



APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/359,540	11/12/2019	10472938	DMC007USCON3	9246

81796 7590 10/23/2019  
Moyles IP, LLC  
1 Enterprise Drive, Suite 428  
Shelton, CT 06484

## ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

### **Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)** (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

David C. Parks, Calgary, CANADA;  
DynaEnergetics GmbH & Co. KG, Troisdorf, GERMANY;  
Frank Haron Preiss, Bonn, GERMANY;  
Liam McNelis, Bonn, GERMANY;  
Eric Mulhern, Edmonton, CANADA;  
Thilo Scharf, Letterkenny, IRELAND;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit [SelectUSA.gov](http://SelectUSA.gov).

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	David C. Parks et al.	Examiner:	SEMICK, Joshua T
Appl. No.:	16/359,540	Art Unit:	3641
Filed:	March 20, 2019	Confirmation No.:	9246
Title:	PERFORATION GUN COMPONENTS AND SYSTEM	Atty Docket No.:	DMC007USCon3

Mail Stop: Issue Fee  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE  
APPLICANT-INITIATED INTERVIEW SUMMARY**

Sir:

Applicant respectfully submits in this paper (“Submission”) Comments on the Examiner’s statement of reasons for allowance and an Applicant-Initiated Interview Summary in response to the Notice of Allowability mailed September 11, 2019. Applicant respectfully requests entry on the record of this Submission in its entirety.

### **COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE**

The examiner's statement of reasons for allowance indicates, among other things, "[t]he examiner's reasons for the indication of allowable subject matter may be found in the Non-Final Office action mailed 3 May 2019 . . ." (Notice of Allowability at 2.) While Applicant agrees that claims 1-3, 5, 7-11, 13-16, and 18-24 are in condition for allowance, Applicant does not agree with the Examiner's statement of reasons for allowance for at least the reasons presented in Applicant's Reply ("Reply") dated May 21, 2019 in response to the Non-Final Office action and the indication of allowable subject matter found in the Non-Final Office action. (*See* Reply at 8-9.)

The examiner's statement of reasons for allowance further indicates, in part, that "Applicant has amended the independent claims to incorporate subject matter previously indicated as allowable . . . [and a] final search has not revealed prior art that anticipates or makes obvious all claimed limitations." (Notice of Allowability at 2.) Applicant disagrees with the examiner's statement of reasons for allowance to the extent that the statement of reasons for allowance implies that allowability of the claims may be based only on "all claimed limitations" of the amended claims, for at least the reasons presented in Applicant's Reply at 8-9, as noted above.

While Applicant has addressed in this Submission certain portions of the Examiner's statement of reasons for allowance, Applicant does not necessarily agree with or acquiesce to any other reasons for allowance that may be considered implicit or implied by the Examiner's statement of reasons for allowance, and Applicant reserves the right to traverse any such additional reasons.

**APPLICANT-INITIATED INTERVIEW SUMMARY**

Applicant thanks the Examiner for the courtesy of an interview on September 6, 2019. Applicant's representative and the Examiner discussed the Examiner's application of U.S. Patent No. 9,194,219 ("Hardesty") as the primary reference in all of the 35 U.S.C. § 103 rejections in the Final Office Action dated August 14, 2019. Applicant's representative brought to the Examiner's attention that Hardesty is not available as prior art against the Application at least in view of the foreign priority claim of the Application versus the effective filing date of Hardesty. The Examiner agreed that Hardesty is not available as prior art and later notified Applicant's representative that the finality of the Final Office Action would be withdrawn.

### CONCLUSIONS

Applicant does not believe that any fees are required for this Submission. Entry on the record of this Submission in its entirety is respectfully requested.

Please charge any deficiency or credit any overpayment to Deposit Account Number 600151, with reference to the above-referenced attorney docket number. The undersigned attorney may be contacted at the number below to facilitate the resolution of any matters.

Respectfully submitted,

                  /Jason M. Rockman/                  

Jason M. Rockman

Registration No.: 63,473

**Moyles IP, LLC**  
1 Enterprise Drive, Suite 428  
Shelton, CT 06484  
T: (203) 428-4420  
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[jrockman@moylesip.com](mailto:jrockman@moylesip.com)

October 3, 2019

Document Description: Issue Fee Payment (PTO-85B)

**Issue Fee Transmittal Form**

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
16359540	20-Mar-2019	David Parks	DMC007USCON3	9246

**TITLE OF INVENTION :**

PERFORATION GUN COMPONENTS AND SYSTEM

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Regular Undiscounted	Utility under 35 USC 111(a)	3641	310000	JOSHUA SEMICK
Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
\$1000	\$0	\$1000	11-Dec-2019	\$0

**1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)**

Current Correspondence Address:	Current Indicated Fee Address :
81796 Moyles IP, LLC  1 Enterprise Drive, Suite 428  Shelton CT 06484 UNITED STATES 203-428-4420 docket@moylesip.com	
<input type="checkbox"/> Change of correspondence address requested, system generated AIA/122-EFS form attached	<input checked="" type="checkbox"/> Fee Address indication requested, system generated SB/47-EFS form attached

**2.Entity Status****Change in Entity Status**

Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.

Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.  
 If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.

Applicant asserting small entity status. See 37 CFR 1.27.

Note: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

Applicant changing to regular undiscounted fee status.

Note: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

Document Description: Issue Fee Payment (PTO-85B)

**3.The Following Fee(s) Are Submitted:**

Issue Fee

I authorize USPTO to apply my previously paid issue fee to the current fees due

Publication Fee

The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number \_\_\_\_\_

Advance Order - # of copies \_\_\_\_\_

If **in addition to** the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency, or credit any overpayment, to Deposit Account Number 600151.  
**The issue fee must be submitted with this form. If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

**4.Firm and/or Attorney Names To Be Printed**

**NOTE: If no name is listed, no name will be printed**

For printing on the patent front page, list to be displayed as entered

1. Moyles IP, LLC

2.

3.

