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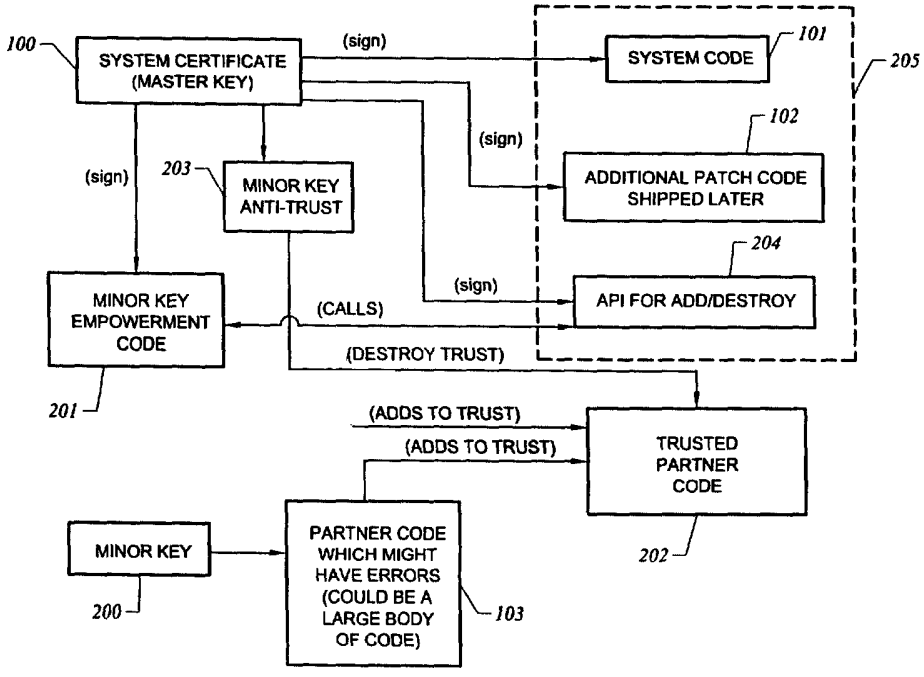
(54) Title: TRUST GRANT AND REVOCATION FROM A MASTER KEY TO SECONDARY KEYS



(57) Abstract: A method and apparatus is provided that allows code signed by a master key to grant trust to an arbitrary second key, and also allows code, referred to as an antidote and also signed by the master key to revoke permanently the trust given to the second key.

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TRUST GRANT AND REVOCATION FROM A MASTER KEY TO SECONDARY KEYS

BACKGROUND OF THE INVENTION

TECHNICAL FIELD

The invention relates to security trusts. More particularly, the invention relates to allowing code signed by a master key to grant trust to an arbitrary second key, and allowing code, referred to as an antidote, also signed by the master key to revoke permanently the trust given to the secondary key.

DESCRIPTION OF THE PRIOR ART

Simply speaking, computer systems are at a state such that companies can relatively easily distribute a lot of code to a lot of end users. To protect their code or their product from hackers and unknown impurities, such companies typically apply a security mechanism. An example of a security mechanism is trust using Certificate Revocation Lists (CRL).

In this context, the definition of trust has two parts. The first part is establishing identity of a participant. Typically, the participant has, as an analogy a letter of introduction signed by some other entity. The signing entity is typically referred to as a certificate of authority, or CA. The certificate of authority, or simply, certificate establishes the participant's name and

signature. Other terms used interchangeably with certificate are master key, super key, and system certificate. Therefore, the participant's identity is a letter of introduction signed by a CA.

The second part is a statement of trust, which according to the analogy above may be a letter stating trust the participant. That is, the first step is to establish identity of a participant, and the second step is an agreement provided stating trust such identity. The identity and the agreement together work to establish trust.

From a typical computer system's perspective, an example of an implementation of trust is accomplished by using CRL's. The use of CRL's is bundled with the released software. Associated with the released software is a system certificate. This certificate along with a plurality of other certificates reside in a certificate database. The use of certificates is adaptable to be applied to releases of additional software released by the same entity that released the first system code. Sometimes they are referred to as patches. Signed patches mean for the end user to trust the patches as well as the originally signed software.

Another level of complexity is added by desiring partner or vendor code to be released with the original system code. In order for all three types of code, original system code, patches, and partner code to work together seamlessly, they all currently need to be signed by the same certificate.

Currently, in the event that the partner code is faulty and was signed by the certificate, then the system code and its patches are at jeopardy. The current remedy is to modify the partner code for corrections and re-release it. However, because the erroneous partner code was signed by the certificate, the certificate's power must be revoked. Revoking the certificate's power impacts trust granted to the signed original system code and any of its signed patches. A second master key or certificate needs to be created to sign the original system code, its patches, and the corrected partner code prior to their re-release.

