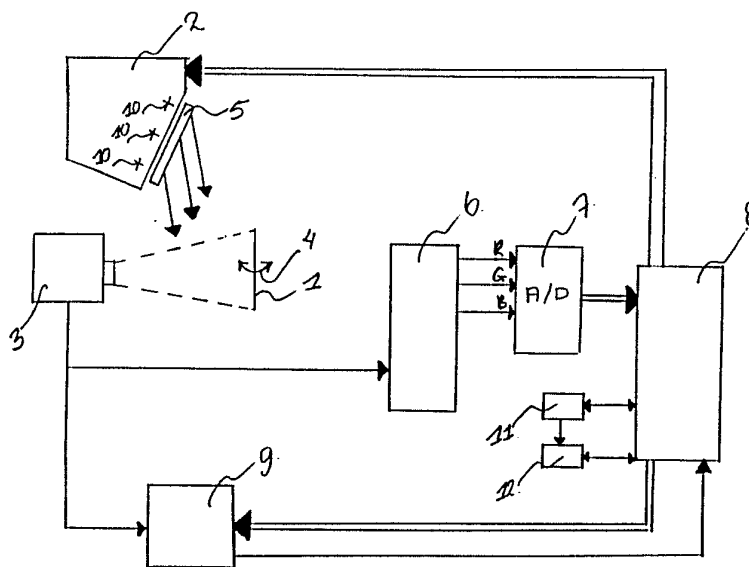




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(21) International Application Number: PCT/NL91/00124 (22) International Filing Date: 12 July 1991 (12.07.91) (30) Priority data: 9001616 16 July 1990 (16.07.90) NL (71) Applicant (for all designated States except US): D.A.H.T. FOUNDATION [NL/NL]; Rusthofstraat 13, NL-4337 KK Middelburg (NL). (72) Inventor; and (75) Inventor/Applicant (for US only) : VOERMAN, Roelof [NL/NL]; Rusthofstraat 13, NL-4337 KK Middelburg (NL). (74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).		(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, SD, SE, SE (European patent), SN + (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US. Published <i>With international search report.</i> <i>In English translation (filed in Dutch).</i>

(54) Title: METHOD OF IDENTIFYING A HOLOGRAM AND DEVICE FOR CARRYING OUT SAID METHOD

**(57) Abstract**

Method of identifying a hologram. In this method, of the hologram to be identified, such as a rainbow hologram, various recordings are made of the entire hologram or of predetermined parts. Said recordings take place at predetermined angles of observation and/or illumination which are different for each recording. Predetermined picture elements of said recordings are stored in a memory and are compared electrically with corresponding picture elements of recordings or a standard hologram obtained in a corresponding manner. The authenticity of the respective hologram investigated is determined on the basis of differences which have, or have not, been observed.

+ DESIGNATIONS OF "SU"

It is not yet known for which States of the former Soviet Union any designation of the Soviet Union has effect.

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Method of identifying a hologram and device for carrying out said method

The invention relates to a method of identifying a hologram, in which a recording is made of the hologram to be identified and a number of predetermined picture elements in said recording is stored in a memory, and furthermore to a device for carrying out said method.

In recent years, use has been made of holograms to an increasing extent in order to combat forging of documents such as identity cards, cheques and bank notes. See, for example, German Offenlegungsschrift 2,508,889, in which not only is said use reported, but a device is also described for investigating the authenticity of a document provided with a hologram. Said device makes it possible simultaneously to form a real image of the information stored in the hologram on a first screen and to project information on the document which can be read out with white or ultraviolet light on a second screen. These images which appear next to one another are then checked visually.

This method of checking the authenticity of a hologram is, however, inadequate simply because it is possible, with the present prior art, to forge a hologram of a standard type in a manner such that not only can a real image of the information contained in the forged hologram not be distinguished from a similar information image contained in the "genuine" hologram, but this is also the case with images which have been produced with different angles of observation and/or illumination, although it is in fact appreciably more difficult to produce a fake hologram which is not recognised as fake on viewing and/or illuminating at different angles.

There is, however, an advanced type of hologram which can in fact be multiplied if the so-called master hologram is available but which cannot be copied (forged) with the present prior art without making use of the master hologram without it being possible to detect that a forgery is involved. These are the so-called rainbow

holograms (Bruno Ernst, Holografie; toveren met licht (Holography; making magic with light), Amsterdam, Aramith, 1986).

5 If such a rainbow hologram is observed or illuminated in various directions lying in a first plane perpendicular to the plane of the hologram, it is as if the information stored in the hologram is viewed from different directions or, as it were, it is possible to walk round it. If, however, the direction of observation
10 and/or illumination is varied in a second plane which is perpendicular to the first plane and to the plane of the hologram, the colour of the observed image appears to depend on the said direction if, at least, illumination is carried out with polychromatic (white) light.

