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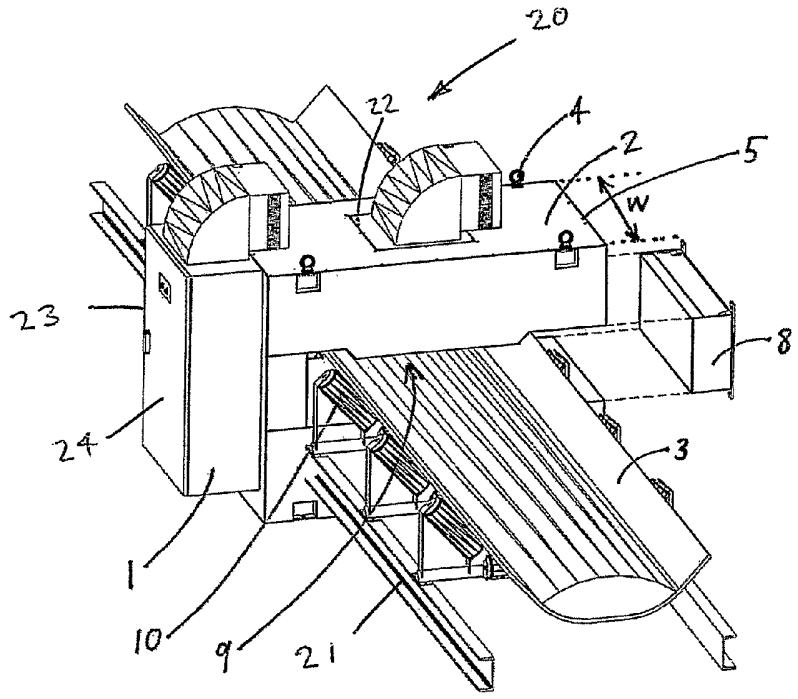
(54) Title: ON-BELT ANALYSER SYSTEM



(57) Abstract: An analyser system (20) including an on-belt analyser having a housing (2) adapted to be positioned across a path of a conveyor belt (3) which carries material to be analysed, wherein the housing defines a tunnel (9) dimensioned to allow the belt to travel therethrough in suspended relation in order to allow analysis of the material without the belt contacting the analyser (1).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ON-BELT ANALYSER SYSTEM

Related Applications

This application claims priority from Australian Provisional Patent Application No. 2005900951 and United States Provisional Patent Application No. 60/658195, the contents of which are incorporated herein by reference.

Field of the Invention

This invention relates to an on-belt analyser.

Background of the Invention

One form of on-belt analyser, which utilises a thermal neutron capture and gamma ray production technique known as PGNAA (Prompt Gamma Neutron Activation Analysis), is employed to analyse the composition of material such as coal or other mineral product transported on a conveyor belt. The analyser has a C-shaped housing provided with lifting points to allow the analyser to be appropriately positioned across a path of the belt. The weight of the analyser is quite substantial, in the order of 6500 to 9000 kg and the lifting points are necessarily provided at a base of the analyser due to structural load-bearing limitations of the housing. Once positioned, removable side shielding is fitted to close the open side of the C-shaped housing, to thereby define a tunnel in the order of 2 meters long, through which the belt passes.

The tunnel has a radiation source in its base and sensors in the roof thereof. Tunnel slider panels are provided above the radiation source to support the belt as it passes through the analyser.

Installation and operating costs of the analyser are relatively high given the analyser generally needs to be installed in a shed or the like for protection from the elements and

various component parts such as the slider panels are subject to wear during operation. Also, in order to install the analyser substantial parts of the conveyor belt support structure, such as frame work and stringer or idler wheels, need to be removed. The remaining structure, at either side of the analyser, then needs to be configured in order to ensure an appropriate profile is applied to the conveyor belt, as it enters the analyser, compatible with the shape of the tunnel and the slider panels.

Object of the Invention

The present invention seeks to provide an improved analyser system.

