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(54) Title: DEVICES AND METHODS FOR DETECTING AN EXPLOSIVE SUBSTANCE

(57) Abstract: A wipe for detecting the presence of an explosive substance is composed of an absorbent or adsorbent substrate and a chemical detection solution impregnated within the substrate. In one embodiment the chemical detection solution includes a combination of reagents operable, when contacted with a particular explosive substance to undergo a chemical reaction or a series of chemical reactions to produce a compound having a visible color. In another embodiment, the chemical detection solution includes a redox color indicating agent that is operable to exhibit a color change upon reacting with the explosive substance.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 17/57336

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
--Please see attached 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 additional fees, this Authority did not invite payment of additional fees.
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.:
1-8

- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 17/57336

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - G01N 31/22; G01N 33/22 (2018.01)
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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)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2004/0114130 A1 (NGUYEN et al.) 17 June 2004 (17.06.2004); para [0005], [0017]-[0019], [0025], [0053], [0075], [0080], [0083]	1-8
Y	US 2012/0003746 A1 (AMISAR) 05 January 2012 (05.01.2012); para [0002], [0016], [0022], [0029], [0031]-[0035], [0065], [0069], [0078], [0094], [0148]	1-8
Y	STOYANOVA A. "Spectrophotometric determination of iron (III) based on its catalytic effect on the oxidation of diphenylamine with hydrogen peroxide in the presence of cetylpyridinium chloride", Journal of the University of Chemical Technology and Metallurgy, 2006, Vol 41, issue 2, pp. 205-210; see entire document; especially pg 205-206.	7-8
A	US 2008/0182334 A1 (AMISAR) 31 July 2008 (31.07.2008); see entire document	1-8
A	STOYANOVA A. "Determination of Trace Iron (III) by Catalytic Kinetic Spectrophotometry with N,N-Diphenylamine", Trakia Journal of Sciences, 2006, Vol.3, issue 3, pp. 10-15; retrieved from the Internet: < http://tru.uni-sz.bg/tsj/vol3no3/stoyanova%20a.pdf >; see entire document	1-8

Further documents are listed in the continuation of Box C.

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

"E" earlier application or patent 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

Date of the actual completion of the international search

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Attachment to Box.No.III:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I: Claims 1-8 directed to a method of detecting hydrogen peroxide on a surface, comprising: providing a detection wipe fabricated from a fibrous substrate impregnated with a chemical detection solution that includes a redox color indicating agent operable to change color when contacted with hydrogen peroxide; contacting the detection wipe with the surface; observing whether the detection wipe exhibits a change in color; and determining whether hydrogen peroxide is present on the surface based on whether the detection wipe exhibits a color change.

Group II: Claims 9-10 and 49-60 directed to a method of detecting a nitrate ester compound, a nitroamine compound or other nitro compound on a surface and determining whether an explosive substance is present on a surface, comprising: providing a detection wipe fabricated from a fibrous substrate impregnated with a chemical detection solution; contacting the detection wipe with the surface; observing whether the detection wipe exhibits a change in color; and determining whether a nitrate ester compound or a nitroamine compound is present on the surface based on whether the detection wipe exhibits a color change.

Group III: Claims 11-34, directed to a wipe for detecting the presence of an explosive substance, comprising: a fibrous substrate; and a chemical detection solution impregnated into the substrate, the chemical detection solution including a carrier fluid and a combination of reagents operable to undergo a chemical reaction or a series of chemical reactions to produce a compound having a visible color when the solution contacts the explosive substance.

Group IV: Claims 35-48, directed to a method of fabricating an explosive substance detection wipe, the method comprising: providing a chemical detection solution that includes a carrier fluid and a combination of reagents operable to undergo a chemical reaction or a series of chemical reactions to produce a compound having a visible color when the solution contacts the explosive substance; providing a fibrous substrate; and impregnating the fibrous substrate with the chemical detection solution to provide an impregnated substrate.

The group of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features:

Group I includes the technical feature of a method for detecting hydrogen peroxide on a surface, not required by Groups II-IV.

