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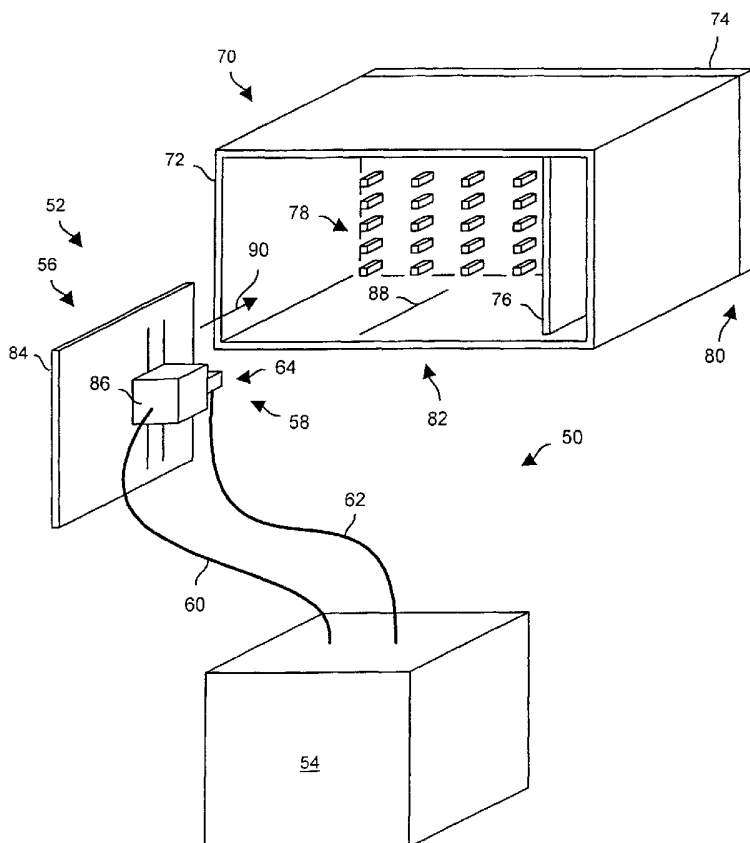
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[Continued on next page]

(54) Title: SYSTEMS AND METHODS FOR INSPECTING AN OPTICAL INTERFACE

(57) Abstract: A system enables inspection of an optical connector. The system includes a positioning subassembly, an electronic sensor (e.g., a scanner, a camera, etc.), and a controller coupled to the positioning subassembly and the electronic sensor. The controller is configured to position the electronic sensor over the optical connector, activate the electronic sensor to obtain a set of electronic signals which defines a set of current images of the optical connector, and electronically generate a result based on the set of electronic signals. The result indicates an attribute of the optical connector. Accordingly, the system is capable of inspecting the optical connector in a repeatable and non-subjective manner.





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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G02B G01R

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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 179 419 A (PALMQUIST JOHN M ET AL) 12 January 1993 (1993-01-12)	1,8,17
Y	abstract; figures 1-3,5,6,22 column 4, line 49 - column 5, line 16 column 6, line 46 - column 7, line 4 column 8, lines 21-32 column 18, lines 15-35	1,8,17, 31,38
X	US 5 459 564 A (CHIVERS JAMES T) 17 October 1995 (1995-10-17) abstract; figures 1,2,1a,3a,3b column 4, line 34 - column 5, line 49 column 6, line 41 - column 7, line 19 column 10, lines 24-32 ----- -/--	1,8,17



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
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98/14810 A (WHITE JOHN ANDREW ; TOWFIG FOAD (US); NGUYEN SANG VAN (US)) 9 April 1998 (1998-04-09) abstract; figures 2,6d,14 page 23, line 6 - page 24, line 12 page 27, lines 24-30 -----	1,8,15, 17,31,38
X	DE 196 53 754 A (KERNFORSCHUNGSANLAGE JUELICH) 2 July 1998 (1998-07-02) abstract; figures 1-5 column 6, line 31 - column 7, line 2 -----	1,17
P,Y	WO 03/102656 A (TERADYNE INC) 11 December 2003 (2003-12-11) abstract; figures 1-3d,5 -----	1,15,17, 31

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 03/41251

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

see annex

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-3,8,15,17-19,31,38

A method of inspecting an optical connector comprising the steps of sensor positioning, sensor activating, image defining and electronically generating a result (cf. claim 1) comprising the special technical features of

- employing a set of actuators that couples the electronic sensor to a card shaped member,
- wherein the optical connector is disposed within a backplane which resides in a fixed position relative to a card cage, and
- wherein the step of positioning the electronic sensor includes the steps of:
 - inserting the card shaped member toward the backplane; and
 - providing a set of actuator signals to the actuators to move the electronic sensor over the optical connector (cf. claim 2).