Summary of the Invention

In accordance with the invention, there is provided an analyser system including an on-belt analyser having a housing adapted to be positioned across a path of a conveyor belt which carries material to be analysed, wherein the housing defines a tunnel dimensioned to allow the belt to travel therethrough in suspended relation in order to allow analysis of the material without the belt contacting the analyser.

In another aspect there is provided an on-belt analyser with a C-shaped housing, to allow the analyser to be positioned across a path of a conveyer belt, wherein an upper arm of the housing includes lifting points.

In another aspect, there is provided an analyser with a housing adapted to be positioned across a path of a conveyor belt and a canopy for protecting the housing.

Preferably, the canopy is fitted to lifting points located on an upper arm of the housing.

Preferably, the housing defines a tunnel through which the conveyor belt passes and has extension panels fitted thereto to provide protection adjacent the analyser and external of the tunnel, from radiation emissions generated from a radiation source within the analyser.

In another aspect, there is provided an analyser including a housing adapted to be positioned across a path of a conveyor belt, wherein the housing defines a tunnel arranged to receive the belt such that the belt passes through the tunnel without contacting the analyser.

In another aspect, there is provided an analyser system including an analyser with a housing, which defines a tunnel, and a conveyor assembly with a conveyor belt that passes through the tunnel without contacting the analyser.

Preferably, the housing has a width dimension in the order of 1 meter to allow the analyser to be positioned between existing adjacent supporting idlers of the conveyor belt. Preferably, an under side of the belt has a clearance in the order of 30 mm from a base of the tunnel.

Preferably, the weight of the analyser is in the order of 2000 kg.

Brief Description of the Drawings

The invention is described by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of an analyser;
Figure 2 is a perspective view of the analyser of Figure 1, fitted with extension panels, automatic source drive shield, and canopy;
Figure 3 is a cross-sectional view of the analyser; and
Figure 4 is a diagrammatic end view of the analyser with a canopy.

Detailed Description

An analyser system 20 is shown in Figure 1 as including an analyser 1 and a conveyor

assembly 21. The analyser 1 has a C-shaped housing 2 arranged to be positioned across a path of a conveyor belt 3 of the assembly 21. The analyser 1 is designed so as to weigh only in the order of 2000 kg which is light enough for the housing 2 to maintain structural integrity even if lifted from lifting points 4 provided by eye-bolts, which are provided on an upper arm 5 of the analyser 1. For that purpose, the analyser 1 is preferably formed of a steel framed enclosure filled with cast neutron shielding (CNS). The CNS is a dense suspension of 60% high-density polyethylene beads cemented together with a mixture of 20% borax and 20% polyester resin-plus catalyst. This material provides most of the shielding required since it is effective in slowing down and absorbing neutrons. The material is also waterproof, non-corrosive and intrinsically fire resistant.

Once the analyser 1 is positioned in the manner shown, side shield 8 is fastened in place so that the analyser defines a tunnel 9 through which the belt 3 passes. A width dimension "w" of the analyser is preferably in the order of 1 metre to allow the analyser to be positioned between existing supporting structure, such as idlers 10, of the conveyor assembly 21, which are conventionally spaced at between 1.2 and 1.5 metres apart.

In some circumstances, it may be necessary to provide additional shielding for radiation protection and, in that case, a further side shield 6 may be provided and extension panels 11 may be fitted either side of the tunnel, as shown in Figure 2. The extension panels are preferably formed of UV stabilised polyethylene or like material, which is suitable for absorbing radiation from, for example, a Cf-252 source. The panels 11 may be dimensioned so as to provide protection for an additional length "L" of, say, 1 metre either side of the analyser 1.

Figure 2 also shows the system 20 as including an optional microwave moisture content analyser 7 positioned above the belt 3.

