus den beobachteten Einzelheiten und zu jeder der ausgesuchten Einzelheiten in beliebiger Reihenfolge, aufeinanderfolgend oder gleichzeitig, Zuweisung einer Datengruppe, welche einen oder mehrere maschinenlesbare Codes bezüglich des Typs, der relativen Orientierung und der relativen Lage dieser beobachteten Einzelheit und bezüglich der einzelnen Anzahlen der Rillen zwischen dieser beobachteten Einzelheit und jeder anderen Einzelheit der besagten beobachteten Einzelheiten enthält;

c) Auswählen von wenigstens vier der Datengruppen aus der Aufzeichnung oder der Datengruppe bezüglich der beobachteten Einzelheit in beliebiger Reihenfolge, aufeinanderfolgend oder gleichzeitig;

d) Vergleich in beliebiger Reihenfolge, aufeinanderfolgend oder gleichzeitig, der maschinenlesbaren Codes der Datengruppen der ausgewählten Datengruppen mit den maschinenlesbaren Codes der Datengruppen in der anderen Aufzeichnung oder der Datengruppe bezüglich der beobachteten Einzelheit;

e) Nachweis des Vorhandenseins oder andernfalls der wesentlichen Identität zwischen wenigstens vier der ausgewählten Datengruppen mit Datengruppen der anderen Aufzeichnung oder der Datengruppen bezüglich der beobachteten Einzelheiten.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Einzelheiten die Einzelheiten des

Fingerabdrucks einer Person sind.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Vergleich in Schritt d) vollzogen wird zwischen den Datengruppen, die sich auf wenigstens sechs Einzelheiten im Rillenmuster der Haut des Körpers der Person oder des Tieres beziehen.

4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Vergleich zwischen den maschinenlesbaren Codes für die Einzelheiten in der Aufzeichnung und solchen für die beobachteten Einzelheiten durchgeführt wird, indem Einzelheiten identifiziert werden, welche sowohl in der aufgezeichneten als auch der beobachteten Einzelheit auftreten und im wesentlichen gleichen Typ, gleiche relative Lage und gleiche relative Orientierung haben, und die Zählungen der Anzahl der Rillen zwischen Einzelheiten durchgeführt werden zwischen diesen identifizierten Einzelheiten.

5. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Aufzeichnung in Form binär-codierter Informationen in einem Speichermedium erfolgt, das in einer Plastikkarte enthalten ist.

6. Verfahren zur Feststellung der Identität einer Person bezüglich einer Aufzeichnung von Einzelheiten im Rillenmuster der Hautoberfläche, welche besagt, zu dieser Person zu gehören, wobei das Verfahren dadurch gekennzeichnet ist, daß die Aufzeichnung Informationen in maschinenlesbarer Form bezüglich des Typs der relativen Lage und der relativen Orientierung von mindestens sechs Einzelheiten und bezüglich der Anzahl der Rillen zwischen jeder Einzelheit und jeder anderen Einzelheit in der Aufzeichnung enthält, und daß das Verfahren die Beobachtung des Typs, der relativen Lage und der relativen Orientierung von Einzelheiten und der Anzahl der Rillen zwischen jeder dieser beobachteten Einzelheiten auf einem Finger dieser Person, der am Ort der Identifikation vorgelegt wird, umfaßt; und daß die Daten der beobachteten Einzelheiten mit den besagten Aufzeichnungsinformationen verglichen werden.

7. Verfahren zur Herstellung einer Aufzeichnung zur Verwendung im Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Rillenmuster der Hautoberfläche einer Person oder eines Tieres beobachtet wird, um maschinenlesbare Codes von dem Typ, der relativen Lage, der relativen Orientierung und der Anzahl der Rillen zwischen jeder dieser beobachteten Einzelheiten wenigstens in einem Teil der besagten Rillenmuster zu erstellen; und daß besagte maschinenlesbare Codes in einem Speichermedium gespeichert werden für das Erstellen der besagten Aufzeichnung.