15 The invention is based on the insight that in most cases forged holograms can be unmasked by making more than one image of said holograms with different angles of observation and/or illumination and not checking said images visually but electronically.

20 The invention therefore relates to a method of identifying (checking for authenticity) a hologram, more particularly a rainbow hologram, in which a recording is made of the hologram to be identified and a predetermined number of picture elements in said recording is compared
25 with those of a standard hologram, which is characterised in that more than one recording is made of the whole hologram to be identified or of predetermined parts thereof at predetermined angles of observation and/or illumination, which are different for each recording, and
30 in that predetermined picture elements of said recordings are stored in a memory and are compared electronically with corresponding picture elements of a standard (genuine) hologram obtained in a corresponding manner, after which a decision is made ^{or} whether the hologram
35 investigated is genuine or fake on the basis of the differences which have, or have ^{or} not, been observed.

The reading-out and the storing of a few picture elements in a hologram is known per se from European Patent Application 0,201,274. The object of said storage

is, however, to use the stored data in adjusting the illumination intensity of the read-out equipment, and is therefore not for comparison purposes and ultimately establishing the authenticity or fraudulence of the
5 hologram.

As has already been explained above, the method according to the invention can be applied to many types of holograms, but, in the case of rainbow holograms, it always leads to the correct result. For this purpose, it
10 is, however, desirable that the illumination is polychromatic and/or coherent, for example white or laser light, because the colour effects characteristic of rainbow holograms do not otherwise occur.

Hitherto recordings made at different angles of observation and/or illumination have been mentioned. It appears to offer technical advantages, however, to arrange the recording device in a fixed position with respect to the hologram and only to vary the angle of illumination in the various recordings by turning on
15 and/or extinguishing one or more light sources of the illumination device synchronously with the making of the recordings. In this way, a number of recordings can be made with different angles of illumination without components of the device being moved mechanically.

It offers advantages to use a video camera as recording device. This does not have to be a complete camera. An optical lens and a part which converts the image formed by the lens into a series of electrical signals is in itself adequate.
25

Said signals are preferably stored in digitised form in a memory and compared with corresponding signals relating to recordings of a standard hologram with the aid of a comparator.
30

It goes without saying that the recordings of a hologram to be identified and of a standard hologram must be made under conditions which are as identical as possible, so that any differences observed are solely the consequence of differences between the two holograms.
35

Thus, a hologram to be investigated should always

be placed in the same position with respect to the camera. The application of at least two identifying marks to the hologram may facilitate the checking of the position and/or correct the stored signals with the aid of a computer in order to eliminate the effect of the incorrect position. Here consideration is given not only to an incorrect placing of the hologram or of the document to which it is applied in a holder, but also to a document to which a hologram has not been applied in the correct position.

It is furthermore possible that the conditions vary during the making of recordings, for example as a result of alteration of the illumination intensity or the voltage applied to the camera. This can be observed and possibly eliminated by arranging for the making of recordings of one or more holograms to be identified to be preceded by, and to be followed by, the making of recordings of a standard hologram.

By comparing the two recordings of the standard hologram with each other, it can be observed whether the conditions have altered during the recording. Such an alteration, or at any rate the consequences thereof, can be eliminated by comparing the signals originating from the holograms to be identified with the average of the signals originating from the two recordings of the standard hologram.

Some differences will in fact always be observed between the investigated hologram and the standard hologram, for example because one of the two holograms is provided with a transparent protective layer and/or is scratched or has been soiled.

The comparator should therefore be adjusted so that the "fake" signal is delivered only if the value of the observed differences exceeds a certain threshold value.

It is possible to apply an identification, which is, for example, numerical, to the hologram, possibly later, using a pulsed laser such as a CO₂ pulsed laser. Said identification may correspond to an identification

of the object to be identified and serve to individualise.

The invention also relates to a device for carrying out the method according to the invention. Such a device is characterised in that it comprises

5 a holder [1] for clamping a hologram to be recorded or a document or other object on which a hologram to be recorded is located,

10 a device [2] for illuminating the hologram to be recorded,

a device [3] for making recordings,

a device [4] for regulating the position of the recording device with respect to the hologram,

a device [5] for regulating the direction of illumination

15 of the hologram,

a device [6, 7] for converting recordings into (digital) signals,

a device [9] for selecting certain of said signals and storing the selected signals in a memory [11],

20 a comparator [12] for comparing the selected signals relating to different holograms, for example stored in the memory [11] or in a separate background memory and reporting the result of said comparison.

As has already been explained, it is usually

25 preferable that the recording device [3] occupies a fixed position with respect to the hologram holder [1], and that the illumination device [2] comprises a number of light sources [10] which are arranged in a fixed manner and radiate preferably white light or coherent light

30 (laser) and of which one or more is in each case turned on and/or extinguished synchronously with the making of the recordings. Such an illumination device [2] may take the form of a matrix of punctiform light sources [10], for example halogen lamps. It is furthermore possible to

35 regulate the direction of the radiated light with the aid of lenses or a system of optical fibres.