Referring now to Figure 3, a cross-section of the analyser 1 is shown in detail with the side shielding 8 attached to the housing 2, so as to define the tunnel 9. A radiation source 12 is provided in a base 13 of the tunnel and detectors 14 are appropriately located above the

tunnel 9. The tunnel 9 is positioned and dimensioned so as to receive the conveyor belt 3 in an elevated position relative to the base 13 of the tunnel 9. The clearance is preferably in the order of 30 mm to allow for a slight droop in the belt 3 between its supporting idlers 10. Previously, it was considered critical to minimise the distance between the Cf-252 source and material to be analysed in order to maximise absorption of neutrons in the material. Accordingly, the prior-art analyser was designed to have contact between the belt and the analyser using 25 mm thick slider panels. The geometry of the analyser illustrated in Figure 3, however, has been investigated using a program called MCNP (Monte Carlo N-particle) and it has been found that replacing the slider panels with air made little difference. Accordingly, a clearance is provided between the belt 3 and the base 13 of the tunnel 9, which allows the previous slider panels to be dispensed with, thereby reducing construction and maintenance costs. The tunnel 9 is shaped to accommodate conveyor belts 3 from 600 mm to 1400 mm wide with trough angles from 30° to 45° with no modification to belt 3 or tunnel 9. As a result of the relative clearance, an additional advantage is realised in that belt clips and staples (not shown) can not damage analyser 1.

Turning now to Figure 4, the analyser 1 is shown with a canopy 15 supported on struts 16 fixed to the lifting points 4. The canopy 15 is preferably formed of 3 mm thick steel or fibreglass and stands approximately 400 mm above the analyser 1, leaving an approximate clearing of 50 mm above the 350 mm high air conditioners 17. The canopy 15 provides protection to the top 18 of the analyser 1 from direct sunlight, rain and snow. The canopy 15 should also minimise dust build-up on and around the air conditioner 17. Provision of the canopy 15 additionally allows the analyser to be installed in an external environment at any desired location along the length of the conveyor belt 3, as compared to the prior art analyser, which needed to be installed within a shed. As such, the analyser 1 provides for further reduction in installation costs.

In addition to the above, the prior-art analyser used proprietary analogue electronics and NaI (sodium iodide crystal) detectors. The present analyser 1, on the other hand, uses off-the-shelf digital multi-channel analysers and bismuth germinate crystal (BGO) detectors.

The digital multi-channel analysers provide more consistent, linear, stable spectra and are more reliable as compared to the previous analyser electronics, for which components are becoming obsolete. The BGO detectors capture more gamma rays and have better photo-peak fraction due to higher crystal density, have better peak to background ratio (ie better signal-to-noise ratio) and better linearity. The detectors 14 and associated multi-channel analyser electronics are preferably located within a single common air-conditioned, temperature-controlled detector enclosure 22 to simplify operational and construction requirements. The remaining electronics such as an analyser computer and other electronics modules are likewise located within a single air-conditioned, temperature-controlled electronics cabinet 23, which has a sealed and locked door 24.

As such, the above-described analyser 1 provides a number of advantages over the prior-art analyser, which result from internal componentry, reduced weight and dimensions, as well as the provision of a canopy and the clearance between the analyser and a conveyor belt passing through the analyser tunnel. As may be appreciated then, the analyser may be installed on an existing conveyor assembly with minimal modification or removal of steel work of the belt support structure since the analyser is of a width sufficient to fit between pre-existing idlers and does not contact the belt so the supporting structure does not need to be configured in any particular fashion necessary to form a specific belt profile suitable for the tunnel, as compared to the prior-art analyser arrangement.

Further and more particular details of a preferred form of analyser are provided in Applicant's publications "On Belt Analyser Operation & Maintenance Manual" Version 1.3, September 2005; "On Belt Analyser-5 Health & Safety Review" Version 1.6, February 2006; and "On Belt Analyser Installation Manual" Version 7.3, October 2005, the contents of which are incorporated herein by reference.