Obviously, re-releasing good software (original system and patches) is a redundant process that can prove crippling and prohibitively expensive for a company.

It is also a major task for a company to re-release corrected partner software when the partner software is of a large quantity, which is typically the case.

It is could also be very detrimental to a company should its partner provide code unbeknownst to the company or to the partner until after its release contain code that is offensive and cannot be revoked in a timely and efficient manner.

R. Sudama, D. M. Griffin, B. Johnson, D. Sealy, J. Shelhamer, and O. H. Tallman, U.S. Patent No. 5,619,657 (Apr. 8, 1997) discloses a method for providing a security facility for a network of management servers utilizing a database of trust relations to verify mutual trust relations between

management servers. The disclosure consists of a method for providing security for distributing management operations among components of a computer network using a network of mutually trusting, mutually authenticating management services to dispatch operations to selected host systems. Mutual authentication and trust are established on every transmission link from a point of submission to a designated management server which invokes a service provider to perform management operations on a selected host.

However, Sudama *et al* requires the prior art standard technique of querying a database to the trusted identification of concern and does not comprise revoking trust.

M. Gasser, A. C. Goldstein, C. W. Kaufman, and B. W. Lampson, U.S. Patent No. 55,224,163 (June 29, 1993) discloses a method for delegating authorization from one entity in a distributed computing system to another in a single computing session through the use of a session public/private encryption key pair. At the end of the computing session. the private encryption key is erased and terminates the computing session.

Gasser *et al* addresses security on a temporary, or session basis. In addition, the user is required to certify that the workstation in question possessing the private encryption key is authorized to speak on the user's behalf.

It would be advantageous to provide an elegant, simple, and efficient means to revoke the trust previously granted to partner code.

It would be advantageous to allow partner code to be signed by its own, unique certificate so as not to impact the release of other code signed by other certificates.

It would be advantageous to revoke a minor key for destroying trust of partner code and reassign a new minor key to grant trust to corrected or modified partner code, rather than re-releasing or shipping all code signed by a master key.

SUMMARY OF THE INVENTION

A method and apparatus is provided that essentially adds two elements of functionality to a client. The first element of functionality allows code signed by a master key to grant power, or trust to an arbitrary second, or minor key. The second element of functionality allows code, referred to as an antidote, signed by a master key to preclude giving power to a specific secondary key permanently.

The master key is used to sign only extremely small elements of code. These code elements convey either a grant or denial of trust for a secondary key. The fact that these sections of code are small and simple ensures no errors are made in the code and hence the master key never needs to be revoked.

The idea of the antidote is that trust can be permanently denied for a secondary key. Once the antidote is applied by rerunning the trust code, the secondary key will never have any more effect. From a usage perspective, the code fragment is run as an upgrade to combat a security breach that was discovered. The upgrade running the antidote permanently prevents the upgraded client from paying attention to the trusted code that has been breached. This makes the granted trust benign once it is breached.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a schematic diagram of a trust system according to the prior art; and

Fig. 2 shows a schematic diagram of a trust system according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

A method and apparatus is provided that essentially adds two elements of functionality to a client. The first element of functionality allows code signed by a master key to grant power, or trust to an arbitrary second, or minor key. The second element of functionality allows code, referred to as an antidote, signed by a master key to preclude giving power to a specific secondary key permanently.

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Example Problem

The invention can be understood by an example problem and its solution. The example is of a client shipping software to end users and the client's partner desiring to ship software that can be viewed as an add on to the client's software. The problem can arise when both the client software and the partner software are each signed by a single master key.

Referring to Fig. 1, the prior art teaches a master key 100 signs system code 101 of a client. At some point later in time, the client releases an additional patch of code 102 that is also signed by the master key 100 to ensure that all code works in unison.

When it is desired to ship or release partner code 103 of the client that is associated with or added on to the client code the master key 100 also signs the partner code 103. Such signing 104 by the master key 100 can be viewed as dangerous because the partner code 103 might have errors. This can be particularly troublesome when the partner code 103 is a large body of code.

The problem arises when the client has distributed code (101-103) and some of the partner code 103 is faulty. The corrective procedure according to the prior art is to correct the errors in the partner code 103 and subsequently redistribute the entire amount of previously distributed code (101-103) containing the corrections and again signed by the master key 100.