The invention will now be explained in greater detail by way of example on the basis of the attached drawing which shows a device according to the invention,

in particular in diagrammatic form.

[1] is a hologram holder in which the hologram to be investigated is located. [3] is a video camera which is arranged in a fixed manner with respect to [1]. [2] is a light matrix which is controlled by a computer [8]. [9] is a synchronisation device; the computer [8] controls a value which determines which picture line is retrieved. The video signal from the camera [3] is demodulated in [6] into red, green and blue signals, indicated by the arrows R, G and B, which signals are digitised in [7]. The computer [8] then carries out the necessary analysis.

The device described can be built up from commercially obtainable components and can therefore be produced rapidly and at relatively low costs. The device may, if desired, be designed as a portable apparatus and makes it possible to investigate large numbers of holograms (for example identity cards) in a short time and with great accuracy. As a result of using a personal computer, the device is very flexible and can readily be adapted to special requirements and conditions.

CLAIMS

1. Method of identifying a hologram, more particularly a rainbow hologram, in which a recording of the hologram to be identified is made and a predetermined number of picture elements in said recording is compared with those of a standard hologram, characterised in that more than one recording is made of the entire hologram to be identified or of predetermined parts thereof at predetermined angles of observation and/or illumination, which are different for each recording and in that predetermined picture elements of said recordings are stored in a memory and are compared electronically with corresponding picture elements of a standard hologram obtained in a corresponding manner, after which a decision is made on whether the hologram investigated is genuine or fake on the basis of the differences which have, or have not, been observed.
2. Method according to the preceding claim, characterised in that the recordings are made with polychromatic light, such as white light.
3. Method according to Claim 1, characterised in that the recordings are made with coherent light, such as laser light.
4. Method according to one of the preceding claims, characterised in that all the recordings are made with a fixed position of the hologram with respect to the recording apparatus [3].
5. Method according to one of the preceding claims, characterised in that the alteration of the angle of illumination is effected by turning on and/or extinguishing light sources [10] arranged in a fixed manner synchronously with making the recordings.
6. Method according to one or more of the preceding claims, characterised in that the recordings are made with a video camera [3] and that the signals of one or several predetermined lines of each recording are stored in digitised form in a memory [11], after which the stored signals relating to a hologram to be identified are compared with the aid of a comparator [12] with the

signals relating to recordings of a standard hologram.

7. Method according to one or more of the preceding claims, characterised in that the making of recordings of one or more holograms to be identified is both preceded and followed by the making of recordings of a standard hologram, and in that the two recordings of the standard hologram are compared with each other to check the constancy of the conditions under which the recordings have been made.

8. Method according to one or more of Claims 1-6, characterised in that the making of recordings of one or more holograms to be identified is both preceded and followed by the making of recordings of a standard hologram, and in that the signals relating to the recordings of the standard hologram are averaged and then compared with the signals originating from the recordings of the hologram to be identified or of the holograms to be identified.

9. Method according to one of the preceding claims, characterised in that after the application of the hologram, a further, individualising identification is applied thereto.

10. Device for carrying out the method according to one or more of the preceding claims, characterised in that it comprises

a holder [1] for clamping a hologram to be recorded or a document or other object on which a hologram to be recorded is located,

a device [2] for illuminating the hologram to be recorded,

a device [3] for making recordings,

a device [4] for regulating the position of the recording device with respect to the hologram,