The invention has been described, by way of non-limiting example only, and many modifications and variations may be made thereto, without departing from the spirit and scope of the invention, as described.

The Claims:

1. An analyser system including an on-belt analyser having a housing adapted to be positioned across a path of a conveyor belt which carries material to be analysed, wherein the housing defines a tunnel dimensioned to allow the belt to travel therethrough in suspended relation in order to allow analysis of the material without the belt contacting the analyser.

2. An analyser system as claimed in claim 1, wherein the tunnel is dimensioned to receive a belt of between 600 mm and 1400 mm in width, with a trough angle of between 30° and 45° without requiring any modification to the tunnel or belt profile.

3. An analyser system as claimed in claim 1, including a conveyor assembly with idlers arranged to support the belt at either side of the analyser so as to suspend the belt through the tunnel.

4. An analyser system as claimed in claim 3, wherein the idlers are spaced at between 1.2 and 1.5 metres apart.

5. An analyser system as claimed in any one of claims 1 to 4, wherein the width of the analyser, in a direction lengthwise of the conveyor belt, is in the order of 1 metre.

6. An analyser system as claimed in claim 1, arranged whereby a clearance in the order of 30 mm is provided between the belt and a base of the tunnel.

7. An analyser system as claimed in claim 1, including lifting points at an upper section of the housing.

8. An analyser system as claimed in claim 1, wherein the lifting points are provided by eye-bolts.

9. An analyser system as claimed in claim 1, wherein extension panels are fitted either side of the tunnel to provide protection adjacent the analyser and external of the tunnel, from radiation emissions generated from a radiation source within the analyser.

10. An analyser system as claimed in claim 1, wherein a canopy can be provided for protecting the analyser.

11. An analyser system as claimed in claim 1 for analysing bulk material in the form of coal, minerals, cement raw materials, or the like.

12. An analyser system as claimed in claim 1, including a radiation source and detector for analysis using Prompt Gamma Neutron Activation Analysis (PGNAA).

13. An analyser system as claimed in claim 1, wherein the detector and multi-channel analyser electronics are located within a common air-conditioned, temperature-controlled detector enclosure.

14. A method for on-belt analysis of bulk material including suspending a conveyor belt through an analyser, as defined in claim 1, without the belt contacting the analyser.