From these special technical features the objective problem to be solved by the first invention can be construed as how to inspect optical connectors disposed within a backplane that resides in a card cage.

Dependent claims 3 and 15 have been included in this group since they relate to associated problems or steps that would need to be carried out; namely, protecting the sensor whilst inserting the card and cleaning the connectors before inspection.

Claims 18, 19 & 31 are product claims correspond to claims 2, 3 & 15 and so are also included in the group as well.

2. claims: 4-7,16,20-23,37

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A method of inspecting an optical connector comprising the steps of sensor positioning, sensor activating, image defining by a set of electronic signals, and electronically generating a result (cf. claim 1) comprising the special technical features of

- the set of electronic signals including a digital code signal which represents a
- (i) digital code on a surface of the optical connector, and
- (ii) a set of current image signals which defines the current images of the optical connector, and
- wherein the step of electronically generating the result includes the steps of:
 - retrieving, based on the digital code signal, a set of prior image signals from a database, defining a set of prior images;
 - outputting a difference signal based on a comparison of the current image signals with the prior image signals; and
 - providing, an indication whether the optical interface of the optical connector has a defect (cf. claim 4).

From these special technical features the objective problem to be solved by the second invention can be construed as how recognize to presence and nature/type of connector to be inspected.

Claims 5 to 7 define further limiting features.

Claims 20 to 23 are product claims correspond to claims 4 to 7 and so are also included in this group as well.

Dependent claims 16 and 37 have been included in this group since they apparently relate to identifying the connector by an alternate means; e.g. a radio frequency tag instead of a digital code on the surface of the connector.

3. claims: 9-12,24-28

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A method of inspecting an optical connector comprising the steps of sensor positioning, sensor activating, image defining, electronically generating a result (cf. claim 1) and supplying light to the optical connector during the step of activating the electronic sensor (cf. claim 8) comprising the special technical features of

- providing dark field illumination to the optical connector during the step of activating the electronic sensor (cf. claim 9) or

- providing bright field illumination to the optical connector during the step of activating the electronic sensor (cf. claim 10), or

- providing substantially white light to the optical connector during the step of activating the electronic sensor (cf. claim 11), or

- providing substantially short wavelength light to the optical connector during the step of activating the electronic sensor, (cf. claim 12).

From these special technical features the objective problem to be solved by the third invention can be construed as what kind of lighting conditions and light to use when inspecting a connector (for a defect).

Claims 24 to 28 are product claims that correspond to claims 9 to 12 and so are included in this group as well.

4. claims: 13,14,29,30

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A method of inspecting an optical connector comprising the steps of sensor positioning, sensor activating, image defining, and electronically generating a result (cf. claim 1),

- wherein the optical fibre includes an interface having multiple fibre ends, comprising the special technical features of the step of activating the electronic sensor including, for each fibre end of the optical interface, the steps of:

- aiming the electronic sensor at that fibre end; and
- forming a respective current image signal which defines a captured current image of that fibre end (claim 13),

or,

wherein the optical fibre includes an interface having multiple optical interfaces, comprising the special technical features of
- the step of activating the electronic sensor including the steps of:

- aiming the electronic sensor over a first optical interface of the optical connector and
- forming a first set of current image signals which defines a first set of current images of the first optical interface;

- automatically moving the electronic sensor from a location over the first optical interface to a location over the second optical interface; and

- aiming the electronic sensor over a second optical interface of the optical connector and
- forming a second set of current image signals which defines a second set of current images of the second optical interface (claim 14).

From these special technical features the objective problems to be solved by the fourth invention can be construed as how to deal with connectors having multiple fibres or multiple optical interfaces. (These are similar problems requiring similar solutions.)

Claims 29 & 30 are product claims that correspond to claims 13 & 14 and so are also included in this group as well.

5. claims: 32,33,34,35,36

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A system for inspecting an optical connector comprising a electronic positioning subassembly, an associated controller for positioning the sensor and processing an associated image signal output to produce a result indicating a connector attribute (cf. claim 17) comprising the special technical features of

- the electronic sensor being a linear array of sensor elements (cf. claim 32) or
- the electronic sensor being a two dimensional array of sensor elements (cf. claim 33), or
- the optical connector being disposed on a backplane mounted to a card cage and the electronic sensor including a lens subassembly to capture images (cf. claim 34), or
- the optical connector being disposed on a backplane mounted to a card cage; and the electronic sensor including an elongated lens subassembly which is configured to capture images when a first end of the elongates lens subassembly is disposed adjacent the optical connector, and a second end of the lens subassembly is disposed outside the card cage (cf. claim 35), or
- the electronic sensor including a fibre optic taper which is configured to transmit and transform images when disposed within the card cage adjacent the optical connector (cf. claim 36).

From these special technical features the objective problem to be solved by the fifth invention can be construed as what kind of sensor to use when inspecting a connector.

INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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