**5.Assignee Name(s) and Residence Data To Be Printed**

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

Name	City	State	Country	Category
DynaEnergetics GmbH & Co. KG	Troisdorf		germany	corporation
JDP Engineering and Machine Inc	Calgary		canada	corporation

Document Description: Issue Fee Payment (PTO-85B)

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**6. Signature**

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I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

<b>Signature</b>	/Jason M. Rockman/	<b>Date</b>	10-03-2019
<b>Name</b>	Jason M. Rockman	<b>Registration Number</b>	63473

### FEE ADDRESS INDICATION FORM

Application Number	16359540	Art Unit	3641
Filing Date	20-Mar-2019	Examiner Name	JOSHUA SEMICK
First Name Inventor	David Parks	Attorney Doc. Number	DMC007USCON3

**INSTRUCTIONS:** In order for the fee address identified on this form to be effective, the issue fee must have been paid for the application listed on this form. Only an address represented by a customer number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. For more information on customer numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

**Please recognize as the Fee Address under the provisions of 37 CFR 1.363 the address associated with:**

Customer Number:	81796 Moyles IP, LLC  1 Enterprise Drive, Suite 428  Shelton CT 06484 UNITED STATES 203-428-4420 lmoyles@moylesip.com
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**Signature :**

*I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application.*

<b>Signature</b>	/Jason M. Rockman/	<b>Date</b>	10-03-2019
<b>Name</b>	Jason M. Rockman	<b>Registration Number</b>	63473

## Electronic Patent Application Fee Transmittal

<b>Application Number:</b>	16359540			
<b>Filing Date:</b>	20-Mar-2019			
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM			
<b>First Named Inventor/Applicant Name:</b>	David C. Parks			
<b>Filer:</b>	Jason Marshall Rockman			
<b>Attorney Docket Number:</b>	DMC007USCON3			
Filed as Large Entity				
<b>Filing Fees for Utility under 35 USC 111(a)</b>				
<b>Description</b>	<b>Fee Code</b>	<b>Quantity</b>	<b>Amount</b>	<b>Sub-Total in USD(\$)</b>
<b>Basic Filing:</b>				
UTILITY APPL ISSUE FEE	1501	1	1000	1000
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
<b>Pages:</b>				
<b>Claims:</b>				
<b>Miscellaneous-Filing:</b>				
<b>Petition:</b>				
<b>Patent-Appeals-and-Interference:</b>				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
<b>Post-Allowance-and-Post-Issuance:</b>				
<b>Extension-of-Time:</b>				
<b>Miscellaneous:</b>				
<b>Total in USD (\$)</b>				<b>1000</b>

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	37358564
<b>Application Number:</b>	16359540
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	9246
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM
<b>First Named Inventor/Applicant Name:</b>	David C. Parks
<b>Customer Number:</b>	81796
<b>Filer:</b>	Jason Marshall Rockman
<b>Filer Authorized By:</b>	
<b>Attorney Docket Number:</b>	DMC007USCON3
<b>Receipt Date:</b>	03-OCT-2019
<b>Filing Date:</b>	20-MAR-2019
<b>Time Stamp:</b>	15:50:16
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$1000
RAM confirmation Number	E201903F50143304
Deposit Account	
Authorized User	

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

<b>File Listing:</b>					
<b>Document Number</b>	<b>Document Description</b>	<b>File Name</b>	<b>File Size(Bytes)/ Message Digest</b>	<b>Multi Part /.zip</b>	<b>Pages (if appl.)</b>
1	Amendment after Notice of Allowance (Rule 312)	DMC007USCon3_Comments_and_Interview_Summary.pdf	81920	no	4
			9f1135390118dde939d97374be30f5115f15bbda		
<b>Warnings:</b>					
<b>Information:</b>					
2	Issue Fee Payment (PTO-85B)	Web85b.pdf	48744	no	3
			60dc14dcb4a88d84374a27f5782a39121fe6876e		
<b>Warnings:</b>					
<b>Information:</b>					
3	Maintenance Fee Address Change	web85feeaddress.pdf	32647	no	1
			2bbe6b5de7cc0b32772d9b50a9c5232ea83de74f		
<b>Warnings:</b>					
<b>Information:</b>					
4	Fee Worksheet (SB06)	fee-info.pdf	31850	no	2
			4d9b830e65be4f93ec599266d7d9eacafb2ec30		
<b>Warnings:</b>					
<b>Information:</b>					
<b>Total Files Size (in bytes):</b>			195161		

**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.**

**New Applications Under 35 U.S.C. 111**

**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.**

**National Stage of an International Application under 35 U.S.C. 371**

**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.**

**New International Application Filed with the USPTO as a Receiving Office**

**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.**



UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

81796 7590 09/11/2019
Moyles IP, LLC
1 Enterprise Drive, Suite 428
Shelton, CT 06484

Table with 2 columns: EXAMINER (SEMICK, JOSHUA T), ART UNIT (3641), PAPER NUMBER

DATE MAILED: 09/11/2019

Table with 5 columns: APPLICATION NO. (16/359,540), FILING DATE (03/20/2019), FIRST NAMED INVENTOR (David C. Parks), ATTORNEY DOCKET NO. (DMC007USCON3), CONFIRMATION NO. (9246)

TITLE OF INVENTION: PERFORATION GUN COMPONENTS AND SYSTEM

Table with 7 columns: APPLN. TYPE (nonprovisional), ENTITY STATUS (UNDISCOUNTED), ISSUE FEE DUE (\$1000), PUBLICATION FEE DUE (\$0.00), PREV. PAID ISSUE FEE (\$0.00), TOTAL FEE(S) DUE (\$1000), DATE DUE (12/11/2019)

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

**PART B - FEE(S) TRANSMITTAL**

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**

By fax, send to: **(571)-273-2885**

**INSTRUCTIONS:** This form should be used for transmitting the **ISSUE FEE** and **PUBLICATION FEE** (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

81796                      7590                      09/11/2019  
**Moyles IP, LLC**  
**1 Enterprise Drive, Suite 428**  
**Shelton, CT 06484**

**Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/359,540	03/20/2019	David C. Parks	DMC007USCON3	9246

TITLE OF INVENTION: PERFORATION GUN COMPONENTS AND SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	12/11/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
SEMICK, JOSHUA T	3641	102-310000

<p>1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).</p> <p><input type="checkbox"/> Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.</p> <p><input type="checkbox"/> "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. <b>Use of a Customer Number is required.</b></p>	<p>2. For printing on the patent front page, list</p> <p>(1) The names of up to 3 registered patent attorneys or agents OR, alternatively, _____ 1</p> <p>(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. _____ 2</p> <p>_____ 3</p>
---	---

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE \_\_\_\_\_ (B) RESIDENCE: (CITY and STATE OR COUNTRY) \_\_\_\_\_

Please check the appropriate assignee category or categories (will not be printed on the patent) :  Individual  Corporation or other private group entity  Government

4a. Fees submitted:  Issue Fee  Publication Fee (if required)  Advance Order - # of Copies \_\_\_\_\_

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

Electronic Payment via EFS-Web  Enclosed check  Non-electronic payment by credit card (Attach form PTO-2038)

The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. \_\_\_\_\_

5. Change in Entity Status (from status indicated above)

Applicant certifying micro entity status. See 37 CFR 1.29

Applicant asserting small entity status. See 37 CFR 1.27

Applicant changing to regular undiscounted fee status.