15. A method as claimed in claim 14, including positioning the analyser across the belt, between pre-existing idlers.

16. A method as claimed in claim 14, including analysing bulk material using PGNAA.

17. An analyser system, substantially as described with reference to the drawings.

18. An analyser, substantially as described with reference to the drawings.

19. A method for on-belt analysis of bulk material, substantially as described with reference to the drawings.

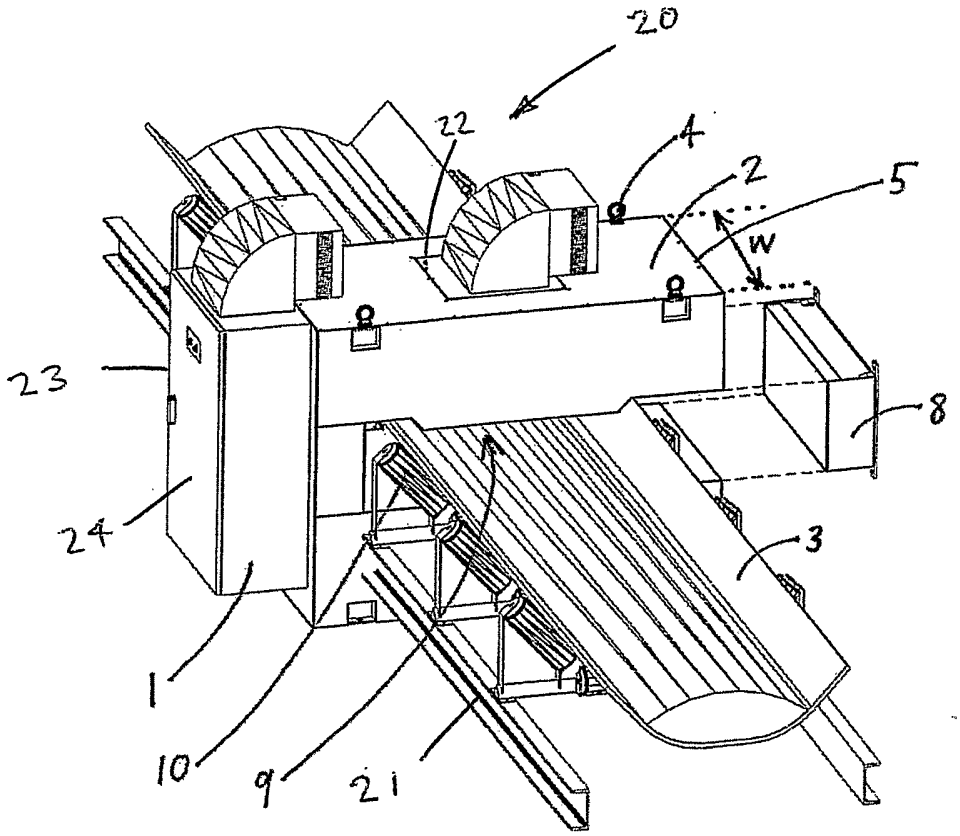


Figure 1

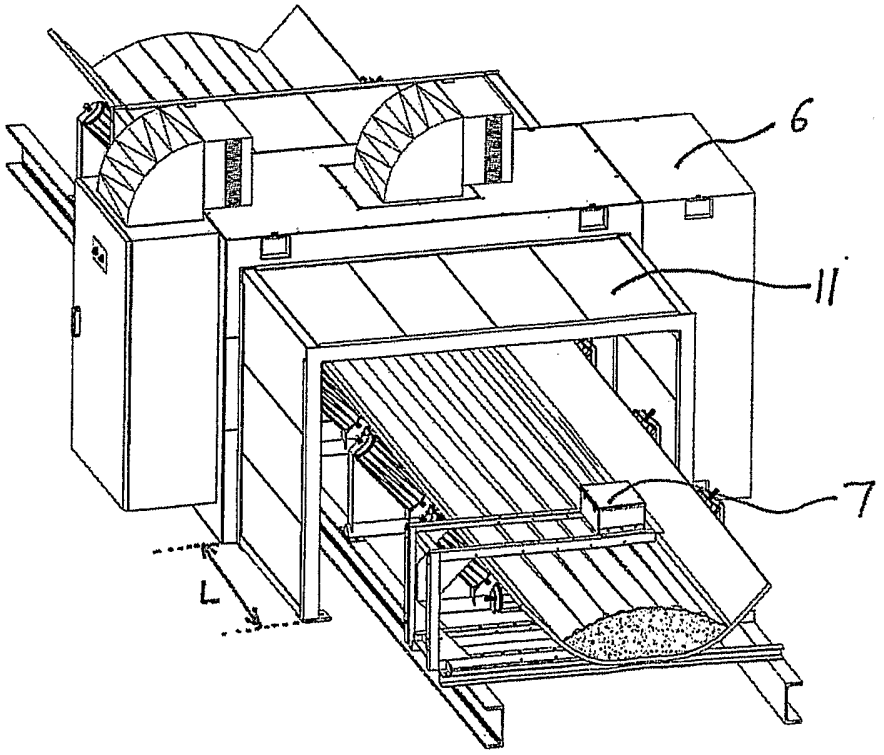
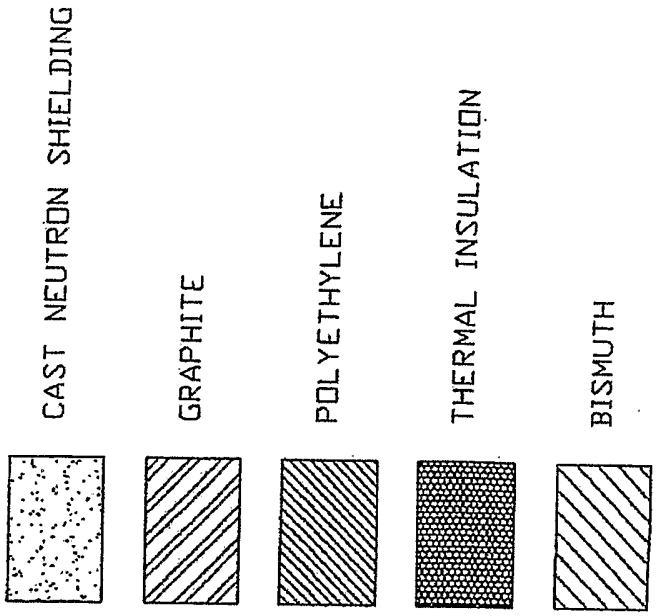