a device [5] for regulating the direction of illumination of the hologram,

a device [6, 7] for converting recordings into (digital) signals,

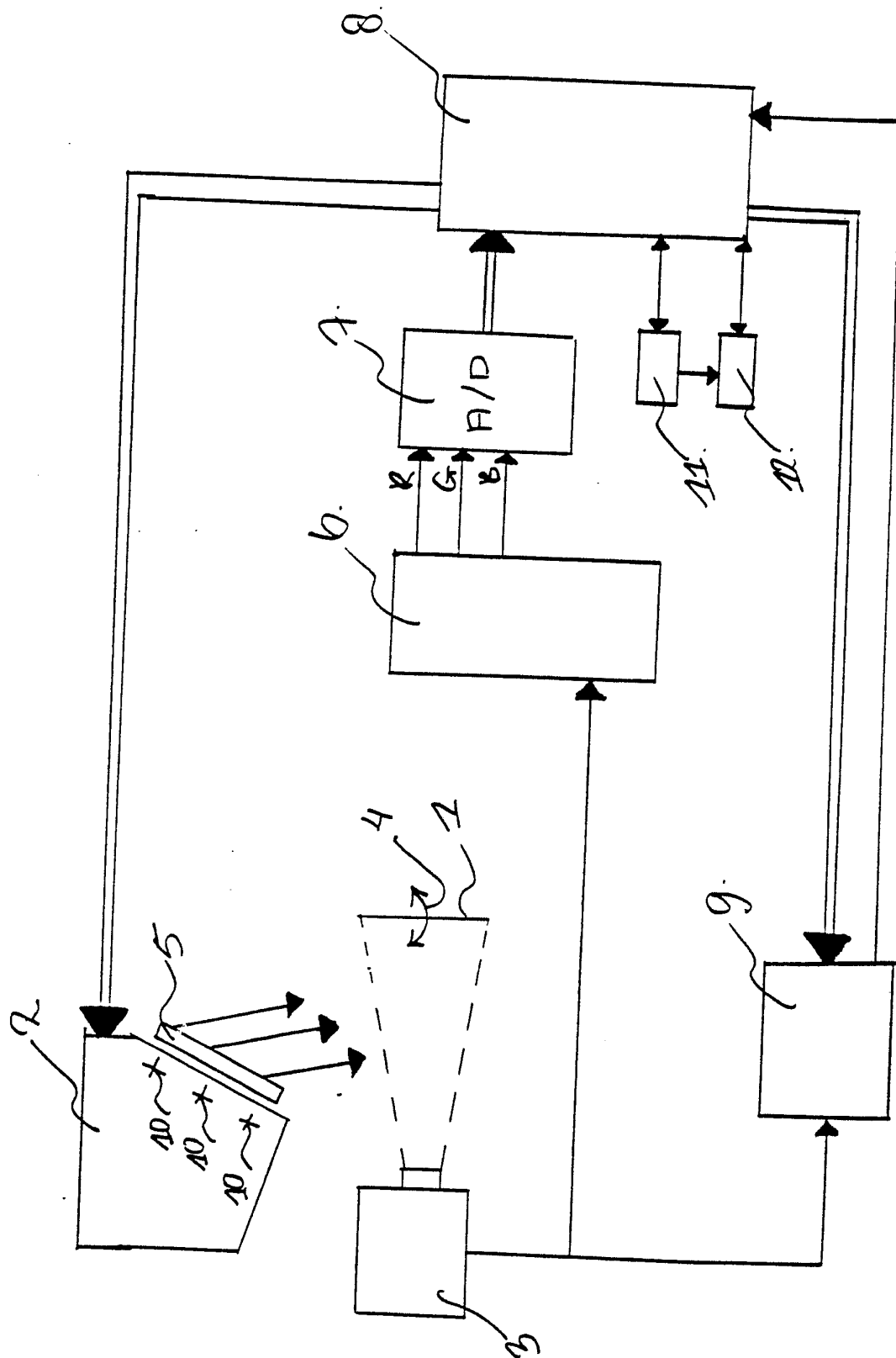
a device [9] for selecting certain of said signals and storing the selected signals in a memory [11],

a comparator [12] for comparing the selected signals relating to different holograms and reporting the result of said comparison.

5 11. Device for carrying out the method according to Claim 2 or 3, optionally also according to one or more of Claims 4-9, characterised in that the illumination device [2] comprises one or more sources [10] of polychromatic light, such as white light.

10 12. Device according to Claim 10 or 11 for carrying out the method according to Claim 4, optionally also according to one or more of Claims 5-8, characterised in that the recording device [3] occupies a fixed position with respect to the hologram holder.

15 13. Device according to Claims 10-12 for carrying out the method according to Claim 5, optionally also according to one or more of Claims 6-9, characterised in that the illumination device [2] comprises a number of light sources [10] arranged in a fixed manner, and in that a regulating device is present for turning on and/or
20 extinguishing said light sources synchronously with making the recordings.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 91/00124

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 G03H1/24 ; G07F7/12 ; G07F19/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	G06K ; G07F ; G09F ; G07C	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	EP,A,0004559 (SIEMENS) 17 October 1979 see abstract; figures 6, 7 see page 9, line 18 - page 11, line 11 ---	1-3, 6, 9-11
A	EP,A,0257808 (THE GENERAL ELECTRIC COMPANY) 02 March 1988 see abstract; figures see column 3, line 29 - column 5, line 5 ---	1, 2, 4-7, 9-13
A	US,A,4171766 (H. RUELL) 23 October 1979 see abstract; claims ; figures ---	1, 2, 9-11
A	EP,A,0256196 (ARTIKA INTERNATIONAL) 24 February 1988 ---	
A	US,A,4820006 (J.N. CONSTANT) 11 April 1989 ---	
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
17 SEPTEMBER 1991	26.09.91	
International Searching Authority	Signature of Authorized Officer	
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

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17/09/91

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US-A-4820006	11-04-89	None	