**NOTE:** Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

**NOTE:** If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

**NOTE:** Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

**NOTE:** This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature \_\_\_\_\_ Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_ Registration No. \_\_\_\_\_



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Table with columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO., EXAMINER, ART UNIT, PAPER NUMBER. Includes application details for David C. Parks and examiner SEMICK, JOSHUA T.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 1.14. This collection is estimated to take 30 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

<b>Notice of Allowability</b>	<b>Application No.</b> 16/359,540	<b>Applicant(s)</b> Parks et al.	
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641	<b>AIA (FITF) Status</b> Yes

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1.  This communication is responsive to communications filed 21 May 2019.  
 A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.
2.  An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.
3.  The allowed claim(s) is/are See Continuation Sheet. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to **PPHfeedback@uspto.gov**.
4.  Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
**Certified copies:**
  - a)  All      b)  Some      \*c)  None of the:
  1.  Certified copies of the priority documents have been received.
  2.  Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3.  Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5.  CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
 including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.  
**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6.  DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

- |   |  |
|---|--|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)  | 5. <input type="checkbox"/> Examiner's Amendment/Comment                             |
| 2. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date _____.          | 6. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material _____. | 7. <input type="checkbox"/> Other _____.   |
| 4. <input checked="" type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date: <u>9/6/2019</u> .     |  |

/JOSHUA T SEMICK/  
Examiner, Art Unit 3641

Continuation of 3. The allowed claim(s) is/are: 1-3,5,7-11,13-16 and 18-24

### **DETAILED ACTION**

1. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

#### ***Priority***

2. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119 (a)-(d). The certified copy has been filed in parent Application No. 14/904,788, filed on 13 January 2016.

#### ***Reasons for Allowance***

3. **Claims 1-3, 5, 7-11, 13-16 and 18-24** are allowed.

4. The following is an examiner's statement of reasons for allowance: Applicant has amended the independent claims to incorporate subject matter previously indicated as allowable by the examiner. The examiner's reasons for the indication of allowable subject matter may be found in the Non-Final Office action mailed 3 May 2019 (see ¶11). A final search has not revealed prior art that anticipates or makes obvious all claimed limitations.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSHUA T SEMICK whose telephone number is (571)272-5274. The examiner can normally be reached on M-F: 7AM to 4PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Troy Chambers can be reached on (571)272-6874. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSHUA T SEMICK/  
Examiner, Art Unit 3641

<b><i>Applicant-Initiated Interview Summary</i></b>	<b>Application No.</b> 16/359,540	<b>Applicant(s)</b> Parks et al.		
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641	<b>AIA (First Inventor to File) Status</b> Yes	<b>Page</b> <b>1 of 1</b>
<p>All participants (applicant, applicants representative, PTO personnel):</p> <p>1. JOSHUA T SEMICK (Examiner); Telephonic                      2. JASON M ROCKMAN (Attorney of Record); Telephonic</p> <p><b>Date of Interview:</b> <u>06 September 2019</u></p> <p><b>Prior Art Discussed:</b> US 9,194,219 B1 to Hardesty et al. ("Hardesty")</p> <hr/> <p style="text-align: center;"><b>Issues Discussed:</b></p> <p><b>Priority:</b> Mr. Rockman initiated the interview to bring attention to the foreign priority claim of the instant application and to further indicate the Hardesty reference which was applied as the primary reference in the 35 USC 103 rejection of the prior Office action is not available as prior art. After a review of both the foreign priority claim and the effective filing date of the Hardesty reference, the examiner agreed that Hardesty is not available as prior art and that the finality of the prior Office action would be withdrawn accordingly.</p>				
/JOSHUA T SEMICK/ Examiner, Art Unit 3641				
<p><b>Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04</b></p> <p>Please further see: MPEP 713.04 Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b) 37 CFR § 1.2 Business to be transacted in writing</p>				

**Applicant recordation instructions:** The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

**Examiner recordation instructions:** Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

<b><i>Index of Claims</i></b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

✓	<b>Rejected</b>
=	<b>Allowed</b>

-	<b>Cancelled</b>
÷	<b>Restricted</b>

N	<b>Non-Elected</b>
I	<b>Interference</b>

A	<b>Appeal</b>
O	<b>Objected</b>

CLAIMS										
<input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47										
CLAIM		DATE								
Final	Original	04/29/2019	08/09/2019	09/06/2019						
1	1	✓	✓	=						
2	2	✓	✓	=						
3	3	✓	✓	=						
	4	✓	-	-						
4	5	✓	✓	=						
	6	○	-	-						
5	7	✓	✓	=						
6	8	✓	✓	=						
9	9	✓	✓	=						
10	10	✓	✓	=						
13	11	✓	=	=						
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20	20	✓	=	=						
7	21		✓	=						
8	22		✓	=						
11	23		✓	=						
12	24		✓	=						

<b>Issue Classification</b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

CPC						
Symbol					Type	Version
E21B	/	43	/	1185	F	2013-01-01
F42D	/	1	/	02	I	2013-01-01
E21B	/	43	/	11855	I	2013-01-01
F42D	/	1	/	043	I	2013-01-01
E21B	/	43	/	119	I	2013-01-01
F42C	/	19	/	06	I	2013-01-01
F42D	/	1	/	04	I	2013-01-01

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version
/	/			

None		<b>Total Claims Allowed:</b>	
(Assistant Examiner)	(Date)	20	
/JOSHUA T SEMICK/ Examiner, Art Unit 3641	06 September 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	27

<b>Issue Classification</b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

<b>INTERNATIONAL CLASSIFICATION</b>			
<b>CLAIMED</b>			
E21B43/1185	/	43	/ 1185
F42D1/02	/	1	/ 02
F42D1/04	/	1	/ 04
F42C19/06	/	19	/ 06

<b>NON-CLAIMED</b>			
E21B43/119	/	43	/ 119

<b>US ORIGINAL CLASSIFICATION</b>	
<b>CLASS</b>	<b>SUBCLASS</b>

<b>CROSS REFERENCES(S)</b>					
<b>CLASS</b>	<b>SUBCLASS (ONE SUBCLASS PER BLOCK)</b>				

None			<b>Total Claims Allowed:</b>	
(Assistant Examiner)	(Date)	20		
/JOSHUA T SEMICK/ Examiner, Art Unit 3641	06 September 2019	O.G. Print Claim(s)	O.G. Print Figure	
(Primary Examiner)	(Date)	1	27	

<b>Issue Classification</b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

Claims renumbered in the same order as presented by applicant
  CPA
  T.D.
  R.1.47

CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	10	19	19										
2	2	13	11	20	20										
3	3		12	7	21										
	4	14	13	8	22										
4	5	15	14	11	23										
	6	16	15	12	24										
5	7	17	16												
6	8		17												
9	9	18	18												