Figure 2


CAST NEUTRON SHIELDING
GRAPHITE
POLYETHYLENE
THERMAL INSULATION
BISMUTH

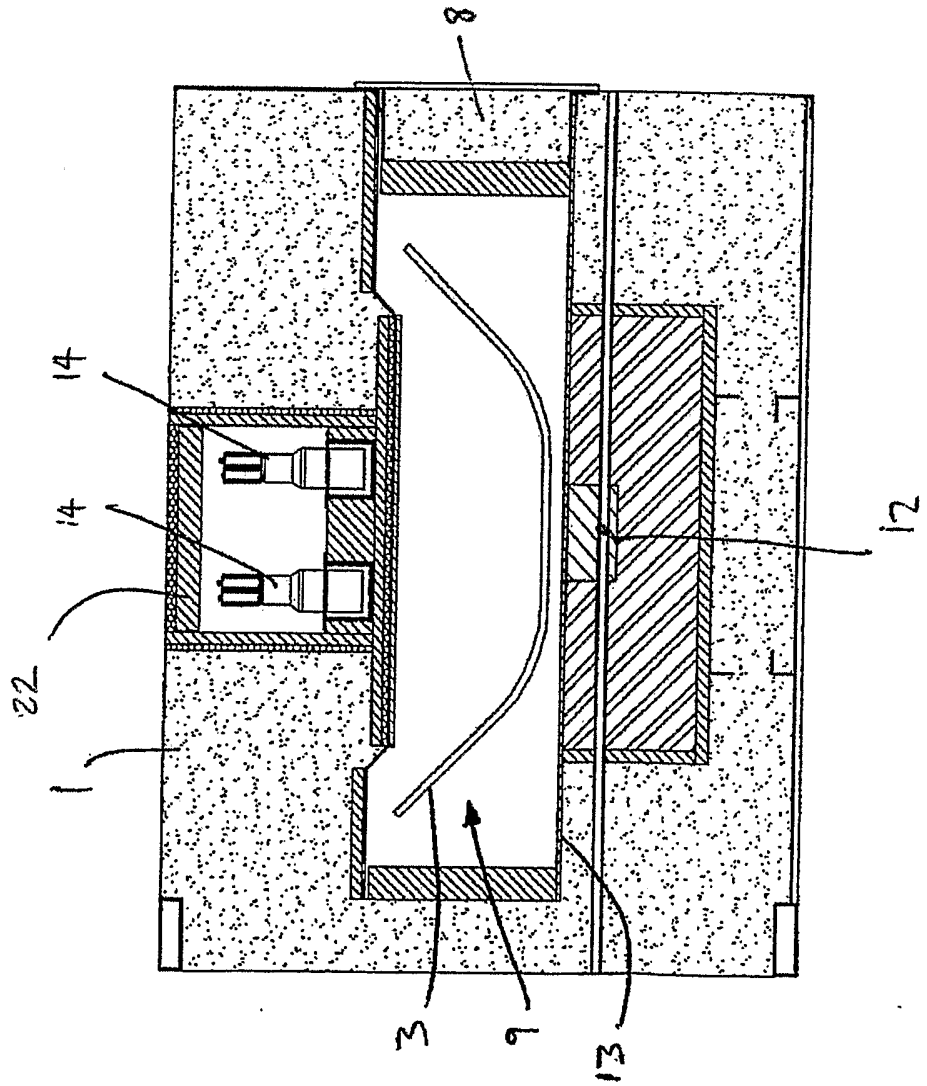

8
14
14
12
22
1
3
9
13

Figure 3

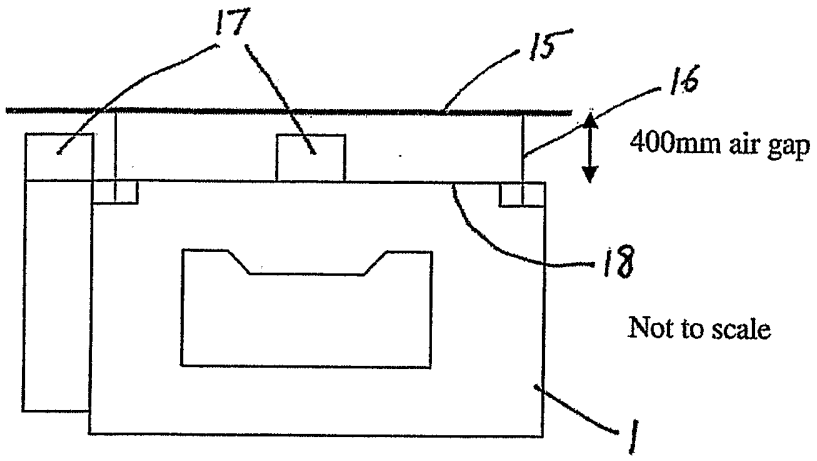


Figure 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/000263

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G01N 33/24 (2006.01) *G01N 23/222* (2006.01)

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)

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 practicable, search terms used)
DWPI & keywords (convey, belt, analyse, housing, suspend and similar terms); USPTO & keywords (conveyor belt, housing, suspend and similar terms); Espacenet & keywords (convey, belt, housing, analyse)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 96092 A1 (SCZIMAROWSKI) 21 December 1983 See Espacenet English abstract and figure 1	1-6,10,11,14, 15
X	US 2004/0245449 A1 (NAKASHIGE et al) 9 December 2004 See abstract and figure 1	1,3-5,10,14,15
X	US 6304629 B1 (CONWAY et al) 16 October 2001 See abstract, column 8 lines 10-59 and figures 2-5 claims 6, 13 and 15 are IS "X" only)	1,3-6,9,10,13, 15

[X] Further documents are listed in the continuation of Box C [X] See patent family 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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"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
04 May 2006	- 9 MAY 2006
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **STEPHEN CLARK** Telephone No : (02) 6283 2781

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/000263

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 866332 A2 (GAMMA-METRICS) 23 September 1998 See abstract and figures 1 and 2 (all claims IS "X" only)	1,2,5,9-14,16
X	DE 4414434 A1 (RUHRKOHLE AG et al) 2 November 1995 See Espacenet English abstract and figure (all claims IS "X" only)	1-4,10,11,14, 15
A	US 6362477 B1 (SOWERBY et al) 26 March 2002 See abstract and figures 7 and 8	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/000263

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	0096092	NONE					
US	2004245449	CA	2433058	EP	1376095	JP	2004028675
		US	6806450	US	6940067	US	2003234357
US	6304629	US	6058159				
EP	0866332	AU	58345/98	JP	10339708	US	5825030
DE	4414434	NONE					
US	6362477	AU	16490/99	CA	2317738	EP	1040342
		MX	PA00005804	WO	9930139	ZA	9811352

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX