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International filing date:	06 March 2017 (06.03.2017)
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Document details: Country/Office: US

Filing date: 27 Feb 2017 (27.02.2017)

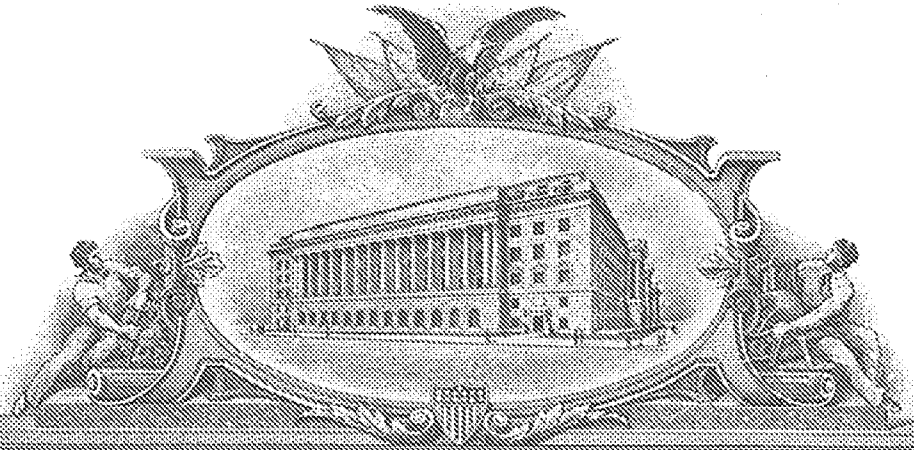
Application number: 15442870

Date of availability of document: 07 Mar 2017 (07.03.2017)

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Date of issue of this certificate: 20 Mar 2017 (20.03.2017)



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

March 20, 2017

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: *15/442,870*
FILING DATE: *February 27, 2017*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US15/442,870*



Certified by

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	Unknown
Filing Date	Unknown
First Named Inventor	Allan Châtenay
Title	PORTABLE SEISMIC SURVEY DEVICE AND METHOD
Art Unit	Unknown
Examiner Name	Unknown
Attorney Docket Number	148-16

SIGNATURE of Applicant or Patent Practitioner

Signature	/David A. Guerra/	Date (Optional)	
Name	David A. Guerra	Registration Number	46443
Title (if Applicant is a juristic entity)			

Applicant Name (if Applicant is a juristic entity)

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐

*Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

- ☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 29689
- OR
- ☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

- ☒ The address associated with the above-mentioned Customer Number
- OR
- ☐ The address associated with Customer Number:
- OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

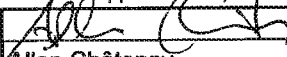
I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Explor Geophysical, Ltd

- ☐ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	22 Feb 2017
Name	Allan Châtenay		
Title	President, Explor Geophysical, Ltd.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	28465317
Application Number:	15442870
International Application Number:	
Confirmation Number:	8771
Title of Invention:	PORTABLE SEISMIC SURVEY DEVICE AND METHOD
First Named Inventor/Applicant Name:	Allan Châtenay
Customer Number:	29689
Filer:	David A. Guerra.
Filer Authorized By:	
Attorney Docket Number:	148-16
Receipt Date:	27-FEB-2017
Filing Date:	
Time Stamp:	11:50:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 730
RAM confirmation Number	022717INTEFSW11511700
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	Transmittal-App-Explor.pdf	151725	no	1
			3feaa472aea5f1987df5d1e6006637a7c33ffa0a		
Warnings:					
Information:					
2	Application Data Sheet	ADS-Explor.pdf	1822896	no	8
			dbd7e821dfc401138c69c2d6ef8b2b84b5246173		
Warnings:					
Information:					
3		Utility-Application-Explor.pdf	2441264	yes	35
			388da2babf67373a6942e47e5c38140e8619931d		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Drawings-only black and white line drawings		29	35	
	Abstract		28	28	
	Claims		24	27	
	Specification		1	23	
Warnings:					
Information:					
4	Oath or Declaration filed	Declaration-Utility-App-Explor.pdf	97868	no	2
			40a10c2f7a5c0f48044bcf159a0ddfa80f404554		
Warnings:					
Information:					

5	Power of Attorney	POA-Explor.pdf	167344	no	2
			df795090e3227c1ceae5d71b75bd410bb631ca99		
Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	IDS-Explor.pdf	612755	no	6
			497cfd822a126457cb5684f1c73f3fb5bd729e16		
Warnings:					
Information:					
A U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form. You may remove the form to add the required data in order to correct the Informational Message or if you chose not to, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
7	Foreign Reference	CA1168347A1.pdf	332978	no	20
			2cd79293ae2c1edd30763d1ee392b714403b1d4c		
Warnings:					
Information:					
8	Foreign Reference	CA2495141A1.pdf	642589	no	42
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9	Foreign Reference	CA2504119A1.pdf	933810	no	51
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10	Foreign Reference	CA2763973A1.pdf	421984	no	35
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11	Foreign Reference	WO9629613A1.pdf	425980	no	21
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Information:					
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Warnings:					
Information:					
13	Fee Worksheet (SB06)	fee-info.pdf	34828	no	2
			5e7fc6fb197f91c69a19dca7f1c73113e5e8c7e		
Warnings:					
Information:					
Total Files Size (in bytes):				8632908	
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

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UTILITY PATENT APPLICATION TRANSMITTAL <i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>	Attorney Docket No.	148-16
	First Named Inventor	Allan Châtenay
	Title	PORTABLE SEISMIC SURVEY DEVICE AND METHOD
	Express Mail Label No.	

APPLICATION ELEMENTS <i>See MPEP chapter 600 concerning utility patent application contents.</i>	Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450
1. ☒ Fee Transmittal Form (PTO/SB/17 or equivalent) 2. ☒ Applicant asserts small entity status. See 37 CFR 1.27 3. ☐ Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent. 4. ☒ Specification [Total Pages <u>28</u>] Both the claims and abstract must start on a new page. (See MPEP § 608.01(a) for information on the preferred arrangement) 5. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets <u>7</u>] 6. Inventor's Oath or Declaration [Total Pages <u>2</u>] (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e)) a. ☒ Newly executed (original or copy) b. ☐ A copy from a prior application (37 CFR 1.63(d)) 7. ☒ Application Data Sheet * See note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent) 8. CD-ROM or CD-R in duplicate, large table, or Computer Program (Appendix) ☐ Landscape Table on CD 9. Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. – c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies	ADDRESS TO: ACCOMPANYING APPLICATION PAPERS 10. ☐ Assignment Papers (cover sheet & document(s)) Name of Assignee _____ 11. ☐ 37 CFR 3.73(c) Statement ☒ Power of Attorney (when there is an assignee) 12. ☐ English Translation Document (if applicable) 13. ☒ Information Disclosure Statement (PTO/SB/08 or PTO-1449) ☒ Copies of citations attached 14. ☐ Preliminary Amendment 15. ☐ Return Receipt Postcard (MPEP § 503) (Should be specifically itemized) 16. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed) 17. ☐ Nonpublication Request Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 18. ☐ Other: _____ _____ _____ _____ _____

***Note:** (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
 (2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS					
☒ The address associated with Customer Number: <u>29689</u> OR ☐ Correspondence address below					
Name					
Address					
City	State	Zip Code			
Country	Telephone	Email			
Signature	/David A. Guerra/			Date	02/27/2017
Name (Print/Type)	David A. Guerra			Registration No. (Attorney/Agent)	46443

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Allan		Châtenay		
Residence Information (Select One) US Residency • Non US Residency Active US Military Service					
City	Calgary	Country of Residence ⁱ	CA		
Mailing Address of Inventor:					
Address 1	c/o Explor Geophysical, Ltd				
Address 2	Suite 1500, 630 6th Ave. SW				
City	Calgary	State/Province	AB		
Postal Code	T2P 0S8	Country ⁱ	CA		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					
Add					

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence Information of this application.			
Customer Number	29689		
Email Address	davidguerra@internationalpatentgroup.com	Add Email	Remove Email

Application Information:

Title of the Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		
Attorney Docket Number	148-16	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	Suggested Figure for Publication (if any)	1

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	29689		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)	Remove

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1	Remove
------------------	---	------------------------

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

[Clear](#)

Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
----------	--	----------------

☒ Person to whom the inventor is obligated to assign.
 ☐ Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		

Assignee	1
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First Name	David A.	Last Name	Guerra	Registration Number
				46443

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	148-16
		Application Number	
Title of Invention	PORTABLE SEISMIC SURVEY DEVICE AND METHOD		

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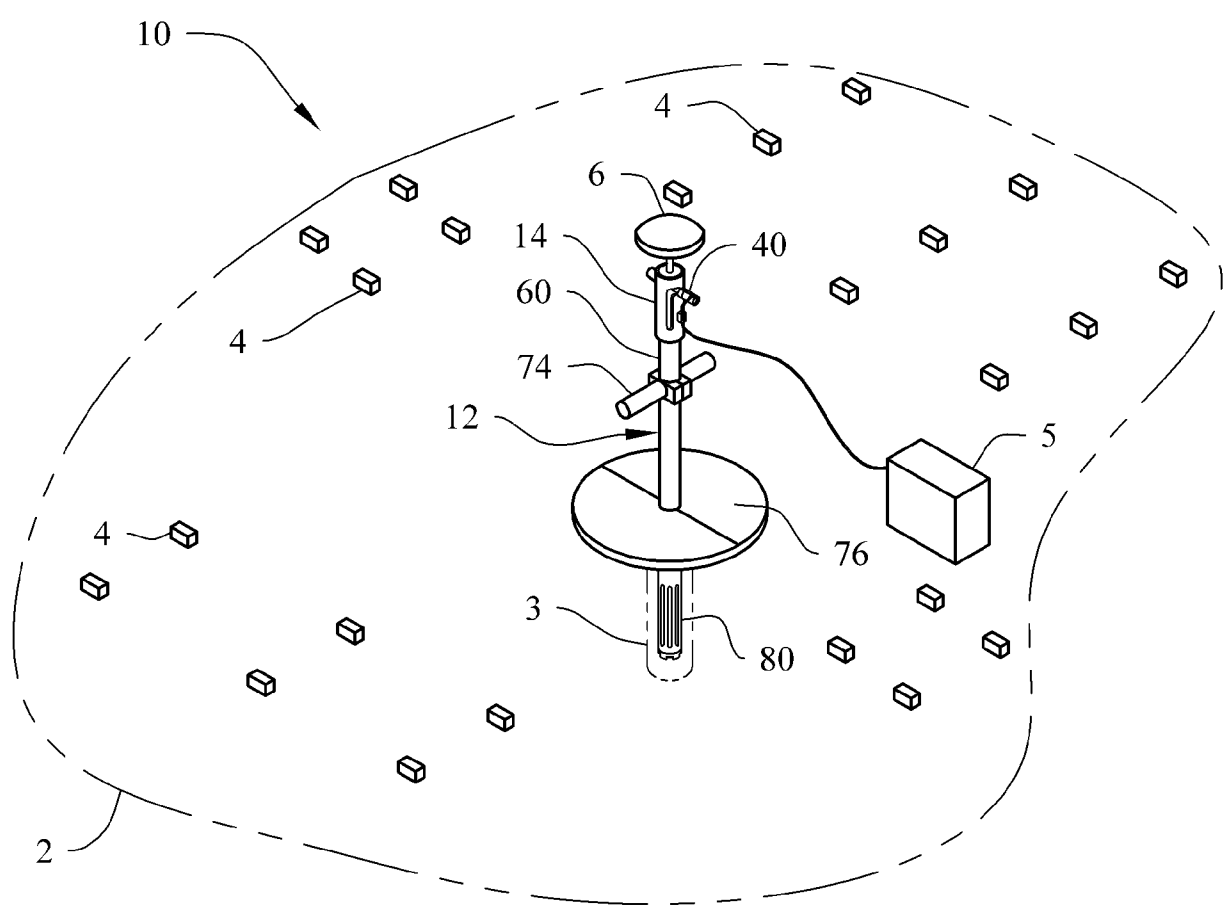


FIG. 1

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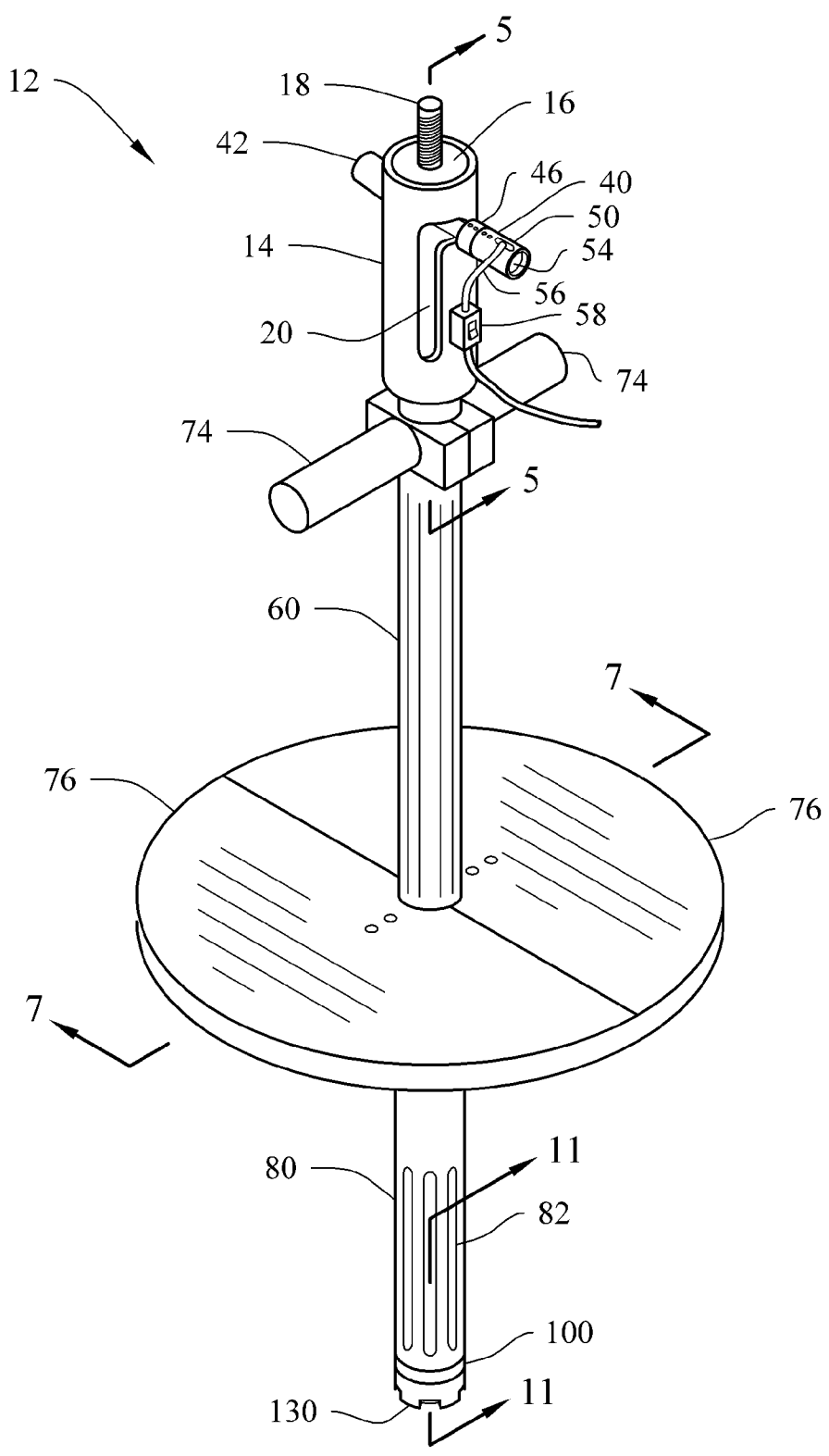
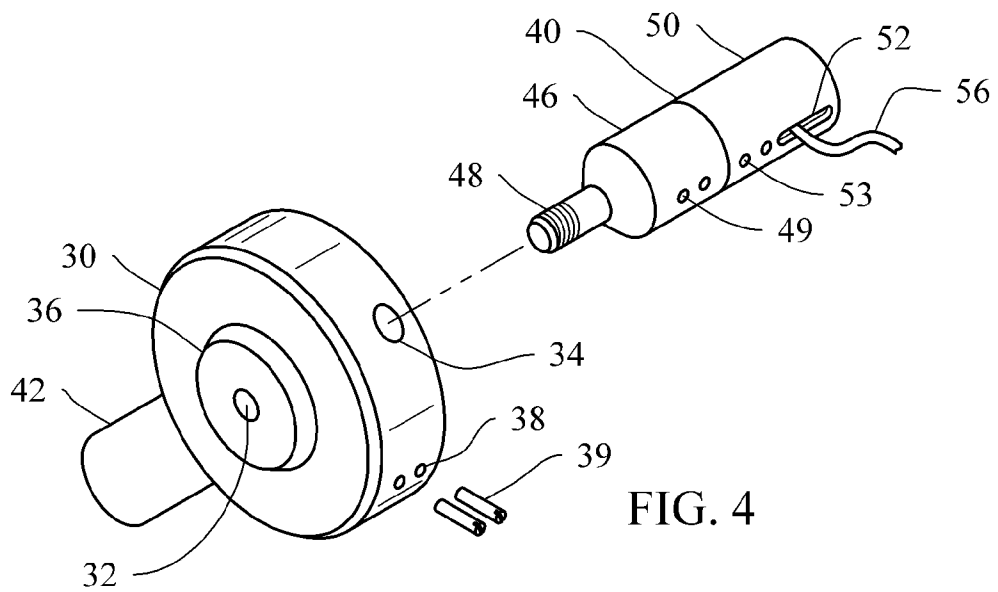
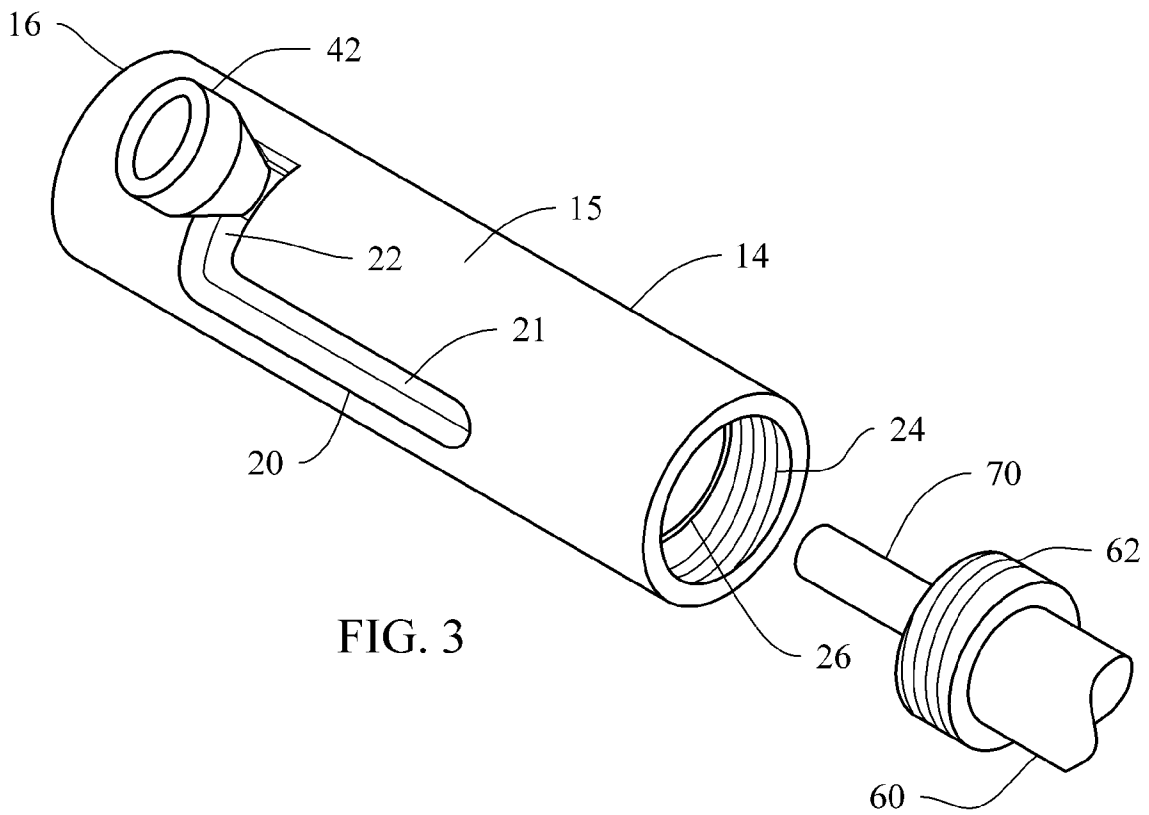


FIG. 2

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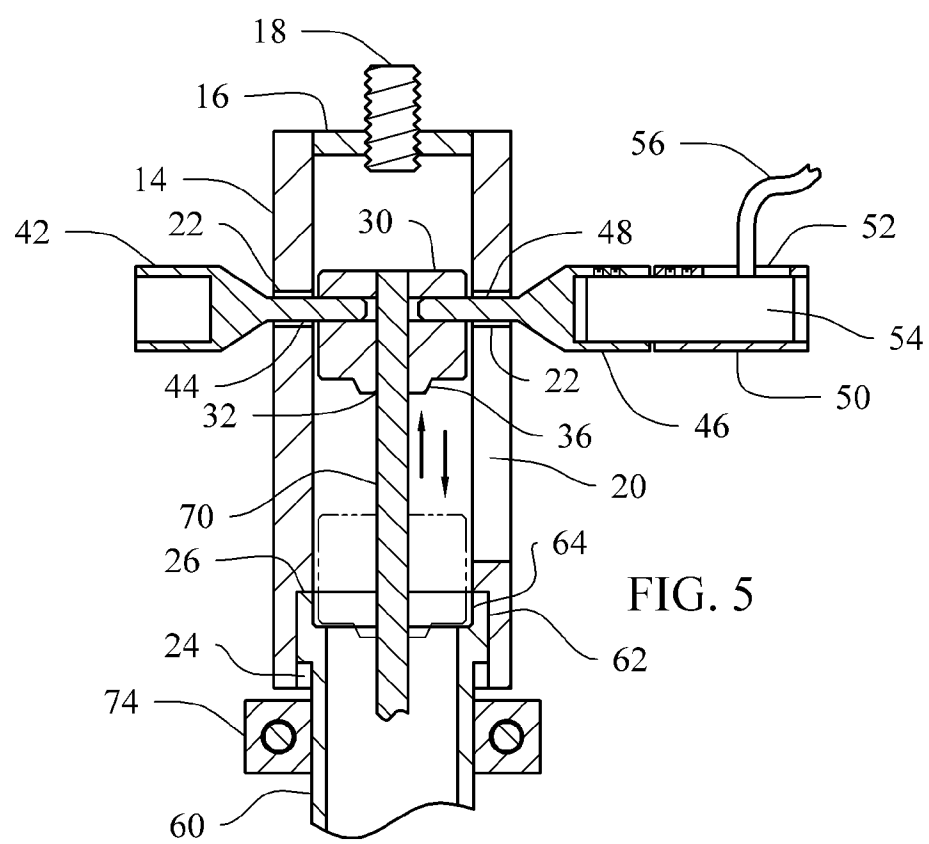


FIG. 5

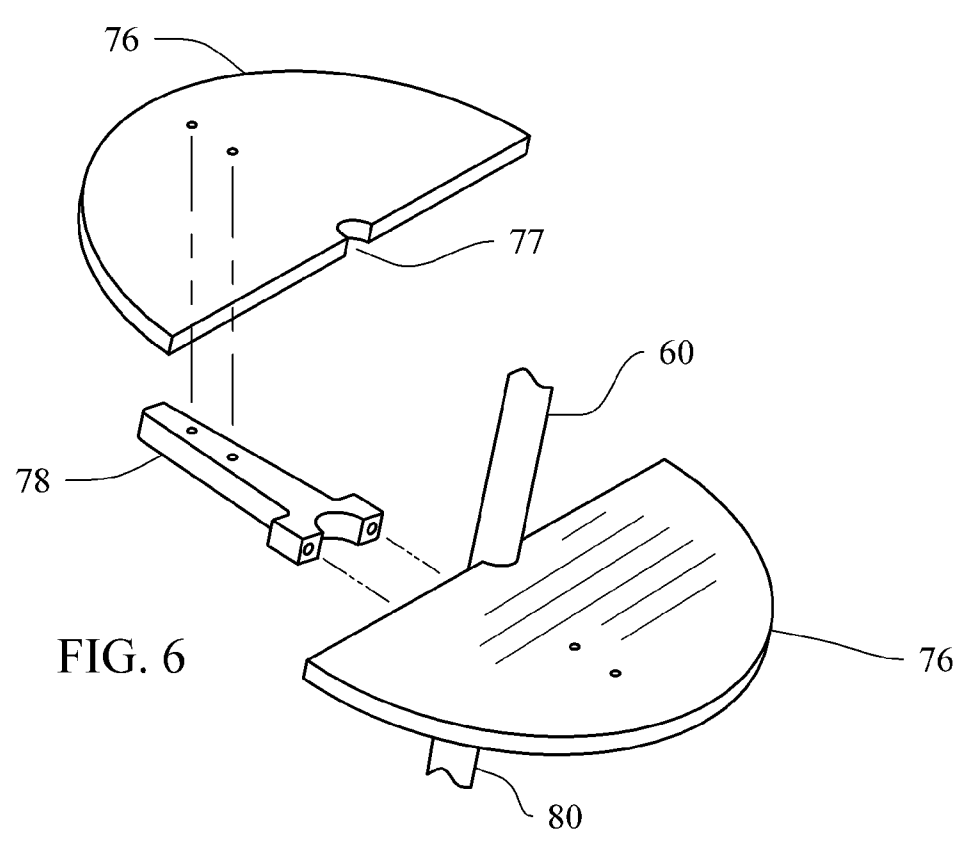


FIG. 6

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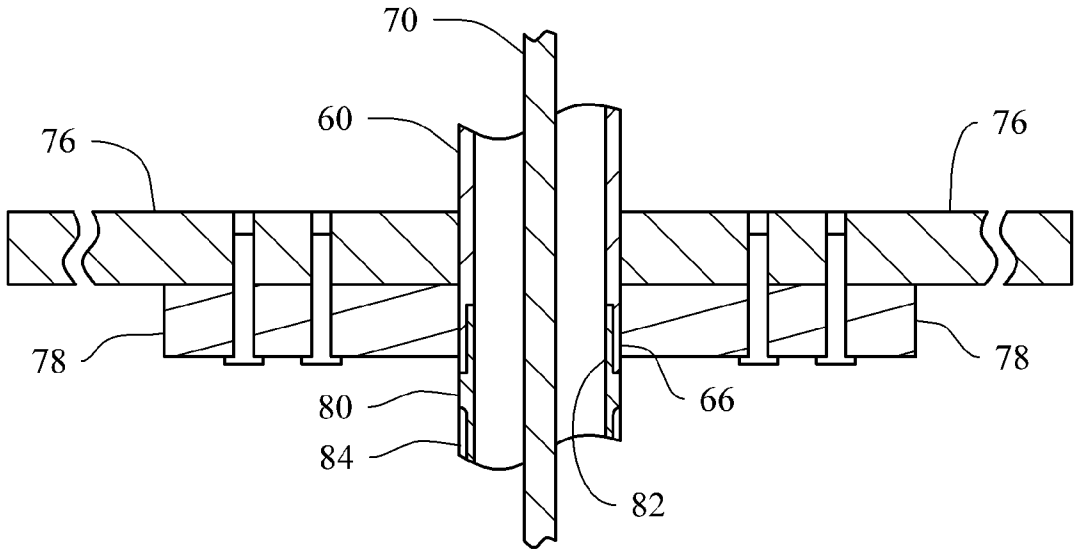


FIG. 7

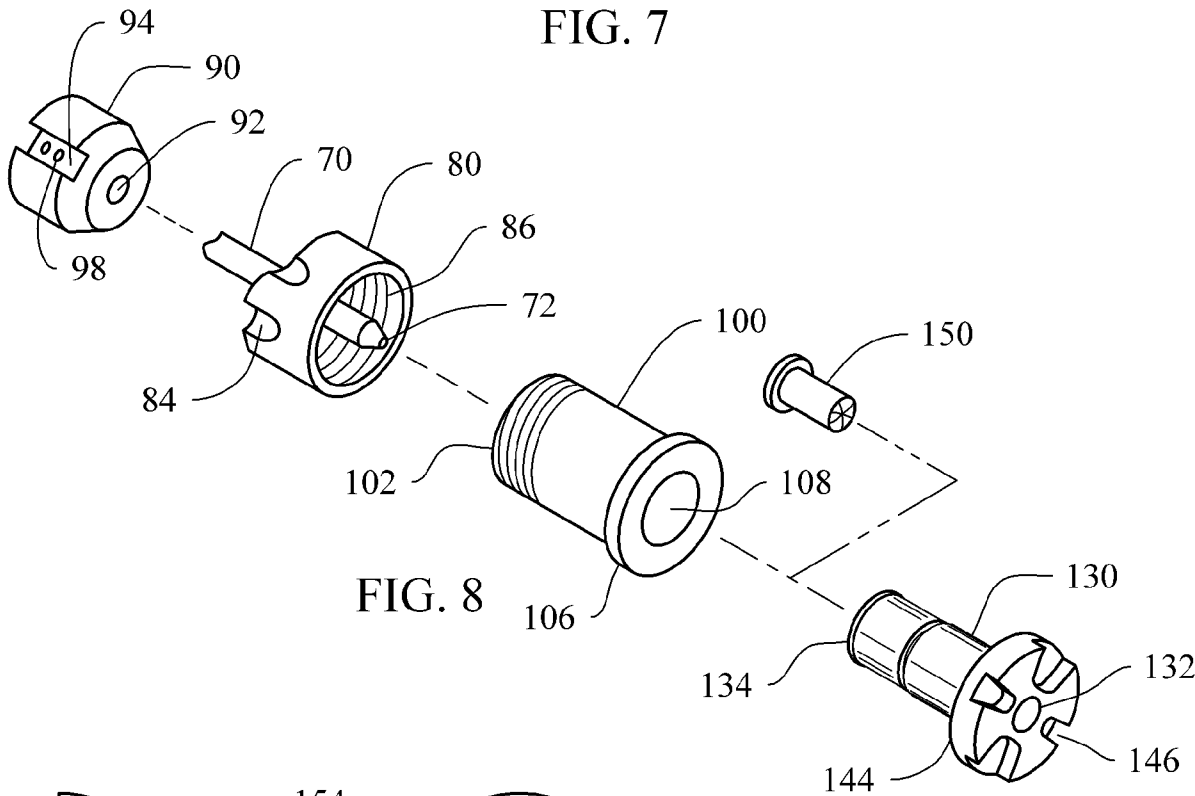


FIG. 8

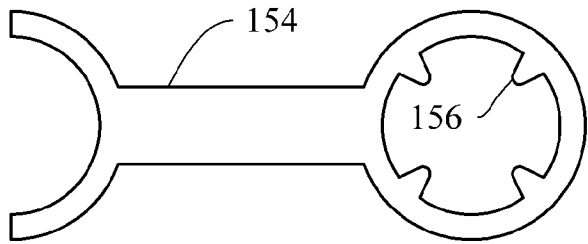


FIG. 12

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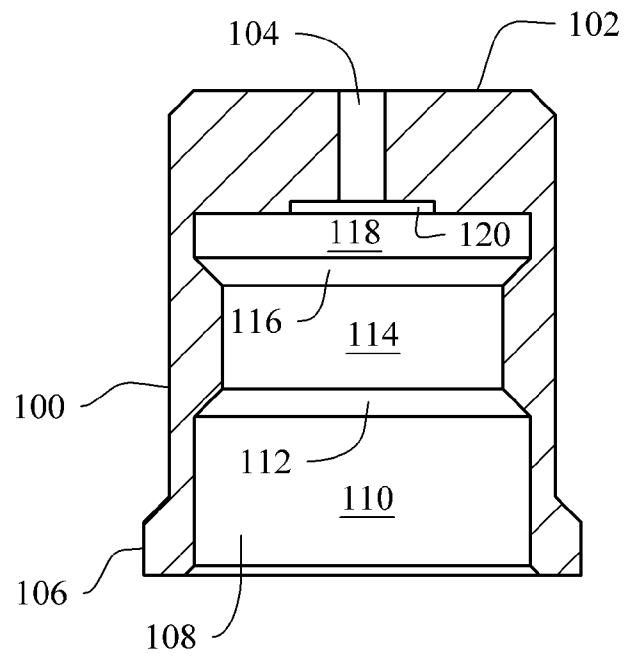


FIG. 9

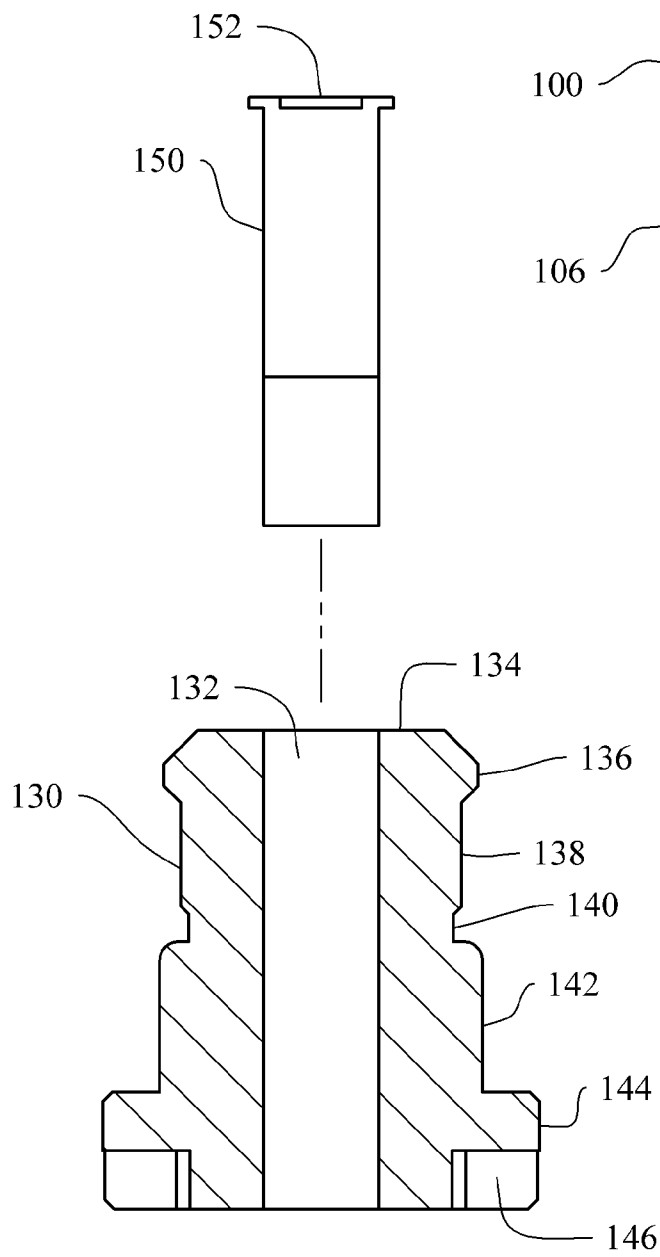


FIG. 10

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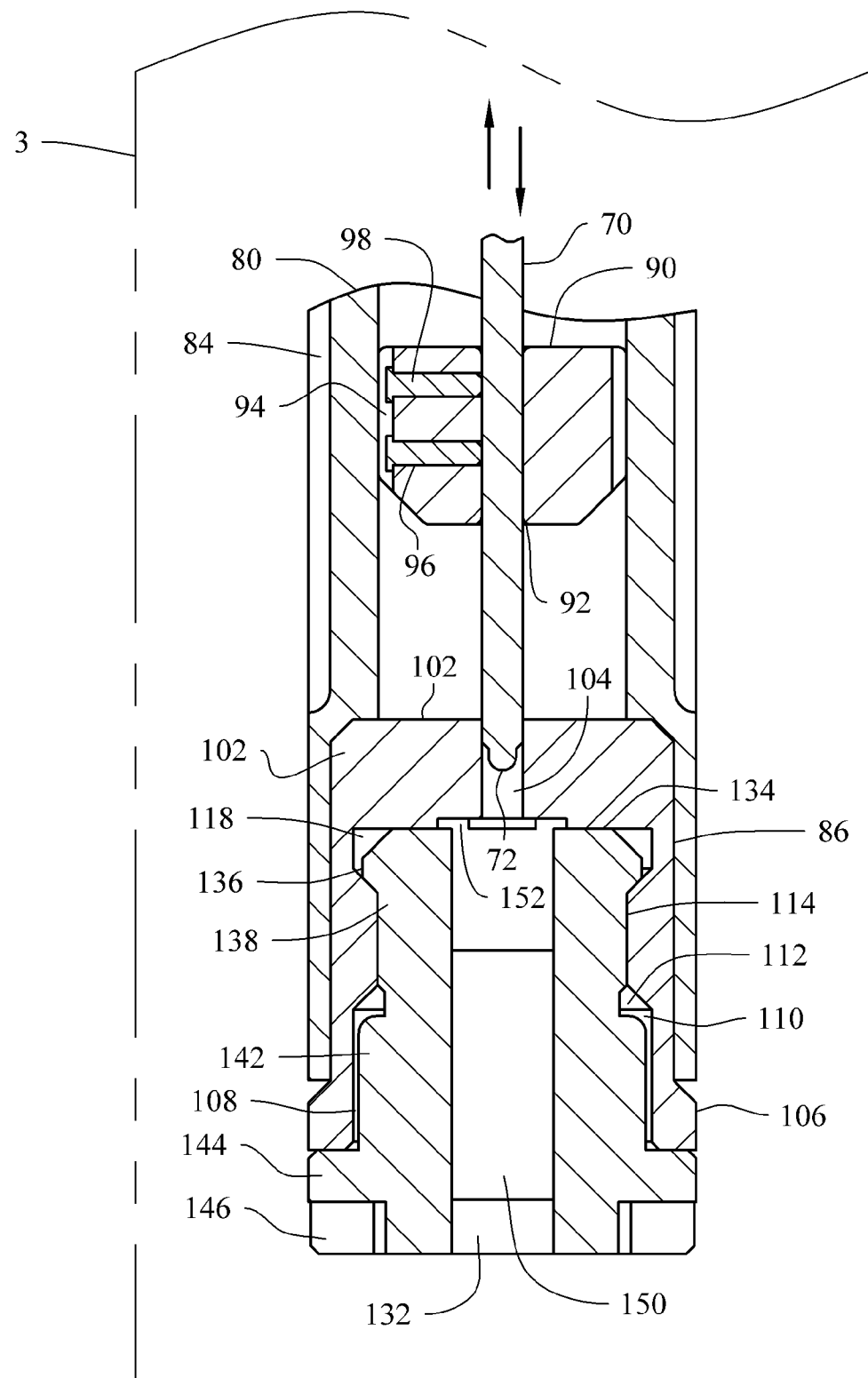


FIG. 11

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ABSTRACT OF THE DISCLOSURE

The present invention is essentially a portable seismic survey device and method using reflection seismology for mapping subterranean formations. The device includes an upper assembly, a firing pin operably associated with a firing pin actuator, a lower assembly including a cartridge holder
5 capable of retaining a blasting cartridge, and a detonation sensor capable of detecting detonation of the blasting cartridge. The detonation sensor transmits a signal to an event marking device to trigger a recordation of detonation time and geographic location of the seismic survey device. A seismic wave is generated upon detonation which is then reflected back toward seismometers. Data from the event marking device and seismometers can then be processed to provide geological formation
10 information.