None		<b>Total Claims Allowed:</b>	
(Assistant Examiner)	(Date)	20	
/JOSHUA T SEMICK/ Examiner, Art Unit 3641	06 September 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	27

<b><i>Search Notes</i></b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

CPC - Searched*		
Symbol	Date	Examiner
E21B43/1185, 43/11852, 43/11855, 43/117	09/06/2019	JTS
F42D1/041, 1/043, 1/045	09/06/2019	JTS
F42C19/06	09/06/2019	JTS

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

/JOSHUA T SEMICK/ Examiner, Art Unit 3641	
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<b>Search Notes</b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

<b>Search Notes</b>		
<b>Search Notes</b>	<b>Date</b>	<b>Examiner</b>
searched inventor names in DAV	04/26/2019	JTS
searched Assignee in EAST	04/26/2019	JTS
E21B43/1185, 43/11852, 43/11855 - searched entirety	04/26/2019	JTS
E21B43/117 - text searched	04/26/2019	JTS
E21B43/117-11855	04/29/2019	JTS
citation searched	04/29/2019	JTS
text searched	06/07/2019	JTS
text searched	08/08/2019	JTS
citation searched	08/08/2019	JTS
E21B43/1185, 43/11852, 43/11855, 43/117 - searched all published on or after 8/8/19	09/06/2019	JTS
F42D1/041,1/043,1/045 - searched all published on or after 8/8/19	09/06/2019	JTS
F42C19/06 - text searched	09/06/2019	JTS

<b>Interference Search</b>			
<b>US Class/CPC Symbol</b>	<b>US Subclass/CPC Group</b>	<b>Date</b>	<b>Examiner</b>
E21B	43/1185, 43/11852, 43/11855, 43/117	09/06/2019	JTS
F42D	1/041,1/043,1/045	09/06/2019	JTS
F42C	19/06	09/06/2019	JTS

/JOSHUA T SEMICK/ Examiner, Art Unit 3641	
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## Bibliographic Data

Application No: 16/359,540

Foreign Priority claimed:  Yes  No

35 USC 119 (a-d) conditions met:  Yes  No  Met After Allowance

Verified and Acknowledged: /JOSHUA T SEMICK/

Examiner's Signature

Initials

Title: PERFORATION GUN COMPONENTS AND SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/20/2019	102	3641	DMC007USCon3
<b>RULE</b>			

### APPLICANTS

DynaEnergetics GmbH & Co. KG, Troisdorf, GERMANY

### INVENTORS

David C. Parks Calgary, CANADA

Frank Haron Preiss Bonn, GERMANY

Liam McNelis Bonn, GERMANY

Eric Mulhern Edmonton, CANADA

Thilo Scharf Letterkenny, IRELAND

### CONTINUING DATA

This application is a CON of 15920812 03/14/2018

15920812 is a CON of 15617344 06/08/2017

15617344 is a DIV of 15287309 10/06/2016 PAT 9702680

15287309 is a DIV of 14904788 01/13/2016 PAT 9494021

14904788 is a 371 of PCT/CA2014/050673 07/16/2014

### FOREIGN APPLICATIONS

CANADA 2821506 07/18/2013

### IF REQUIRED, FOREIGN LICENSE GRANTED\*\*

04/05/2019

### STATE OR COUNTRY

CANADA

### ADDRESS

Moyles IP, LLC

1 Enterprise Drive, Suite 428

Shelton, CT 06484

UNITED STATES  
**FILING FEE RECEIVED**  
\$5,860

## EAST Search History

## EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S63	39	("20030001753"   "20040238167"   "20080103948"   "20090084535"   "20120037365"   "20120250208"   "20120255842"   "20120298361"   "20130043074"   "20150000509"   "2545024"   "2655619"   "2946283"   "2968243"   "3010396"   "3173992"   "3246707"   "3378069"   "3648785"   "4234768"   "6095258"   "8365825"   "8875796").PN. OR ("9194219").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2019/09/06 13:56
L1	4357	E21B43/1185,11852,11855,117.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:17
L2	2138	F42D1/041,043,045.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:18
L4	15	3 and @pd> = "20190808"	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:20
L3	6162	1 or 2	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:20
L6	13	5 and @pd> = "20190808"	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:22
L5	4433	E21B43/117-11855.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:22
L10	15	9 and ground near5 (contact\$4 or connect\$4) near10 (detonator or initiator)	US-PGPUB; USPAT; FPRS;	OR	ON	2019/09/06 16:28

			EPO; JPO			
L9	1272	(F42C19/06).cpc.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/09/06 16:28

## EAST Search History (I nterference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L8	1616	E21B43/1185,11852,11855,117.cpc.	US- PGPUB; USPAT	OR	ON	2019/09/06 16:23
L7	572	F42D1/041,043,045.cpc.	US- PGPUB; USPAT	OR	ON	2019/09/06 16:23
L11	375	(F42C19/06).cpc.	US- PGPUB; USPAT	OR	ON	2019/09/06 16:28
L12	2397	7 or 8 or 11	US- PGPUB; USPAT	OR	ON	2019/09/06 16:29
L13	41	12 and (ground near5 (contact\$4 or connect\$4) and (detonator or initiator)).clm.	US- PGPUB; USPAT	OR	ON	2019/09/06 16:31

9/ 6/ 2019 4:32:14 PM

C:\Users\jsemick\Documents\EAST\Workspaces\16359540.wsp



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Table with columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO., EXAMINER, ART UNIT, PAPER NUMBER, NOTIFICATION DATE, DELIVERY MODE. Includes application details for David C. Parks and examiner SEMICK, JOSHUA T.

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@moylesip.com
lmoyles@moylesip.com



### DETAILED CORRESPONDENCE

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.
2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
3. **Claims 1-3, 5, 7-11, 13-16 and 18-24** are active and an examination of those claims follows.