8. Vorrichtung zur Verwendung bei dem Verfahren nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß sie umfaßt: Mittel, um einen Finger einer Person zu scannen, um Einzelheiten im Rillenmuster der Haut des Fingers zu beobachten; ein signalerzeugendes Gerät in Wirkverbindung mit dem Scanner und programmiert zur Erstellung maschinenlesbarer Codes, die den Typ, die relative Lage und die relative Orientierung von mindestens vier der beobachteten Einzelheiten des Rillenmusters dieses Fingers und die Anzahl der Rillen zwischen jeder dieser besagten mindestens vier beobachteten Einzelheiten identifizieren; Mittel zum Scannen einer Aufzeichnung, die maschinenlesbare Codes enthält, die den Typ, die relative Lage, die relative Orientierung und Anzahl der Rillen für ein Rillenmuster identifizieren, welche besagt, mit dem im Scanner-Durchlauf beobachteten Rillenmuster übereinzustimmen; Mittel zur Verarbeitung der Signale, zum Empfang der Signale aus dem Scanner-Durchlauf der Aufzeichnung und von den signalerzeugenden Mitteln von dem Scanner-Vorgang des Fingers, wobei die Mittel zur Verarbeitung so programmiert sind, daß die Identität des Typs, der relativen Lage, der relativen Orientierung und Anzahl der Rillen von wenigstens vier der Einzelheiten in der Aufzeichnung und in den beobachteten Einzelheiten festgestellt oder nicht festgestellt wird.

9. Vorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß sie umfaßt:

a. Mittel, um einen Finger, der von einer Person an einem Ort, an dem ein Vorgang stattfinden soll, präsentiert wird, zu scannen, so daß maschinenlesbare Signale erzeugt werden, die den Typ, die relative Lage und die relative Orientierung der Einzelheiten im Rillenmuster des Fingerabdrucks identifizieren und die die Anzahl der Rillen im Rillenmuster zwischen jeder dieser ausgewählten Gruppen von Einzelheiten, die während des Scanner-Durchlaufs lokalisiert wurden, identifizieren,

b. Mittel zur Aufnahme einer Karte oder anderer Mittel, die eine Aufzeichnung von maschinenlesbaren Signalen bezüglich des Typs, der relativen Lage, der relativen Orientierung und der Anzahl der Rillen von Einzelheiten enthalten, die beinhalten, zu dem Fingerabdruck dieser Person zu gehören, und um die Signale dieser Aufzeichnung zu scannen, um eine Serie von Aufzeichnungssignalen zu erstellen;

c. Mittel, um die maschinenlesbaren Signale vom Scannen des Fingers und von der Aufzeichnung zu erhalten, und um die Signale zu vergleichen, welche Mittel so programmiert sind, daß sie das Vorhandensein von Einzelheiten sowohl in der Aufzeichnung als auch in den ausgewählten der beobachteten Einzelheiten, welche den gleichen Typ, die gleiche relative Lage und relative Orientierung haben, und zwischen denen jeweils die gleiche spezielle Anzahl von Rillen liegen, entdecken; und

d. ein Mittel zum Erzeugen eines Signals zum Starten des auszuführenden Vorgangs, wenn ei-

ne geforderte Mindestanzahl der Einzelheiten in der Aufzeichnung und in den beobachteten Einzelheiten entdeckt wurde, welche bezüglich des Typs, der relativen Lage, der relativen Orientierung und Anzahl der Rillen identisch sind.

Revendications

1. Méthode de vérification de l'identité d'une personne ou d'un animal par comparaison avec un enregistrement des points singuliers du dessin des sillons de la peau d'une personne ou d'un animal, sachant que cet enregistrement est propre à cette personne ou à cet animal, cet enregistrement comportant au moins quatre ensembles de données, chaque ensemble de données contenant un ou plusieurs codages lisibles par une machine et ayant trait au type, à l'orientation relative et à la position relative chacun de ces points singuliers, cet enregistrement contenant donc des données relatives à au moins quatre points singuliers, caractérisée en ce que:

A. ces ensembles de données comportent en outre chacun un ou plusieurs codages lisibles par une machine et relatifs au comptages séparés du nombre des sillons existant entre le point singulier auquel correspond cet ensemble de données et chacun des autres points singuliers faisant partie des susdits au moins quatre points singuliers; et