Solution to Example Problem

According to the preferred embodiment of the invention, a solution to the problem is as follows. Referring to Fig. 2, the partner creates a secondary or minor key 200. The client provides empowerment or trust code 201 signed by the master key 100 that essentially allows trusting the minor key 200 with power substantially close to the power of the master key 100. The empowerment code 201 signed by the master key 100 together with the partner code 103 signed by the minor key 100 make trusted partner code 202.

To revoke the trust created by use of the minor key empowerment code 201 signed by the master key 100 and the partner code 103 signed by the minor key 100, code referred to as antidote code 203 is created, signed by

the master key 100, and distributed when necessary to users of the trusted partner code 202.

A small piece of Application Programming Interface (API) add/destroy trust code 204 is provided for the client's system 205. This API 204 is also signed by the master key 100. The empowerment code 201 and the antidote code 203 each make calls to this API to ensure that the system 205 has the ability to add or destroy the trust granted by the minor key 200.

According to the preferred embodiment of the invention, implementation is as follows. First the add/destroy trust API 204 is added to the system 205. Then the client simply writes the small piece of empowerment code 201 and the small piece of antidote code 203 that each make calls to the API 204. In the preferred embodiment, any of the API, empowerment, and antidote code is written in, but not limited to the Java or JavaScript programming languages, or in any other general purpose code.

It is noted that the granting and revoking of trust according to the invention is performed outside of the standard infrastructure as in using certificates and revocation lists as according to the prior art. Also, it is noted that according to the invention, the master key or certificate is trusting code, as opposed to trusting another certificate or key as according to the prior art.

It is noted that the invention does not require the standard general mechanism of certificate revocations lists, whereby validating a particular certificate requires accessing a central area to check for revocations. In the preferred embodiment of the invention, an upgrade is downloaded to the end user, wherein the upgrade carries the revocation of the trust.

It is noted that the antidote code 203 destroying trust is more powerful than the empowerment code 201 together with the signed partner code 203 making the added trust. That is, the antidote code 203 has permanence meaning that when the system 205 encounters trusted partner code 202 signed by the minor key 200 at a later point in time and after the antidote code 203 has been applied, the system 205 will continue to honor the revocation of trust by the minor key 200.

According to the preferred embodiment of the invention, after revocation of the minor key 200 and when the partner feels confident about redistributing modified code 103, a new minor key is issued and the adding of trust can be reinstated.

It is noted that if a client has multiple partners, then in one embodiment of the invention, each partner can have its own unique minor key.

An End User's Perspective

According to the prior art, an end user is presented with dialog boxes asking the end user whether or not the end user trusts code about to be loaded or run. Such dialogs typically confuse the end user.

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According to the preferred embodiment of the invention, such dialog boxes are avoided. When an end user requests the upgrade containing the partner code add on, the end user actually receives the signed (by the master key) empowerment code and the signed (by the minor key) partner
10 code, without receiving any questions. The end user experiences the system code, any additional patches, and powerful partner code all working together seamlessly.

Although the invention has been described in detail with reference to
15 particular preferred embodiments, persons possessing ordinary skill in the art to which this invention pertains will appreciate that various modifications and enhancements may be made without departing from the spirit and scope of the claims that follow.

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CLAIMS

1. A method for granting trust to and revoking said granted trust from an arbitrary secondary key by a master key, comprising:

providing empowerment code signed by said master key to grant trust to said arbitrary secondary key; and

providing antidote code signed by said master key to revoke said granted trust to said arbitrary key;

2. The method of Claim 1, wherein said revocation of said granted trust by said antidote code is permanent.

3. The method of Claim 1, wherein amount of said empowerment code is significantly small, and wherein amount of said antidote code is significantly small.

4. The method of Claim 1, wherein said antidote code is run as upgrade software to combat a security breach.

5. The method of Claim 4, wherein said antidote code is downloadable.

6. The method of Claim 1, comprising a plurality of secondary keys each associated with each of a plurality of partner entities.

7. The method of Claim 1, wherein said empowerment and antidote code are general purpose code and written in any of, but not limited to:

the Java language; and

JavaScript.

8. An apparatus for granting trust to and revoking said granted trust from a partner of a system using a master key, comprising:

a minor key associated with said partner;

general purpose empowerment entity associated with said minor key, said entity signed by said master key for said granting trust to said partner;

general purpose antidote entity associated with said minor key, said entity signed by said master key for said revoking said granted trust from said partner; and

an interface to said system for granting trust and revoking trust of said partner, said interface signed by said master key.

9. The apparatus of Claim 8, wherein:

said system comprises system code;

said partner comprises partner code;

said empowerment entity comprises general purpose empowerment code;

said antidote entity comprises general purpose antidote code; and

said interface is an application program interface (API).