Group II includes the technical feature of a method of detecting the presence of an explosive substance on a surface, not required by Groups I and III-IV.

Group IV includes the technical feature of a method of fabricating an explosive substance detection wipe, not required by Groups I-III.

Common technical features:

Groups I-IV share the technical feature of an explosive substance detection wipe, fabricated from a fibrous substrate impregnated with a chemical detection solution.

Groups III and IV further share the technical feature of a chemical detection solution that includes a carrier fluid and a combination of reagents operable to undergo a chemical reaction or a series of chemical reactions to produce a compound having a visible color when the solution contacts the explosive substance.

These shared technical features, however, do not provide a contribution over the prior art as being obvious over US 2004/0114130 A1 to Nguyen et al. (hereinafter Nguyen).

Nguyen discloses a wipe for detecting the presence of an explosive substance (para [0019]: "method and system for detecting small quantities of explosives and other contraband substances located on the surfaces of objects"), comprising: a fibrous substrate (para [0080]: "the collection means employed in some aspects of the present invention comprises a wipe used to collect a sample mechanically ... the term wipe includes disposable swabs or wipes of dry paper or cloth"); and a chemical detection solution, the chemical detection solution (para [0025]: "the reaction cell containing an alkaline, aqueous luminol-containing solution") including a carrier fluid (para [0075]: "an aqueous, alkaline luminol solution") and a combination of reagents (para [0053]) operable to undergo a chemical reaction or a series of chemical reactions to produce a compound (para [0017]: "the resulting reaction produces an optical signature characteristic of the explosive residue") having a visible color when the solution contacts the explosive substance (para [0083]: "the presence of different contraband substances may be represented by different colors, intensity, or shading patterns").

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Whereas Nguyen does not specifically disclose that a chemical detection solution impregnated into the substrate, in view of the above disclosure, it would have been obvious for the person of ordinary skill in the art to adjust the detection protocol in the course of routine experimentation and impregnate said detection wipe with the detection solution before its contact with the tested surface instead of just wetting it with solvent (Nguyen, para [0080]) without detecting reagents and engaging the used wipe with test reagent later, in order to enhance the efficacy of detection.

Groups I and II further share the technical feature of a method comprising: contacting the detection wipe with a surface; observing whether the detection wipe exhibits a change in color; and determining whether a substance is present on the surface based on whether the detection wipe exhibits a color change.

These shared technical features, however, do not provide a contribution over the prior art as being obvious over Nguyen.

Nguyen discloses a method of detecting peroxide (para [0083]: "reaction system of the present invention can be used to detect organic peroxides") on a surface (para [0019]: "method and system for detecting small quantities of explosives and other contraband substances located on the surfaces of objects"), comprising: providing a detection wipe (para [0080]: "the collection means employed in some aspects of the present invention comprises a wipe used to collect a sample mechanically") fabricated from a fibrous substrate (para [0080]: "the term wipe includes disposable swabs or wipes of dry paper or cloth or similar items that are rubbed or stroked against baggage items, luggage, or shipping containers to mechanically remove or abrade surface residue"); contacting the detection wipe with the surface (para [0080]); observing whether the detection wipe exhibits a change in color (para [0083]: "the presence of different contraband substances may be represented by different colors, intensity, or shading patterns"); and determining whether peroxide (para [0083]) is present on the surface based on whether the detection wipe exhibits a color change (para [0083]: "a quantitative output may also be given by the intensity or pattern of color displayed"). Whereas Nguyen does not specifically disclose that a chemical detection solution impregnated into the substrate, in view of the above disclosure, it would have been obvious for the person of ordinary skill in the art to adjust the detection protocol in the course of routine experimentation and impregnate said detection wipe with the detection solution before its contact with the tested surface instead of just wetting it with solvent (Nguyen, para [0080]) without detecting reagents and engaging the used wipe with test reagent later, in order to enhance the efficacy of detection.

As said detection wipe, chemical detection solution and method were known in the art at the time of the invention, these cannot be considered special technical features that would otherwise unify the inventions of Groups I-IV.

The inventions of Group I-IV, thus, lack unity under PCT Rule 13.