B. la méthode comporte, dans un ordre quelconque, l'une après l'autre ou concurremment, les étapes suivantes:

a) observation, dans un ordre quelconque, l'un après l'autre ou concurremment, des points singuliers du dessin des sillons de la peau de la personne ou de l'animal;

b) sélection de points singuliers bien définis parmi les points singuliers observés et affectation, dans un ordre quelconque, séquentiellement ou concurremment, à chacun de ces points singuliers sélectionnés, d'un ensemble de données comprenant un ou plusieurs codages lisibles par une machine et relatifs au type, à l'orientation relative et à la position relative du point singulier correspondant observé et relatifs également aux comptages séparés du nombre de sillons existant entre ce point singulier correspondant observé et chacun des autres points singuliers faisant partie des susdits points singuliers observés sélectionnés;

c) choix, dans un ordre quelconque, séquentiellement ou concurremment, d'au moins quatre des ensembles de données pris dans l'un des éléments de l'alternative constituée de soit l'enregistrement, soit les ensembles de données relatifs aux points singuliers, observés ;

d) comparaison, dans un ordre quelconque, séquentiellement ou concurremment, des codages lisibles par une machine pris dans les ensembles de données choisis, avec les codages lisibles par une machine pris dans l'autre des éléments de l'alternative constituée de l'enregistrement et des ensembles de données relatifs aux points singuliers observés; et

e) établissement de l'existence ou non de l'identité fondamentale entre au moins quatre des ensembles de données choisis avec les ensembles de données pris dans l'autre des éléments de l'alternative constituée de l'enregistrement et des ensembles de données relatifs aux points singuliers observés.

2. Méthode selon la revendication 1, caractérisée en ce que les points singuliers sont les points singuliers de l'empreinte digitale d'une personne.

3. Méthode selon la revendication 1, caractérisée en ce que la comparaison de l'étape d se fait, entre ensembles de données relatifs à au moins six points singuliers du dessin des sillons de la peau du corps de la personne ou de l'animal.

4. Méthode selon la revendication 1, caractérisée en ce que la comparaison des codages lisibles par la machine, pour les points singuliers dans l'enregistrement et pour les points singuliers observés, est effectuée en identifiant les point singuliers qui se trouvent être du même type, et d'avoir la même position relative et la même orientation relative à la fois parmi les points singuliers enregistrés que parmi les points singuliers observés; et les comptages du nombre de sillons entre points singuliers sont effectués entre ces points singuliers ainsi identifiés.

5. Méthode selon la revendication 1, caractérisée en ce que l'enregistrement est stocké sous forme d'information codée binaire dans une mémoire portée par une carte en matière plastique.

6. Méthode de vérification de l'identité d'une personne par comparaison avec un enregistrement de points singuliers d'un dessin de sillons de la surface d'une peau de frottement que l'on sait appartenir à cette personne, méthode caractérisée en ce que l'enregistrement contient des informations sous forme lisible par une machine, relative au type, à la position relative et à l'orientation relative d'au moins six points singuliers, ainsi qu'aux comptages du nombre de sillons entre chaque point singulier et tous les autres points singuliers dans l'enregistrement; et en ce que la méthode comporte l'observation du type, de la position relative et de l'orientation relative de points singuliers, ainsi que les comptages du nombre de sillons entre tous ces points singuliers observés sur un doigt de cette personne présenté au lieu où l'on procède à une telle identification; et enfin la comparaison des données sur les points singuliers observés avec

les informations contenues dans le susdit enregistrement.

7. Méthode de préparation d'un enregistrement utilisable dans la méthode faisant l'objet de la revendication 1, caractérisée en ce que le dessin des sillons d'une surface de peau de frottement d'une personne ou d'un animal est observée pour en tirer des codages, lisibles par une machine, du type, de la position relative, de l'orientation relative et des comptages des nombres de sillons entre tous les points singuliers observés pris deux à deux, au moins dans une partie de ce dessin des sillons; et de stockage de ces codages lisibles par une machine dans une mémoire, de façon à constituer ledit enregistrement.