10. The apparatus of Claim 8, wherein application of said antidote entity overrides application of said empowerment entity permanently.

11. The apparatus of Claim 8, adaptable for adding at a later point in time an additional partner, corresponding additional minor key signed by said master key, a corresponding additional empowerment entity signed by said master key, and a corresponding additional antidote entity signed by said master key.

12. The apparatus of Claim 9, wherein said empowerment and antidote code are written in any of, but not limited to:

the Java language; and

JavaScript.

13. The apparatus of Claim 8, wherein said empowerment entity is significantly simple and said antidote entity is significantly simple, thereby eliminating opportunities for error.

14. The apparatus of Claim 8, wherein said empowerment entity uses said system interface to effect said grant of said trust, and said antidote entity uses said system interface to effect said revocation of said granted trust.

15. The apparatus of Claim 8, wherein said minor key is created by said partner.

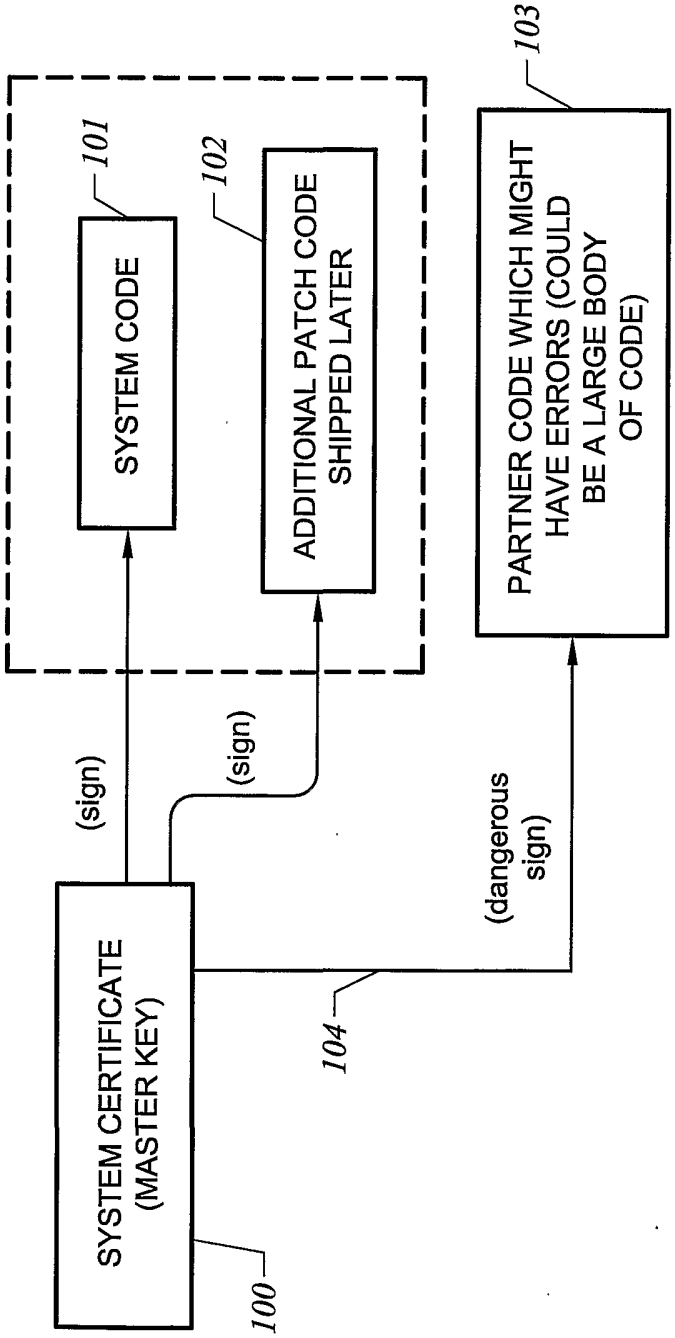

FIG. 1
(PRIOR ART)