CLAIMS

What is claimed as being new and desired to be protected by LETTERS PATENT of the United States is as follows:

1. A seismic survey device comprising:
5 an upper assembly;
a firing pin operably associated with a firing pin actuator;
a lower assembly including a cartridge holder having a configuration capable of retaining a
blasting cartridge so that said firing pin is capable of operationally detonating the
blasting cartridge; and
10 at least one detonation sensor capable of detecting a detonation condition of the blasting
cartridge.
2. The seismic survey device of claim 1, wherein said detonation sensor is operably associated
with said upper assembly.
3. The seismic survey device of claim 1 further comprising at least one tube attachable to said
15 upper assembly and said lower assembly.
4. The seismic survey device of claim 3, wherein said upper assembly defines an internal cavity
having a configuration capable of receiving said firing pin actuator.
5. The seismic survey device of claim 4, wherein said upper assembly further includes at least
one longitudinal slot in communication with said internal cavity, said longitudinal slot have a
20 configuration capable of slidably receiving a portion of a sensor holding assembly, wherein said
detonation sensor is associated with said sensor holding assembly.
6. The seismic survey device of claim 5, wherein said sensor holding assembly includes an
actuator handle featuring said portion slidably receivable in said longitudinal slot, said actuator

handle defining an actuator handle cavity having a configuration capable of receiving at least a portion of said detonation sensor.

7. The seismic survey device of claim 6, wherein said portion of said actuator handle is slidably receivable in said longitudinal slot is attachable to said firing pin actuator.

5 8. The seismic survey device of claim 3, wherein said lower assembly further includes a firing chamber attachable to said cartridge holder, said firing chamber defines a firing chamber bore having a configuration capable of receiving therethrough a firing tip of said firing pin.

9. The seismic survey device of claim 8, wherein said firing chamber further defines an internal firing chamber cavity in communication with said firing chamber bore, said internal firing chamber
10 cavity having a configuration capable of receiving at least a portion of said cartridge holder.

10. The seismic survey device of claim 9, wherein said firing chamber bore is orientated adjacent to a primer end of the blasting cartridge when the blasting cartridge is retained in said cartridge holder and when said cartridge holder is received in said internal firing chamber cavity.

11. The seismic survey device of claim 9 further comprising a lower tube attachable to said tube
15 and said firing chamber.

12. The seismic survey device of claim 11, wherein said lower tube includes channels defined in an external surface of said lower tube.

13. The seismic survey device of claim 3 further comprises at least one firing pin guide attachable to said firing pin, said firing pin guide having a configuration capable of being slidably
20 received in said tube.

14. The seismic survey device of claim 1 further comprises at least one foot support assembly and at least one handle.

15. The seismic survey device of claim 1 further comprises a location antenna attachable to said upper assembly.

16. The seismic survey device of claim 1, wherein said detonation sensor is in communication with an event marking device.

5 17. The seismic survey device of claim 16, wherein said detonation sensor is configured to transmit a signal to the event marking device upon the detecting of the detonation condition of the blasting cartridge, wherein said signal triggers in the event marking device a recordation of a detonation time and a geographic location of said seismic survey device.

10 18. The seismic survey device of claim 17 further comprises at least one switch in electrical communication with said detonation sensor and the event marking device.

19. A seismic survey system comprising:

at least one seismic survey device comprising:

an upper assembly;

at least one tube attachable to said upper assembly;

15 a firing pin operably associated with a firing pin actuator;

a lower assembly attachable to said tube, said lower assembly including a cartridge

holder having a configuration capable of retaining a blasting cartridge so that

said firing pin is capable of operationally detonating the blasting cartridge;

and

20 at least one detonation sensor capable of detecting a detonation condition of the blasting cartridge;

at least one event marking device in communication with said detonation sensor; and

at least one seismometer having a configuration capable of detecting a seismic condition
created by the detonation condition of the blasting cartridge.

20. A method of using a seismic survey device comprising the steps of:

drilling at least one borehole;

5 providing at least one seismic survey device comprising:

an upper assembly;

at least one tube attachable to said upper assembly;

a firing pin operably associated with a firing pin actuator;

a lower assembly attachable to said tube, said lower assembly including a cartridge

10 holder having a configuration capable of retaining a blasting cartridge so that

said firing pin is capable of operationally detonating the blasting cartridge;

and

at least one detonation sensor capable of detecting a detonation condition of the

blasting cartridge;

15 inserting said lower assembly into the borehole;

communicating said detonation sensor with at least one event marking device;

detonating the blasting cartridge inside the borehole using said firing pin;

detecting detonation of the blasting cartridge using said detonation sensor; and

transmitting a signal from said detonation sensor to the event marking device to trigger a

20 recordation of a detonation time and a geographic location of said seismic survey
device.

TITLE

PORTABLE SEISMIC SURVEY DEVICE AND METHOD

BACKGROUND OF THE INVENTION

5 FIELD OF THE INVENTION

[0001] The present invention relates to a portable seismic survey device and method for use in connection with reflection seismology for mapping subterranean formations.

DESCRIPTION OF THE PRIOR ART

10 [0002] It is known in the petroleum, gas, mineral and water exploration industries to use seismic geophysical surveys to map subterranean formations, such as but not limited to: stratigraphy of subterranean formations, lateral continuity of geologic layers, locations of buried paleochannels, positions of faults in sedimentary layers, basement topography, and others. These maps can be deduced through analysis of the nature of reflections and refractions of generated seismic waves from
15 interfaces between layers within the subterranean formation.

[0003] Typically, a seismic energy source is used to generate seismic waves that travel through the earth and are then reflected by various subterranean formations to the earth's surface. At the surface, these reflected seismic waves are detected by an array of ground motion sensors, known as seismometers or geophones, which convert the detected waves into electrical signals. The
20 electrical signals are stored and analyzed by a computer modeling system to determine and display the nature of the subterranean formations at a location surrounding the point the seismic waves were generated.

[0004] Known seismic energy source devices can be in communication with a global position system (GPS) or other telemetry systems to provide logging of the precise location and time of seismic wave generation. Typically, the seismic energy source device is controlled and activated automatically by the telemetry system, which can present a potential disadvantage since multiple error logs can occur by misfires of the seismic energy source device. Further disadvantage of these known systems is that the user does not having full control of the seismic energy source device since detonation is controlled by the telemetry system.

[0005] It has become desirable to extend drilling to locations that are environmentally sensitive or with limited vehicular access, which appear to overlay oil and gas formations. Thus portable seismic energy source devices have been developed and used.

[0006] It has been known to use vehicles that transport or tow a seismic source device from location to location. At a given location the seismic source is placed in direct contact with the ground. The seismic source device is activated to generate a seismic wave. However, the traditional seismic source devices are very heavy and thus need to be deployed by a vehicle, and they typically require large charges for creating a seismic wave that can travel deep through the Earth. As the environmentally sensitive areas prohibit or strictly limit the access of heavy duty equipment or vehicles, the existing methods for generating seismic waves are not suitable for these areas. These large systems are also undesirable for application in shallow wells that span large lateral distances.

[0007] Seismic data is critical to oil and gas companies during the exploration and development of oil and gas reserves. Seismic data is used from the earliest point in exploration right through the life of an oil or gas field, and in some cases even after the well has been abandoned. Seismic data is used for many different purposes; broad based analysis of prospective hydrocarbon basins, localized exploration of a prospective area, high resolution imaging prior to drilling a well,

throughout the drilling process (including pore pressure prediction and micro-fracture analysis), and to enhance production as a field is developed and optimized throughout its productive life.

[0008] While the above-described devices fulfill their respective, particular objectives and requirements, the aforementioned patents do not describe a portable seismic survey device and method that allows reflection seismology for mapping subterranean formations with detonation triggered event marking.

[0009] Therefore, a need exists for a new and novel portable seismic survey device and method that can be used for reflection seismology for mapping subterranean formations. In this regard, the present invention substantially fulfills this need. In this respect, the portable seismic survey device and method according to the present invention substantially departs from the conventional concepts and designs of the prior art, and in doing so provides an apparatus primarily developed for the purpose of reflection seismology for mapping subterranean formations.

SUMMARY OF THE INVENTION

[0010] In view of the foregoing disadvantages inherent in the known types of seismic source systems now present, the present invention provides a novel portable seismic survey device and method, and overcomes the above-mentioned disadvantages and drawbacks of known types of seismic source systems. As such, the general purpose of the present invention, which will be described subsequently in greater detail, is to provide a new and novel portable seismic survey device and method which has all the advantages of the prior art mentioned heretofore and many novel features that result in a portable seismic survey device and method which is not anticipated, rendered obvious, suggested, or even implied by the prior art, either alone or in any combination thereof.

[0011] To attain this, the present invention essentially includes a seismic survey device including an upper assembly, a firing pin operably associated with a firing pin actuator, a lower assembly including a cartridge holder, and a detonation sensor. The cartridge holder can have a configuration capable of retaining a blasting cartridge so that the firing pin is capable of operationally detonating the blasting cartridge. The detonation sensor is capable of detecting a detonation condition of the blasting cartridge.

[0012] At least one tube can be attached to the upper assembly, with the lower assembly attachable to the tube. The firing pin can be slidably receivable in the tube.

[0013] The upper assembly can further define an internal cavity and at least one longitudinal slot in communication with the internal cavity. The longitudinal slot can have a configuration capable of slidably receiving a portion of a sensor holding assembly. A portion of the detonation sensor can be associated with the sensor holding assembly. The firing pin actuator can be slidably received in the internal cavity.

[0014] The sensor holding assembly can include an actuator handle featuring the portion slidably receivable in the longitudinal slot. The actuator handle can define an actuator handle cavity with a configuration capable of receiving at least a portion of the detonation sensor.

[0015] The lower assembly can further include a firing chamber attachable to the cartridge holder. The firing chamber can define a firing chamber bore having a configuration capable of receiving therethrough a firing tip of the firing pin. The firing tip is capable of striking a primer end of the blasting cartridge to initiate detonation.

[0016] The firing chamber can further define an internal firing chamber cavity in communication with the firing chamber bore. The internal firing chamber cavity can have a configuration capable of receiving at least a portion of the cartridge holder.

[0017] There has thus been outlined, rather broadly, features of the invention in order that the detailed description thereof that follows may be better understood and in order that the present contribution to the art may be better appreciated.

[0018] The invention may also include a lower tube attachable to the tube and the firing
5 chamber. The lower tube can include channels defined in an external surface thereof.

[0019] Still further, the invention may include at least one foot support assembly and/or at least one handle.

[0020] Additionally, the cartridge holder may include a flanged end that can define radially arranged notches having a configuration capable of being engageable with a tool for rotation of the
10 cartridge holder.

[0021] The invention may further include at least one firing pin guide attachable to the firing pin. The firing pin guide can have a configuration capable of being slidably received in the tube or the lower tube.

[0022] There are, of course, additional features of the invention that will be described
15 hereinafter and which will form the subject matter of the claims attached.

[0023] Numerous objects, features and advantages of the present invention will be readily apparent to those of ordinary skill in the art upon a reading of the following detailed description of the present invention, but nonetheless illustrative, embodiments of the present invention when taken in conjunction with the accompanying drawings.

20 [0024] As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is, therefore, that the

claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

[0025] It is therefore an object of the present invention to provide a new and novel portable seismic survey device and method that has all the advantages of the prior art seismic source systems and none of the disadvantages.

[0026] It is another object of the present invention to provide a new and novel portable seismic survey device and method that may be easily and efficiently manufactured and marketed.

[0027] An even further object of the present invention is to provide a new and novel portable seismic survey device and method that has a low cost of manufacture with regard to both materials and labor, and which accordingly is then susceptible of low prices of sale to the consuming public, thereby making such portable seismic survey device and method economically available to the buying public.

[0028] Still another object of the present invention is to provide a portable seismic survey device and method for reflection seismology for mapping subterranean formations. This allows for the portability of the seismic survey device that controls and triggers the event marking device at the time of detonation.

[0029] Lastly, it is an object of the present invention to provide a new and novel method of using a seismic survey device including the steps of drilling at least one borehole into the ground to be surveyed, and providing at least one portable seismic survey device. Then inserting a lower assembly of the portable seismic survey device into the borehole. Then further, communicating a detonation sensor of the portable seismic survey device with at least one event marking device. After which, detonating a blasting cartridge inside the borehole using the portable seismic survey device, and detecting detonation of the blasting cartridge using a detonation sensor associated with the

portable seismic survey device. Then transmitting a signal from the detonation sensor to the event marking device to trigger a recordation of a detonation time and geographic location of the seismic survey device.

[0030] These together with other objects of the invention, along with the various features of novelty that characterize the invention, are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated embodiments of the invention.

10

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

15 [0032] Fig. 1 is a perspective view of an embodiment of the portable seismic survey device and method constructed in accordance with the principles of the present invention, with the phantom lines depicting environmental structure and forming no part of the claimed invention.

[0033] Fig. 2 is a perspective view of the portable seismic survey device of the present invention.

20 [0034] Fig. 3 is an exploded perspective view of the upper assembly of the present invention.

[0035] Fig. 4 is an exploded perspective view of the firing weight and piezo holder assembly of the present invention.

[0036] Fig. 5 is a cross-sectional view of the upper assembly taken along line 5-5 in Fig. 2.

[0037] Fig. 6 is an exploded perspective view of the foot support assembly of the present invention.

[0038] Fig. 7 is a cross-sectional view of the foot support assembly taken along line 7-7 in Fig. 2.

5 [0039] Fig. 8 is an exploded perspective view of the lower assembly, the firing pin guide, the firing pin, the firing chamber and the shot holder of the present invention.

[0040] Fig. 9 is a cross-sectional view of the firing chamber of the present invention.

[0041] Fig. 10 is a cross-sectional view of the shot holder with an exploded cartridge of the present invention.

10 [0042] Fig. 11 is a cross-sectional view of the lower assembly taken along line 11-11 in Fig. 2.

[0043] Fig. 12 is a front plane view of the shot holder tool of the present invention.

[0044] The same reference numerals refer to the same parts throughout the various figures.

15 DETAILED DESCRIPTION OF THE INVENTION

[0045] Referring now to the drawings, and particularly to Figs. 1-12, an embodiment of the portable seismic survey device and method of the present invention is shown and generally designated by the reference numeral **10**.

[0046] In Fig. 1, a new and novel portable seismic survey device and method **10** of the
20 present invention for reflection seismology intended for mapping subterranean formations is illustrated and will be described. To collect seismic survey data in a field **2** to be surveyed, a plurality (tens, hundreds or thousands) of ground seismometers **4** can be positioned at predetermined locations in or on the field **2**. The most commonly used seismometer **4** can be a small, portable

single component geophone that is planted into the earth and which converts vertical ground motion into a small analog electrical signal. Of late, such sensors have been manufactured with GPS receivers locally coupled to the sensor as well as a battery and sufficient memory to record the signals detected by each sensor continuously for a period of several weeks. It can be appreciated that more sensitive digital sensing units that sense ground motion in three dimensions can be used with the present invention thereby providing better seismic data and new opportunities for sub-surface imaging.

[0047] Ground motion can then be created with small explosive charges positioned inside a borehole **3** drilled into the surface of the earth at a variable angle and/or a depth that can be variably determined based on local conditions using a portable seismic source device **12**. The angle of the borehole **3** can be configured to facilitate generation of shear waves. The timing and position of these seismic sources should be very accurate, timed to the fraction of a millisecond, with positions accuracies ranging from with 5 metres to less than a metre depending on the geophysical acquisition objectives.

[0048] As the seismic waves of ground motion created by the seismic source device **12** travels through the earth, they reflect and refract off of subsurface geological layers. At the boundary between each geological layer, some energy will be reflected and the rest of the energy will continue through the boundary. As these reflected and refracted signals are detected by the seismometers **4** at the surface, they are either recorded locally into the digital memory coupled to the sensor or they are transmitted either via cable or wireless transmission to a central recording system (not shown) that records all of the reflected ground motion detected by all of the seismometers **4** at the surface.

[0049] By processing these data, a highly detailed image of subsurface layers of the field **2** can be created. This enables geophysicists, geologists and engineers to interpret and understand the subsurface layers with advantages over other imaging technology.

[0050] More particularly, the seismic source device **12** can be in communication with a GPS event marking device **5** that is in communication with a GPS or location antenna **6** that can be mounted to a threaded stud **18** at the top of seismic source device **12**. The GPS event marking device **5** can be, but not limited to, a Leica GS25 GNSS instrument or similar device, that can be portable and/or worn on a backpack. The GPS event marking device **5** can be in communication with the central recording system in real time or event data can be uploaded to the central recording system at a later time.

[0051] As best illustrated in Fig. 2, the seismic source device **12** can include an upper assembly **14**, a sensor holding assembly **40**, a main tube **60**, a foot support assembly **76** and a lower tube **80**. The lower tube **80** can have a ground insertion portion with an end including a firing chamber **100** and a cartridge holder **130**. It can be appreciated that the firing chamber **100** and cartridge holder **130** may be attached directly to the main tube **60**, without the use of the lower tube **80**. It can also be appreciated that the length of main tube **60** and lower tube **80** as well as the position and diameter of foot support assembly **76** can be varied to account for different desired hole depths and local conditions.

[0052] Referring to Fig. 3, the upper assembly **14** can include a tubular housing **15** defining a hollow interior or internal cavity, and featuring a first end **16** closed off with an attachable end cap **17** and the threaded stud **18**, and a second end **24**. The threaded stud **18** can be threadably engageable with the end cap **17**, with an end of the threaded stud **18** being receivable in the hollow interior. The threaded stud **18** can include a hook end for hanging the seismic source device **12** or

additional peripheral devices can be threadably attached to the threaded stud **18**. The threaded stud **18** can further include a quick release mechanism for fitting the peripheral device and/or the GPS antenna **6** thereto. A jam nut and lock washer can be threadably engaged with the threaded stud **18** to more securely attach the threaded stud **18** in position and prevent rotation thereof.

5 **[0053]** A pair of guide slots **20** can be defined through the tubular housing **15** opposite each other, with the guide slots **20** being in communication with the hollow interior. The guide slots **20** can include a longitudinal slot **21** substantially parallel with a longitudinal axis of the upper assembly **14**, and a lateral slot **22**.

[0054] The second end **24** can be annularly notched or recessed to define a diameter greater
10 than the hollow interior thereby creating an upper assembly ledge **26**. The second end **24** can include internal threading or other engagement means.

[0055] The main tube **60** defines a hollow interior capable of freely receiving a firing pin **70** therethrough, and a flanged first end **62**. The flanged first end **62** has a configuration capable of being received in the second end **24** and capable of abutting against the upper assembly ledge **26**
15 when fully assembled. The flanged first end **62** can further include external threading or engagement means capable of engaging with the internal threading of the second end **24**, thereby connecting the upper assembly **14** and the main tube **60** together.

[0056] Referring to Fig. 4, a firing pin actuator **30** can be a firing weight that can have a configuration capable of being slidably receivable in the hollow interior of the upper assembly **14**.
20 The firing weight **30** can include a bore **32** defined parallel with a longitudinal axis of the firing weight **30** which is capable of receiving a first end portion of the firing pin **70**. The firing weight **30** can further include a pair of handle bores **34** opposite each other and lateral to the bore **32**, and an extended end portion **36**. The extended end portion **36** can feature tapered sides.

[0057] It can be appreciated that the firing pin actuator **30** can be in the alternative, but not limited to, a biasing element, a linear drive means or a rotary drive means, which is capable of advancing and/or retracting the firing pin **70**.

[0058] The portion of the firing pin **70** received in the bore **32** is secured in place by at least one set screw **39** threadably engaged with at least one set screw bore **38** defined laterally and in communication with the bore **32**. The set screw **39** is capable of contacting an external surface of the firing pin **70** thereby securing the firing pin **70** and the firing weight **30** together. The firing pin **70** can be pitted for nesting of the set screw **39**, or a hole can be defined through the firing pin **70** to receive the set screw **39**, or even still the firing pin **70** can be textured to create a gripping force with the set screw **39** and/or the surface of the actuator **30** that defines the bore **32**.

[0059] A first actuator handle **42** includes a threaded end **44** capable of engaging with one of the handle bores **34**, wherein the threaded end **44** can have a configuration capable of being slidably received through one of the guide slots **20**.

[0060] The sensor holding assembly **40** can include a second actuator handle **46** featuring a threaded end **48** capable of engaging with the other of the handle bores **34**, wherein the threaded end **48** can have a configuration capable of being slidably received through the other of the guide slots **20**. The second actuator handle **46** can include a recess with a configuration capable of receiving at least a first end portion of a detonation sensor **54**. At least one set screw can be threadably engageable with a set screw bore **49** defined laterally through the second actuator handle **46** so as to secure the first end portion of the detonation sensor **54** to the second actuator handle **46**. It can be appreciated that the first actuator handle **42** and second first actuator handle **46** are identical, thereby simplifying manufacturing and assembly.

[0061] Alternatively, a sensor holder **50** can be used for additional securement of the detonation sensor **54**. The sensor holder **50** can include a tubular housing featuring a hollow interior, and a wiring slot **52** parallel with a longitudinal axis of the sensor holder **50**. The hollow interior of the sensor holder **50** can have a configuration capable of receiving a second end portion of the
5 detonation sensor **54**, with wiring **56** of the detonation sensor **54** being passed and slidably received through wiring slot **52**. At least one set screw can be threadably engageable with a set screw bore **53** defined laterally through the sensor holder **50** so as to secure the second end portion of the detonation sensor **54** to the sensor holder **50**.

[0062] The detonation sensor **54** can be any sensing device that is capable of sensing an
10 operational condition of the seismic source device **12**. The detonation sensor **54** can be, but not limited to, a piezoelectric sensor that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical signal. The detonation sensor **54** can also be, alone or in combination, an acoustical sensor, an impact sensor, a thermal sensor, electrical contact switch (coupled with a battery) and the like. This electrical signal can then
15 be communicated to the GPS event marking device **5** via the wiring **56** or wirelessly. The detonation sensor **54** is configured to detect an operational condition of the seismic source device **12**, so as to trigger an event marking with the GPS event marking device **5**.

[0063] A switch **58** can be associated with the wiring **56** to control voltage or signal transmission from the detonation sensor **54** to the GPS event marking device **5**. Interrupting voltage
20 or signal transmission from the detonation sensor **54** can avoid unintentional recording and/or event marking by the GPS event marking device **5**. It can be appreciated that switch **58** could be augmented with or replaced by with an electronic device capable of eliminating spurious electrical

impulses originating from detonation sensor **54**. Such a device could also record characteristics of those electrical impulses such as the voltage level, timing of the rise or fall in voltage, and so forth.

[0064] As best illustrated in Fig. 5, the flanged first end **62** of the main tube **60** can include an internally defined annular recess **64** capable of receiving an end portion of the firing weight **30** so that at least the extended end portion **36** of the firing weight **30** is receivable in the hollow interior of the main tube **60**. The recess **64** has a diameter greater than the diameter of the main tube hollow interior, thereby creating an annular ledge lateral to the main tube hollow interior.

[0065] Thus it can be appreciated that the detonation sensor **54** can be secured to the second actuator handle **46** and the piezo holder **50** exterior of the upper assembly **14**, with the second actuator handle **46** being securable to the firing weight **30** located in the hollow interior of the upper assembly **14**. Longitudinal movement of the firing weight **30** and firing pin **70** are dependent upon the location of the first and second actuator handle **42**, **46** in relation with the guide slots **20**, respectively. Specifically, the firing weight **30** and the firing pin **70** can move in a direction parallel with the longitudinal axis of the upper assembly **14** only when the threaded ends **44**, **48** of the first and second actuator handles **42**, **46** are in the longitudinal slot **21** of the guide slots **20**, respectively. Further movement of the firing weight **30** is prohibited when the firing weight **30** contacts the annular ledge that defines the recess **64**.

[0066] It can be appreciated that the length of the longitudinal slot **21** and/or the distance of the annular ledge defining the recess **64** from the lateral slot **22** determines the travel distance of the firing weight **30** and firing pin **70**.

[0067] The lateral slot **22** of the guide slots **20** illustrated in Fig. 3 may contain other features that are also within the scope of the present invention. For example, one feature of the present invention is a safety slot (not shown) that extends from the lateral slot **22** in a direction parallel with

the longitudinal slot **21**. The safety slot can receive the threaded ends **44, 48** of the first and second actuator handles **42, 46** in a locked position thereby preventing accidental movement into the longitudinal slot **21** and preventing unwanted dropping of the firing weight **30** and firing pin **70**. Additionally, locking features can be implemented with the guide slot **20** and/or at least one of the
5 actuator handles **42, 46** to prevent unwanted dropping of the firing weight **30** and firing pin **70**.

[0068] A pair of handles **74** can be attachable to the main tube **60** by way of a clamping bracket. The clamping bracket of each of the handles **74** can be coupled together via fasteners or quick release mechanism to produce a clamping force against the main tube **60**. It can be appreciated that the handles **74** can be adjustably secured along the main tube **60** at any desired location and/or
10 orientation.

[0069] Referring to Fig. 6, the foot support assembly **76** can include a pair of semicircular plates each defined a bore **77** capable of receiving the main tube **60** therethrough. Each plate **76** is securable to a foot plate support **78**. Each foot plate support **78** can include a foot support clamping bracket, which can be coupled together via fasteners or quick release mechanism to produce a
15 clamping force against the main tube **60**. It can be appreciated that the foot support assembly **76** can be adjustably secured along the main tube **60** at any desired location and/or orientation.

[0070] Turning to Fig. 7, the main tube **60** can include a second end **66** featuring an internally defined annular recess capable of engageably receiving a first end **82** of the lower tube **80**. The lower tube **80** includes a hollow interior capable of freely receiving the firing pin **70**
20 therethrough. It can be appreciated that the second end **66** of the main tube **60** and the first end **82** of the lower tube **80** can be configured so as to form a flush interior and/or exterior connection between the main tube **60** and the lower tube **80**.

[0071] The lower tube **80** can include a plurality of channels **84** defined in an external surface thereof, as best illustrated in Figs. 1, 2 and 12. The channels **84** prevent a vacuum from being created when inserting and/or removing the lower tube **80** in/from the ground. It can be appreciated that the lower tube **80** can include one or more soil sensing devices such as to sense, but
5 not limited to, soil moisture, photosynthetically active radiation (PAR) at soil surface, soil temperature, soil respiration, soil heat flux, solar radiation, gas detection, radiation, PH level, geochemical measurements and the like.

[0072] As generally shown in Fig. 8, the lower tube assembly includes the lower tube **80**, a firing chamber **100** attachable to the lower tube **80**, and a cartridge holder **130** attachable to the firing
10 chamber **100**. A blasting cartridge **150** is loadable in an end of the cartridge holder **130**.

[0073] As best illustrated in Figs. 8 and 11, the lower tube **80** features a second end **86** that can include an internal annular notch or recess with a diameter greater than the hollow interior of lower tube **80** thereby creating a lower tube ledge. The second end **86** can include internal threading or other engagement means.

[0074] The firing pin **70** is freely received through the hollow interior of the lower tube **80**, so that a firing tip **72** located at a free end of the firing pin **70** is receivable in the firing chamber **100**.

At least one firing pin guide **90** can be secured to the firing pin **70** to guide its movement within the main tube **60** and/or the lower tube **80**. The firing pin guide **90** has a configuration capable of being slidably received within the hollow interior of the main tube **60** or the lower tube **80**. A bore **92** is
20 defined through the firing pin guide **90** parallel to its longitudinal axis, with the bore **92** being capable of receiving therethrough a portion of the firing pin **70**.

[0075] The portion of the firing pin **70** received in the bore **92** is secured in place by at least one set screw **98** threadably engaged with at least one set screw bore **96** defined laterally and in

communication with the bore **92**. The set screw **98** is capable of contacting an external surface of the firing pin **70** thereby securing the firing pin **70** and the firing pin guide **90** together. The firing pin **70** can be pitted for nesting of the set screw **98**, or a hole can be defined through the firing pin **70** to receive the set screw **98**, or even still the firing pin **70** can be textured to create a gripping force with the set screw **98** and/or the surface of the firing pin guide **90** that defines the bore **92**.

[0076] A notch **94** is defined along an external surface of the firing pin guide **90** to accommodate a head or protrusion of the set screw **98**, thereby preventing the head or protrusion of the set screw **98** from contacting the internal surface of the main tube **60** or the lower tube **80**.

[0077] As best illustrated in Figs. 9 and 11, the firing chamber **100** includes a first end **102** defining a first end bore **104** capable of slidably receiving therethrough the firing tip **72**, and a flanged second end **106**. An external portion of the firing chamber **100** can include external threading or other engagement means capable of engaging with the internal threading of the second end **86** of the lower tube **80** or the second end **66** of the main tube **60**, thereby connecting the lower tube **80** or main tube **60** and the firing chamber **100** together. The first end **102** has a configuration capable of abutting against the ledge created by the recessed second end **86** when fully assembled.

[0078] It can be appreciated that an external surface of the flange second end **106** can include protrusions and/or detents that are engageable with a tool to rotate the firing chamber **100** thereby assisting in the assembling and/or disassembling thereof.

[0079] The firing chamber **100** can further define an internal cavity **108** capable of receiving a portion of the cartridge holder **130**, with the internal cavity **108** being in communication with the first end bore **104**. The internal cavity **108** can include an open end cavity **110**, a first transitional cavity portion **112** in communication with the open end cavity **110**, an intermediate cavity **114** in communication with the first transitional cavity portion **112**, a second transitional cavity portion **116**

in communication with the intermediate cavity **114**, and a close end cavity **118** in communication with the second transitional cavity portion **116** and the first end bore **104**.

[0080] The intermediate cavity **114** has a diameter less than a diameter of the open end cavity **110** and/or the close end cavity **118**, with the first and second transitional cavity portions **112**, **116**
5 having a planar or arcuate profile.

[0081] A cartridge cap recess **120** can be defined in the firing chamber **100** adjacent to and in communication with the close end cavity **118**. The cartridge cap recess **120** is capable of receiving a primer end **152** of the blasting cartridge **150**.

[0082] As best illustrated in Figs. 10 and 11, the cartridge holder **130** can include a through
10 bore **132** defined through the cartridge holder **130** parallel with a longitudinal axis thereof. The through bore **132** is capable of receiving a body of the blasting cartridge **150** with a diameter less than a diameter of the primer end **152**, thereby preventing the primer end **152** from passing therethrough. Consequently, the primer end **152** can abut against a first end **134** of the cartridge holder **130**.

15 [0083] The cartridge holder **130** can include a flanged portion **136** adjacent the first end **134**, an intermediate portion **138** adjacent the flanged portion **136**, a transitional portion **140** adjacent the intermediate portion **138**, a guide portion **142** adjacent the transitional portion **140**, and a flanged end **144** adjacent the guide portion **142**.

[0084] The first end **134** is capable of traveling through the open end cavity **110** and the
20 intermediate cavity **114** so as to be receivable in the close end cavity **118** of the firing chamber **100** when assembled. The intermediate portion **138** is capable of traveling through the open end cavity **110**, and can include external threading or other engagement means engageable with internal

threading of the intermediate cavity **114** of the firing chamber **100**. The guide portion **142** is capable of being receivable in the open end cavity **110** of the firing chamber **100**.

[0085] The flanged end **144** can include radial notches **146** that are engageable with teeth **156** of a tool **154** (Fig. 12) such as, but not limited to, a wrench, a socket, pliers and the like. The tool
5 **154** is capable of rotating the cartridge holder **130** thereby assisting in the assembling and/or disassembling thereof.

[0086] As best illustrated in Fig. 11, the blasting cartridge **150** is received in the bore **132** of the cartridge holder **130** so that the primer end **152** abuts the first end **134**. The first end **134** of the cartridge holder **130** is received in the internal cavity **108** of the firing chamber **100** so that the
10 cartridge holder **130** is joined to the firing chamber **100**. The first end **102** of the firing chamber **100**, with the assembled cartridge holder **130**, is then received in the second end **86** of the lower tube **80**.

[0087] When assembled, the firing pin **70** can reciprocally move within the hollow interior of the lower tube **80** while being guided by the firing pin guide **90** attached to the firing pin **70**. The firing tip **72** can reciprocally move within the first end bore **104** so as to impact the primer end **152**
15 of the blasting cartridge **150**.

[0088] In use, it can now be understood that at least one borehole **3** is drilled below the surface of the earth **2**. Ground seismometers **4** are positioned at predetermined locations in or on the field **2** at locations associated with the borehole **3**. The present invention can be used, but not limited to, oil and gas exploration, geotechnical work associated with engineering bridges, pipelines,
20 roadways, tunnels and the like. Imaging of caprock and the underlying reservoir(s) associated with SAGD production is also envisioned for possible uses of the present invention.

[0089] A user would insert the blasting cartridge **150** into the bore **132** of the cartridge holder **130** with its primer end **152** abutting the first end **134** of the cartridge holder **130**. The cartridge

holder **130** can then be coupled to the firing chamber **100**. The tool **154** can be used to assist in engaging the cartridge holder **130** with the firing chamber **100**.

[0090] For safety, the user would position and retain the threaded ends **44, 48** of the first and second actuator handles **42, 46** in their respective lateral slot **22** so that the firing weight **30** and firing pin **70** are in a non-operable position. The detonation sensor **54** is secured to the second actuator handle **46** and the piezo holder **50**.

[0091] While in this non-operable position, the firing chamber **100** and the assembled cartridge holder **130** can then be coupled to the second end **86** of the lower tube **80**, with the firing tip **72** adjacent or received in the first end bore **104** of the firing chamber **100**. The tool **154** can be used to assist in engaging the assembled firing chamber **100** and cartridge holder **130** with the lower tube **80** or the main tube **60**.

[0092] The seismic source device **12** can then be inserted into the borehole **3** so that it is in a substantially vertical orientation. The user can then stand on the foot support assembly **76**, and can grasp as least one of the handles **74**.

[0093] When ready, the user can operate the switch **58** to allow communication from the detonation sensor **54** to the GPS event marking device **5**, and then move the first actuator handle **42** and/or second actuator handle **46** so that their threaded ends **44, 48** are moved out of their respective lateral slot **22** and into their respective longitudinal slot **21**. In this operable position, the threaded ends **44, 48** of the first and second actuator handles **42, 46** are free to drop or travel along the longitudinal slot, due to gravity and the weight of the firing weight **30** or any other driving force.

[0094] As the firing weight **30** drops it simultaneously moves the firing pin **70** toward the firing chamber **100** until the firing tip **72** strikes the primer end **152** of the blasting cartridge **150**, thereby detonating the blasting cartridge **150** inside the borehole **3**. Upon contact, the blasting

cartridge **150** is detonated thereby creating a seismic wave that propagates from inside the borehole **3** and through the earth until it is reflected and refracted off of subsurface geological layers in the field **2**.

[0095] The detonation sensor **54** detects the detonation of the blasting cartridge **150** and
5 generates a voltage or signal to the GPS event marking device **5**. The GPS event marking device **5** is then triggered by this signal from the detonation sensor **54** to record the precise time ($T = 0$) and geographical location of detonation. Detonation time ($T = 0$) can be recorded with sub-millisecond accuracy. It can be appreciated that the detonation sensor **54** triggers and controls the operation of the GPS event marking device **5**, and not the GPS event marking device **5** controlling the time of
10 detonation. It can be appreciated that blasting cartridge **150** can be engineered with a delay, in which case the known delay can be added to the detonation time signaled by the detonation sensor **54** to provide a more accurate adjusted detonation time ($T = 0$).

[0096] The reflected and refracted waves travel back toward the ground seismometers **4**, which may also be equipped with GPS units that record reception time and/or geographical location.
15 Detonation time from the GPS event marking device **5** and reception times from the seismometers **4** can be communicated, along with geographical locations, to the central recording system to be correlated. The central recording system can then process detonation time and location, and reception times and locations, to provide geological formation information.

[0097] Alternatively, the second end **66** of the main tube **60** and the first end **82** of the lower
20 tube **80** can be associated with a bearing, and a drive means can be coupled to the lower tube **80** so as to rotate the lower tube **80** in relation to the main tube **60**. The lower tube **80** or the cartridge holder **130** can further include a drilling bit or teeth means that is capable of drilling into the ground. Thus combining a drilling means with the lower assembly.

[0098] It can further be appreciated that the lower assembly can include an automatic blasting cartridge loading means, which is capable of removing a spent blasting cartridge and loading a new blasting cartridge for subsequent use. The seismic source device **12** can further include a holding device capable of holding one or more blasting cartridges **150**. The firing pin **70** can have a configuration capable of simultaneously detonating several blasting cartridges **150**, some of which would have different orientations (vertical, lateral, etc.).

[0099] Still further, it can be appreciated that the seismic source device **12** can include a spirit (bubble) level or an electronic level having a configuration capable of indicating an angle of the device **12** relative to the earth's nadir.

[00100] Even still further, it can be appreciated that all the above described threading engagements can be replaced with any mechanical engagement means such as, but not limited to, ratchets, clips, clasps, magnetics, tabs, keys, wedges, press fit surfaces, adhesives, welding and the like. Additionally, any or all transitional edges can be chamfered or beveled.

[00101] While embodiments of the portable seismic survey device and method have been described in detail, it should be apparent that modifications and variations thereto are possible, all of which fall within the true spirit and scope of the invention. With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention. For example, any suitable sturdy material may be used.

[00102] Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in

the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)		Attorney Docket Number	148-16
		First Named Inventor	Allan Châtenay
☒ Declaration Submitted With Initial Filing OR ☐ Declaration Submitted After Initial Filing (surcharge (37 CFR 1.16(f)) required)		<i>COMPLETE IF KNOWN</i>	
		Application Number	
		Filing Date	
		Art Unit	
		Examiner Name	

PORTABLE SEISMIC SURVEY DEVICE AND METHOD			
<i>(Title of the Invention)</i>			
As a below named inventor, I hereby declare that:			
This declaration is directed to:			
☒ The attached application,			
OR			
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The above-identified application was made or authorized to be made by me.			
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[Page 1 of 2]

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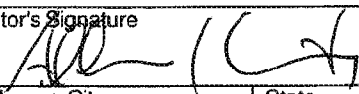
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Additional inventors are being named on the

Supplemental sheet(s) PTO/AIA/10 attached hereto

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Applicant EXPLOR GEOPHYSICAL LTD.	

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Priority datePriority application No.Country or regional Office
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27 February 2017 (27.02.2017)

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18 March 2017 (18.03.2017)

The letters "NR" denote a priority document which, on the date of mailing of this Form, had not yet been received or obtained by the International Bureau in compliance with Rule 17.1(a), (b) or (b-bis). Where the applicant has failed to either submit, request to prepare and transmit, or to request the International Bureau to obtain the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

An asterisk "*" next to a date of receipt, denotes a priority document submitted or transmitted to or obtained by the International Bureau but not in compliance with Rule 17.1(a), (b) or (b-bis) (the priority document was received after the time limit prescribed in Rule 17.1(a); the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b) or the request to the International Bureau to obtain the priority document was made after the applicable time limit under Rule 17.1(b-bis)). Even though the priority document was not furnished in compliance with Rule 17.1(a), (b) or (b-bis), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

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