8. Appareil utilisable dans la méthode selon l'une quelconque des revendications 1 à 6, cet appareil étant caractérisé en ce qu'il comprend: un dispositif de balayage d'un doigt d'une personne afin d'observer les points singuliers dans le dessin des sillons de la peau du doigt; un appareil générant des signaux travaillant conjointement avec le dispositif de balayage et programmé pour générer des codages lisibles par une machine et permettant d'identifier le type, la position relative et l'orientation relative d'au moins quatre des points singuliers observés du dessin des sillons de ce doigt ainsi que les comptages du nombre de sillon existant entre tous ces au moins quatre points singuliers observés, pris deux à deux; un dispositif de balayage d'un enregistrement contenant des codages lisibles par une machine et identifiant le type, la position relative, l'orientation relative et les comptages du nombre de sillons pour un dessin des sillons que l'on sait correspondre à celui observé pendant l'opération de balayage; un moyen de traitement des signaux pouvant recevoir les signaux fournis pour l'opération de balayage de l'enregistrement et par l'appareil générant des signaux pendant l'opération de balayage du doigt, ce moyen de traitement étant programmé pour traiter les signaux provenant de l'enregistrement comme du balayage, de façon à ce qu'il puisse établir s'il y a ou non identité de type, de position relative, d'orientation relative et des comptages de sillons, pour au moins quatre des points singuliers se correspondant dans l'enregistrement et dans les points singuliers observés.

9. Appareil selon la revendication 8, caractérisé en ce qu'il comprend:

a. un dispositif de balayage d'un doigt qui lui est présenté par une personne au lieu où une opération doit être effectuée, de façon à générer des signaux sous une forme lisible par une machine et identifiant le type, la position relative et l'orientation relative de points singuliers du dessin des sillons de l'empreinte digitale, ainsi que le nombre de sillons, dans le dessin des sillons, existant entre tous les points singuliers, pris deux à deux, d'un groupe de points singuliers sélectionnés parmi les points singuliers localisés pendant l'opération de balayage;

b. des moyens pour la réception d'une carte ou de tout autre support d'un enregistrement de signaux lisibles par une machine et relatifs au type, à la position relative, à l'orientation relative et aux comptages de sillons afférents à des points singuliers que l'on sait être ceux de l'empreinte digitale de cette personne, et pour le balayage des signaux de cet enregistrement, de façon à générer une série de signaux d'enregistrement;

c. des moyens pour recevoir les signaux lisibles par une machine émis lors du balayage du doigt et de l'enregistrement, et pour comparer ces signaux, c'est-à-dire programmé pour détecter la présence de points singuliers du même type, ayant la même position relative et la même orientation relative et conduisant aux mêmes comptages individuels du nombre de sillons entre eux, aussi bien dans l'enregistrement que pour les points singuliers sélectionnés parmi les points singuliers observés; et

d. des moyens pour générer un signal autorisant l'opération à effectuer aussitôt détectés, dans l'enregistrement et parmi les points singuliers observés, le nombre minimum requis de points singuliers présentant l'identité de type, la même position relative, la même orientation relative et les mêmes comptages de sillons.

	CHARACTERISTIC FEATURE	BINARY CODING
A1		0010
A2		0100
A3		0101
A4		0001
A5		0011
A6		0110

Fig.1.

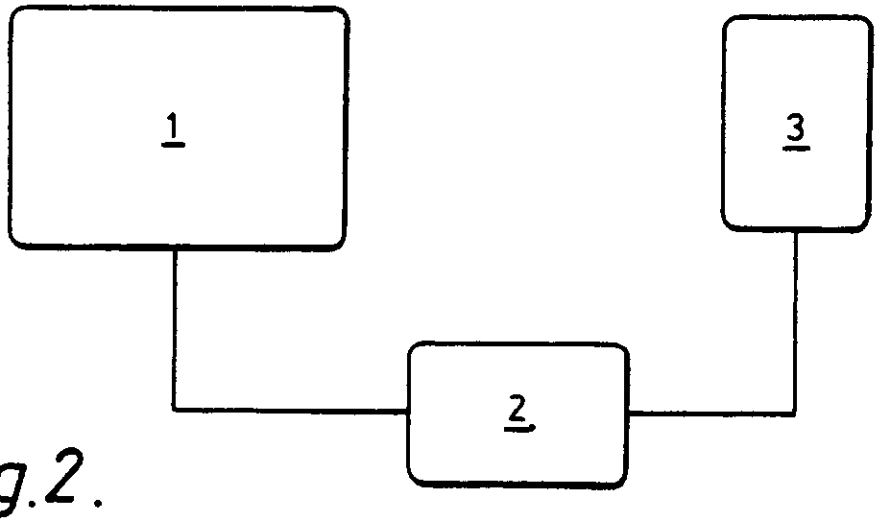
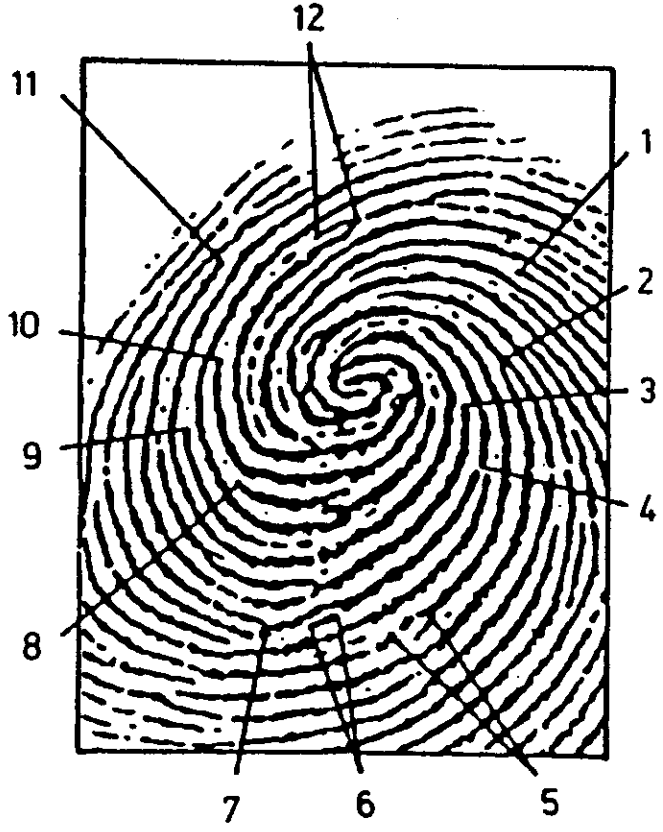


Fig.2.

PHOTOGRAPHIC ENLARGEMENT OF FINGERMARK FOUND AT SCENE.



PHOTOGRAPHIC ENLARGEMENT OF LEFT THUMB IMPRESSION OF CULPRIT.

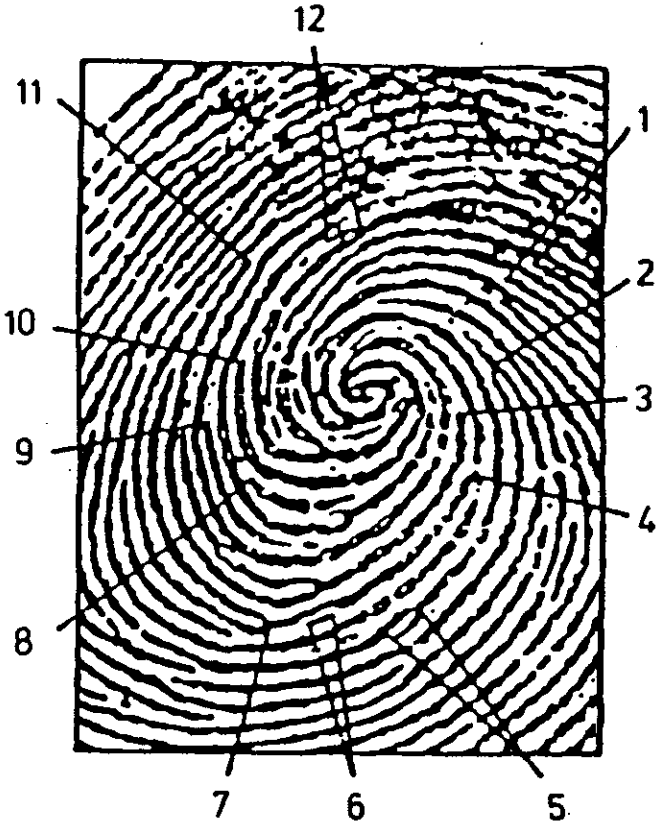


Fig. 3.

1. RIDGE ENDING TO THE LEFT.
2. RIDGE FORKING IN A DOWNWARD DIRECTION.
3. RIDGE ENDING UPWARDS.
4. RIDGE FORKING IN A DOWNWARD DIRECTION.
5. LAKE FORMATION.
6. SHORT INDEPENDENT RIDGE.
7. RIDGE FORKING TO THE LEFT.
8. RIDGE ENDING TO THE LEFT.
9. RIDGE ENDING UPWARD.
10. RIDGE ENDING UPWARD.
11. RIDGE ENDING UPWARD.
12. SPUR.

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