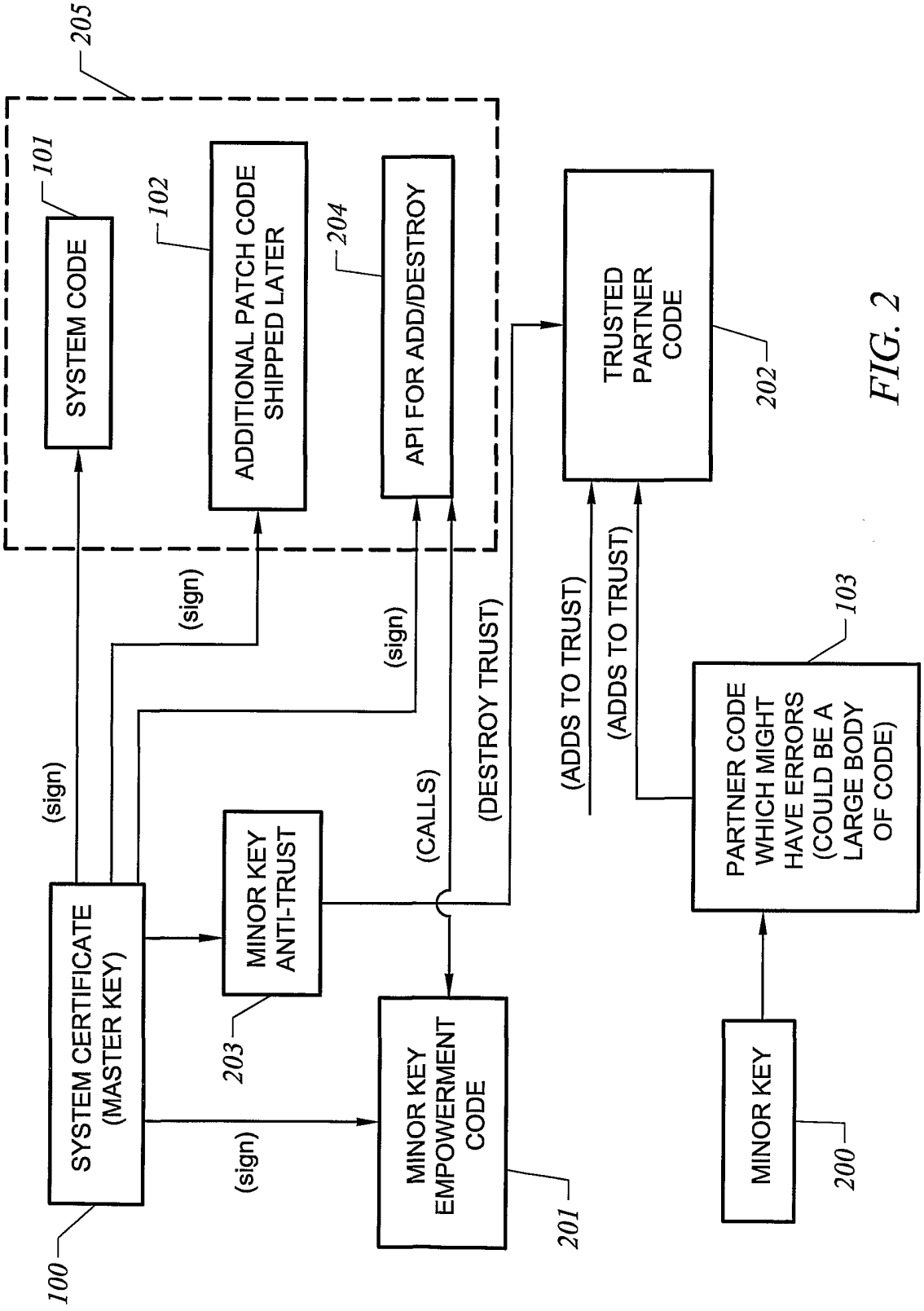
205
101
SYSTEM CODE
102
ADDITIONAL PATCH CODE SHIPPED LATER
204
API FOR ADD/DESTROY
TRUSTED PARTNER CODE
202
(sign)
(sign)
(sign)
(sign)
(CALLS)
(DESTROY TRUST)
(ADDS TO TRUST)
(ADDS TO TRUST)
103
PARTNER CODE WHICH MIGHT HAVE ERRORS (COULD BE A LARGE BODY OF CODE)
SYSTEM CERTIFICATE (MASTER KEY)
MINOR KEY ANTI-TRUST
203
MINOR KEY EMPOWERMENT CODE
201
MINOR KEY
200
100

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/17128

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F1/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06F H04L

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

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

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 224 163 A (GASSER MORRIE ET AL) 29 June 1993 (1993-06-29) cited in the application abstract; examples 5-7 column 7, line 5-11 column 13, line 20 -column 15, line 65	1-8, 10-16
Y	---	9
Y	US 5 761 669 A (MISRA PRADYUMNA K ET AL) 2 June 1998 (1998-06-02) abstract	9
A	---	1-15
	US 4 919 545 A (YU CHE-FN) 24 April 1990 (1990-04-24) the whole document	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 01/17128

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5224163 A	29-06-1993	NONE	
US 5761669 A	02-06-1998	US 5675782 A	07-10-1997
US 4919545 A	24-04-1990	NONE	