#### *Response to Arguments*

4. Applicant's arguments with respect to claims 1 and 9 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

#### *Claim Rejections - 35 USC § 103*

5. **Claims 1, 2, 5, 7, 9-11, 13-16 and 18-24** are rejected under 35 U.S.C. 103 as being unpatentable over US 9,194,219 B1 to Hardesty et al. ("Hardesty") in view of US 7,107,908 B2 to Forman et al. ("Forman")

Regarding **claims 1 and 9**, Hardesty discloses a perforating gun (see Figs. 7 and 13, reproduced below for convenience), comprising:

an outer gun carrier **0701**;

a charge holder (**0500**, Fig. 5) positioned within the outer gun carrier **0701** and including at least one shaped charge (at least two charges are clearly illustrated in Fig. 7); and

a detonator (comprising downstream adapter **0740** and detonator **0704** – see also Fig. 13 downstream adapter **1321** and detonator **1302**) contained entirely within the outer gun carrier (**0701**, wherein Fig. 7 illustrates the detonator –0740 + 0704-- positioned entirely within the outer gun carrier), the detonator including

a detonator body **0704**,

a wireless signal-in connector **0707**,

a wireless through wire connector **0708**, and

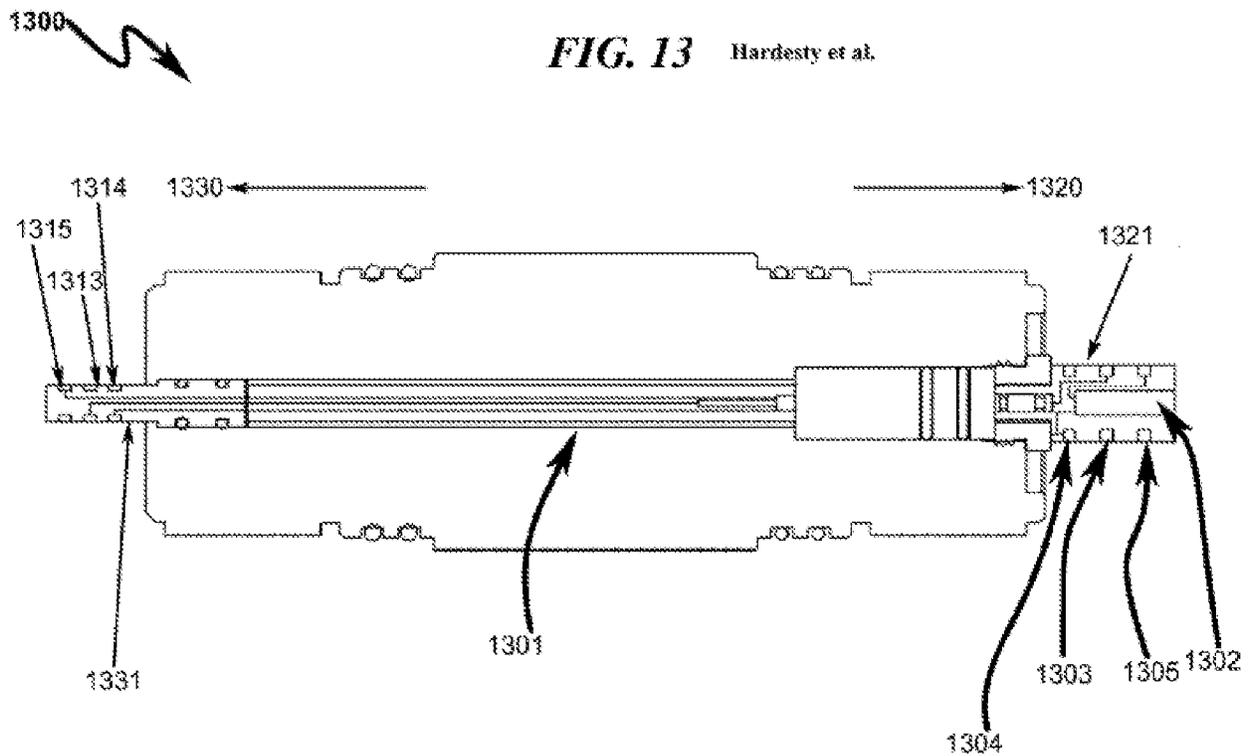
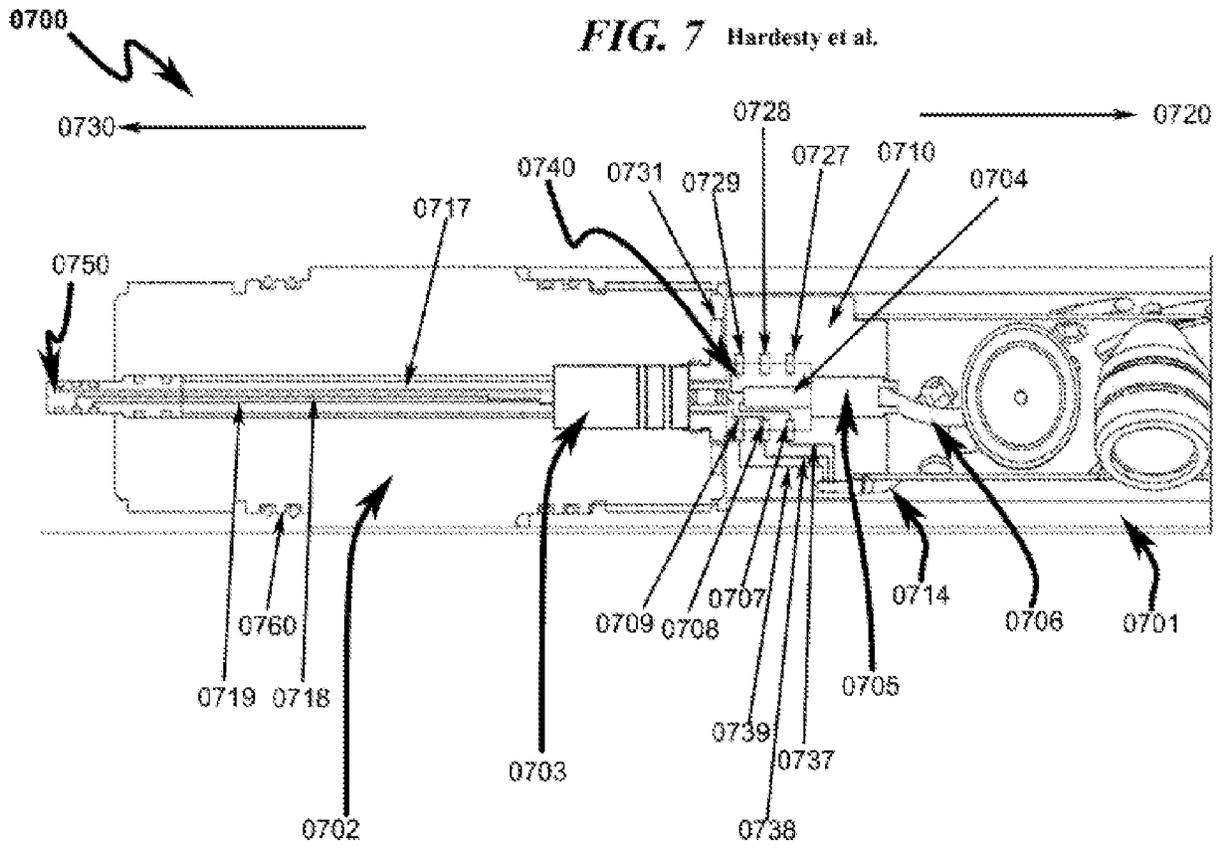
a wireless ground contact connector **0709**, and

an insulator (the body material of the downstream adapter 0740 separating each of the connectors 0707, 0708, 0709, see Fig. 7) electrically isolating the wireless signal-in connector **0708** from the wireless through wire connector **0708**; and,

a bulkhead (switch **0703**), wherein the bulkhead **0703** includes a contact pin (the component of the switch that is accepted within retaining member 0731, 8:25-27, best seen in Fig. 8) in wireless electrical contact with the wireless signal-in connector **0707** (best seen in Figs. 7 and 8, see also Fig. 9 and 9:26 to 10:3 for a wiring diagram and an explanation of the same), wherein

at least a portion of the bulkhead (switch **0703**) is contained within a tandem seal adapter (the main body of switch sub **0702**), and the wireless ground contact connector **0709** is in wireless electrical contact with the tandem seal adapter (best seen in Fig. 8, depicting an electrical path from 0709 to retaining member 0731, wherein retaining member 0731 is connected to the main body of switch sub 0702, see also Fig. 9 and 9:26 to 10:3 for a wiring diagram and an explanation of the same).

Hardesty is silent regarding the detonator containing detonator components and a signal-in wire electrically connecting at least in part the wireless signal-in connector to at least one of the detonator components. However, Forman teaches a detonator (**20**, Fig. 3) for use in blasting systems (abstract), the detonator **20** comprising detonator components (the components internal to shell 29, illustrated in Fig. 3) which are connected a signal-in wire (bridgewire **27**) via a signal-in connector (contact pads **22**). Therefore, it would have been obvious to one of ordinary skill in the art prior to the effective filing date of the claimed invention to modify Hardesty to have a detonator body comprising detonator components connected to a signal in-wire as claimed, as taught by Forman, in order to predictably form a complete and functioning detonator combination.



Regarding **claim 2**, Hardesty, as modified, further teaches a through wire **0738** in electrical contact (see Fig. 7) with the wireless through wire connector **0708**.

Regarding **claim 5**, Hardesty, as modified, further teaches wherein the contact pin (the component of the switch that is accepted within retaining member 0731, 8:25-27, best seen in Fig. 8) transfers an electrical signal from a previous wellbore tool (connected to upstream adapter 0750 via power wire 0717) to the wireless signal-in connector **0707** (the connection can be seen in Figs. 7 and 8 as well as the wiring diagram of Fig. 9).

Regarding **claim 7**, Hardesty, as modified, further teaches a top connector **0710**, wherein the detonator (comprising downstream adapter **0740** and detonator **0704**) is positioned within the top connector (see Fig. 7)

Regarding **claim 10**, Hardesty, as modified, further teaches a detonating cord connecting portion **0705** sized to retain a detonating cord **0706** and positioned to energetically couple to detonating cord **0706** to the detonator (comprising **0704**, see Fig. 7 for positioning).

Regarding **claim 21 and 23**, Hardesty, as modified, further teaches a signal-in wire **0737** connected to the wireless signal-in connector **0707** and a ground wire **0739** electrically connected to the wireless ground contact connector **0709**

Regarding **claim 22 and 24**, Hardesty, as modified, further teaches a detonator configured for being electrically contactably received within the perforating gun without use of a wired electrical connection (4:57-67).

6. **Claims 3 and 8** are rejected under 35 U.S.C. 103 as being unpatentable over Hardesty, as modified, as applied to claims 1 and 7 above, and further in view of US 10,190,398 B2 to Goodman et al. ("Goodman").

Regarding **claims 3 and 8**, Schacherer is silent regarding the charge holder or the top connector being an injection molded part. However, Goodman teaches a detonator structure (**36**, Fig. 2) for

perforating guns (Fig. 1), the detonator having a housing **38** made by injection molding (3:29-33).

Therefore, it would have been obvious to one of ordinary skill in the art prior to the effective filing date of the claimed invention to modify Schacherer to have either the charge holder or the top connector be an injection molded part, as taught by Goodman, in order to utilize a known process that is suitable for making subcomponents of perforating guns.

#### ***Allowable Subject Matter***

7. **Claims 11, 13-16, 18-20** are allowed.

8. The following is an examiner's statement of reasons for allowance:

Applicant incorporates subject matter into independent claim 11 which was previously indicated as allowable subject matter by the examiner. The examiner's reasons for the indication of allowable subject matter can be found in the prior Office action (see ¶11). A final search has not revealed prior art that anticipates or makes obvious all claimed method steps.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### ***Conclusion***

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing

date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSHUA T SEMICK whose telephone number is (571)272-5274. The examiner can normally be reached on M-F: 7AM to 4PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Troy Chambers can be reached on (571)272-6874. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSHUA T SEMICK/  
Examiner, Art Unit 3641

**Notice of References Cited**

Application/Control No. 16/359,540		Applicant(s)/Patent Under Reexamination Parks et al.	
Examiner JOSHUA T SEMICK		Art Unit 3641	Page 1 of 1

**U.S. PATENT DOCUMENTS**

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9194219-B1	11-2015	Hardesty; John T.	F42D1/05	1/1
*	B	US-7107908-B2	09-2006	Forman; David M.	F42D1/055	102/202.5
*	C	US-10190398-B2	01-2019	Goodman; Kenneth	E21B43/1185	1/1
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<b><i>Search Notes</i></b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

CPC - Searched*		
Symbol	Date	Examiner
E21B43/1185, 43/11852, 43/11855	06/07/2019	JTS
E21B43/117	06/07/2019	JTS
F42D1/041,043,045	08/08/2019	JTS
E21B43/1185	08/08/2019	JTS

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

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Search Notes		
Search Notes	Date	Examiner
searched inventor names in DAV	04/26/2019	JTS
searched Assignee in EAST	04/26/2019	JTS
E21B43/1185, 43/11852, 43/11855 - searched entirety	04/26/2019	JTS
E21B43/117 - text searched	04/26/2019	JTS
E21B43/117-11855	04/29/2019	JTS
citation searched	04/29/2019	JTS
text searched	06/07/2019	JTS
text searched	08/08/2019	JTS
citation searched	08/08/2019	JTS

/JOSHUA T SEMICK/ Examiner, Art Unit 3641	
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<b><i>Search Notes</i></b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

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<b><i>Index of Claims</i></b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

✓	<b>Rejected</b>
=	<b>Allowed</b>

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÷	<b>Restricted</b>

N	<b>Non-Elected</b>
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A	<b>Appeal</b>
O	<b>Objected</b>

CLAIMS									
<input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47									
CLAIM		DATE							
Final	Original	04/29/2019	08/09/2019						
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	2	✓	✓						
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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	16359540
	Filing Date	2019-03-20
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	SEMICK, Joshua T
	Attorney Docket Number	DMC007USCon3

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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number		16359540
	Filing Date		2019-03-20
	First Named Inventor	David C. Parks et al.	
	Art Unit		3641
	Examiner Name	SEMICK, Joshua T	
	Attorney Docket Number		DMC007USCon3

1	INTELLECTUAL PROPERTY INDIA, Office Action of IN Application No. 201647004496, dated June 7, 2019, which is in the same family as US App. No. 16/359,540, 6 pgs.
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**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
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Application Number		16359540	
Filing Date		2019-03-20	
First Named Inventor	David C. Parks et al.		
Art Unit	3641		
Examiner Name	SEMICK, Joshua T		
Attorney Docket Number	DMC007USCon3		

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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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Signature	/Jason M. Rockman/	Date (YYYY-MM-DD)	2019-06-20
Name/Print	Jason M. Rockman	Registration Number	63473

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## EAST Search History (Prior Art)

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S46	2311	E21B43/1185-11855.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/06/07 09:17
S47	11	S46 and @pd> = "20190426"	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/06/07 09:18
S48	5	S47 and ground	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/06/07 09:42
S49	6	"53059075".FMID.	US-PGPUB; USPAT; FPRS	OR	ON	2019/06/07 09:51
S50	4619	E21B43/117-11855.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/06/07 10:33
S52	67	S50 and ground near5 (contact\$4 or connect\$4) near10 (detonator or initiator)	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/06/07 10:55
S53	2256	F42D1/041,043,045.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/08 12:04
S57	430	S56 and (initiator or detonator).ti.	US-PGPUB; USPAT; FPRS;	OR	ON	2019/08/08 12:05

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S56	2737	S53 or S55	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/08 12:05
S55	565	S54 and downhole	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/08 12:05
S54	1524	E21B43/1185.cpc.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/08 12:05
S58	1	("2003/0221576").URPN.	USPAT	OR	ON	2019/08/08 12:44
S59	33	("20030221575"   "20030221576"   "20080223241"   "20100000435"   "20110247517"   "20130075747"   "4393779"   "4699241"   "5309841"   "6085659"   "6173651"   "6789483"   "6892643"   "6966262"   "6988449"   "7017494"   "7054131"   "7082877"   "7086334"   "7107908"   "7301750"   "7322293"   "7347145"   "7464647"   "7533613"   "7577756"   "7617775"   "7681500"   "7870825"   "7971531"   "7975612"   "8176848"   "9243877").PN. OR ("10359264").URPN.	US- PGPUB; USPAT; USOCR	OR	ON	2019/08/08 12:45
L8	2	6 or 7	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/09 10:01
L7	1	us-20080149338-\$.did.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/09 10:01
L6	1	us-6006833-\$.did.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/08/09 10:01

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CONFIRMATION NO. 9246

PUBLICATION NOTICE

81796
Moyles IP, LLC
1 Enterprise Drive, Suite 428
Shelton, CT 06484



Title:PERFORATION GUN COMPONENTS AND SYSTEM

Publication No.US-2019-0219375-A1
Publication Date:07/18/2019

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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	16359540
	Filing Date	2019-03-20
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	SEMICK, Joshua T
	Attorney Docket Number	DMC007USCon3

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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	16359540
	Filing Date	2019-03-20
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	SEMICK, Joshua T
	Attorney Docket Number	DMC007USCon3

1	INTELLECTUAL PROPERTY INDIA, Office Action of IN Application No. 201647004496, dated June 7, 2019, which is in the same family as US App. No. 16/359,540, 6 pgs.
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**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number	16359540		
Filing Date	2019-03-20		
First Named Inventor	David C. Parks et al.		
Art Unit	3641		
Examiner Name	SEMICK, Joshua T		
Attorney Docket Number	DMC007USCon3		

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**OR**

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jason M. Rockman/	Date (YYYY-MM-DD)	2019-06-20
Name/Print	Jason M. Rockman	Registration Number	63473

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<b>TRANSMITTAL FORM</b>  <i>(to be used for all correspondence after initial filing)</i>	Application Number	16/359,540	
	Filing Date	03/20/2019	
	First Named Inventor	David C. Parks et al.	
	Art Unit	3641	
	Examiner Name	SEMICK, Joshua T	
Total Number of Pages in This Submission	12	Attorney Docket Number	DMC007USCon3

ENCLOSURES (Check all that apply)				
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT			
Firm Name	Moyles IP, LLC		
Signature	/Jason M. Rockman/		
Printed name	Jason M. Rockman		
Date	June 20, 2019	Reg. No.	63473

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## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	36364818
<b>Application Number:</b>	16359540
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	9246
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM
<b>First Named Inventor/Applicant Name:</b>	David C. Parks
<b>Customer Number:</b>	81796
<b>Filer:</b>	Jason Marshall Rockman
<b>Filer Authorized By:</b>	
<b>Attorney Docket Number:</b>	DMC007USCon3
<b>Receipt Date:</b>	20-JUN-2019
<b>Filing Date:</b>	20-MAR-2019
<b>Time Stamp:</b>	18:33:51
<b>Application Type:</b>	Utility under 35 USC 111(a)

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### File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	DMC007USCon3_IDS_SB08A.pdf	1034353  b21d3b82e7260961a979d9c50892e855861e4162	no	4

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2	Non Patent Literature	DMC007IN_Office_Action_07Jun19.pdf	232336	no	6
			1d4e2cc722c8d5148b0af118a7e476132b50131d		

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3	Transmittal Letter	DMC007USCon3_Transmittal_Form_Post_Filing_SB021.pdf	232697	no	2
			2491016e7bd35209f1a99ad8e1295f9b3b70f3fe		

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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.

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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.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	David C. Parks et al.	Examiner:	SEMICK, Joshua T
Appl. No.:	16/359,540	Art Unit:	3641
Filed:	03/20/2019	Confirmation No.:	9246
Title:	PERFORATION GUN COMPONENTS AND SYSTEM	Atty Docket No.:	DMC007USCon3

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**REPLY UNDER 37 C.F.R. §1.111**

**AMENDMENT UNDER 37 C.F.R. §1.121**

Sir:

Responsive to the Non-Final Office Action mailed May 3, 2019 (hereinafter “the Office Action”) to which a reply is due by August 3, 2019, Applicant respectfully requests reconsideration, withdrawal of the rejections, and allowance of the Claims based upon the following amendments and remarks. Please charge or credit any additional fee due to Deposit Account Number 600151, with reference to the above-referenced attorney docket number.

**Amendments to the Claims** are set forth in the Listing of Claims that begins on page 2 of this correspondence.

**Remarks** begin on page 7 of this correspondence.

## AMENDMENTS TO THE CLAIMS

A listing of all claims and their current status in accordance with 37 C.F.R. §1.121(2) is provided below. This listing of claims replaces all prior versions and listing of claims in the application.

1. (Currently Amended) A perforating gun, comprising:
  - an outer gun carrier;
  - a charge holder positioned within the outer gun carrier and including at least one shaped charge; ~~and~~
  - a detonator contained entirely within the outer gun carrier, the detonator including
    - a detonator body containing detonator components,
    - a wireless ~~bulkhead-signal-in connector-portion~~, a wireless through wire ~~connector-connecting portion~~, and a wireless ground ~~contact connector-portion~~, and
    - an insulator electrically isolating the wireless ~~bulkhead-signal-in connector portion~~ from the wireless through wire ~~connector-connecting portion~~; and,
    - a bulkhead, wherein the bulkhead includes a contact pin in wireless electrical contact with the wireless signal-in connector, wherein
    - at least a portion of the bulkhead is contained within a tandem seal adapter, and the wireless ground contact connector is in wireless electrical contact with the tandem seal adapter.
2. (Currently Amended) The perforating gun of claim 1, further comprising a through wire for relaying an electrical signal along a length of the charge holder, wherein the through wire is a wire and the wireless through wire ~~connector-connecting portion~~ is in electrical contact with the through wire.
3. (Original) The perforating gun of claim 1, wherein the charge holder is an injection molded part.

4. (Cancelled)
5. (Currently Amended) The perforating gun of claim 1[[4]], wherein the contact pin transfers an electrical signal from a previous wellbore tool to the wireless signal-in ~~bulkhead~~-connector ~~portion~~.
6. (Cancelled)
7. (Original) The perforating gun of claim 1, further comprising a top connector, wherein the detonator is positioned within the top connector.
8. (Original) The perforating gun of claim 7, wherein the top connector is an injection molded part.
9. (Currently Amended) A modular detonator, comprising:
  - a detonator body containing detonator components;
  - a wireless signal-in connector ~~bulkhead connecting portion~~;
  - a wireless through wire connector ~~connecting portion~~;
  - a wireless ground contact connector ~~portion~~;
  - a signal-in wire electrically connecting at least in part the wireless signal-in connector ~~bulkhead connecting portion~~ to at least one of the detonator components; and,
  - an insulator electrically isolating the wireless signal-in connector ~~bulkhead connecting portion~~ from the wireless through wire connector ~~connecting portion~~, wherein the wireless signal-in connector is configured for making wireless electrical contact with an electrical contact of a bulkhead assembly contained at least in part within a tandem seal adapter when the modular detonator is received within a gun assembly of a perforating gun system, and

the wireless ground contact connector is configured for making wireless electrical contact with the tandem seal adapter when the modular detonator is received within the gun assembly of the perforating gun system.

10. (Original) The modular detonator of claim 9, further comprising a detonating cord connecting portion, wherein the detonating cord connecting portion is sized to retain a detonating cord and positioned to energetically couple the detonating cord to the detonator.

11. (Currently Amended) A method for assembling a perforation gun system, comprising:

(a) inserting a charge holder within a hollow interior of an outer gun carrier, wherein the charge holder includes a detonating cord connected to the charge holder and at least one shaped charge;

(b) inserting a top connector into the outer gun carrier adjacent to the charge holder, the top connector comprising a hollow channel;

(c) inserting a detonator into the hollow channel of the top connector ~~outer gun carrier~~, the detonator including

a detonator body containing detonator components,

a wireless signal-in ~~bulkhead connector portion~~, a wireless through wire connector ~~connecting portion~~, and a wireless ground contact connector ~~portion~~, and

an insulator electrically isolating the wireless signal-in ~~bulkhead connector portion~~ from the wireless through wire connector ~~connecting portion~~; and

~~(e)~~(d) connecting a through wire to the wireless through wire connector; ~~connecting portion~~

(e) energetically coupling the detonating cord to the detonator; and,

(f) transporting the perforation gun system to a wellbore site, wherein at least one of steps (a), (b), and (d) is performed before transporting the perforation gun system, and step (c) is performed at the wellbore site.

12. (Cancelled)

13. (Original) The method of claim 11, wherein inserting the detonator into the outer gun carrier includes pushing the detonator into the outer gun carrier.

14. (Currently Amended) The method of claim 11, wherein the through wire is a wire, and the wireless through wire ~~connector-connecting portion~~ of the detonator is in electrical contact with the through wire.

15. (Currently Amended) The method of claim 11, further comprising connecting a bulkhead into the outer gun carrier, wherein the bulkhead includes a contact pin and connecting the bulkhead into the outer gun carrier includes placing the contact pin in wireless electrical contact with the wireless ~~signal-in bulkhead connector-portion~~.

16. (Currently Amended) The method of claim 11[[12]], wherein one or more of steps (a), ~~(b)(e)~~, and (d) is performed at a factory or a facility that is not a wellbore site.

17. (Cancelled)

18. (Currently Amended) The method of claim 11[[12]], further comprising performing a continuity test to ensure continuity between one or more electrical connections of the perforation gun system.

19. (Currently Amended) The method of claim 11[[12]], wherein performing ~~at least~~ steps (a) to ~~[-]~~~~(e)~~ and (e) a first time with a first set of components completes a first perforating gun segment and the method further comprises:

performing ~~at least~~ steps (a) to ~~[-]~~~~(e)~~ and (e) a second time with a second set of components to complete a second perforating gun segment; and  
connecting the second perforating gun segment to the first perforating gun segment.

20. (Currently Amended) The method of claim 11, wherein the detonator further includes a signal-in ~~portion~~-wire electrically connecting at least in part the wireless signal-in connector ~~bulkhead-connecting portion~~ to at least one of the detonator components.

21. (New) The perforating gun of claim 1, wherein the detonator includes a signal-in wire electrically connected to the wireless signal-in connector and a ground wire electrically connected to the wireless ground contact connector.

22. (New) The perforating gun of claim 1, wherein the detonator is configured for being electrically contactably received within the perforating gun without using a wired electrical connection, and the wireless signal-in connector, the wireless through-wire connector, and the wireless ground contact connector together are configured to replace the wired electrical connection and to complete an electrical connection merely by contact.

23. (New) The modular detonator of claim 9, the modular detonator further comprising a ground wire electrically connected to the wireless ground contact connector.

24. (New) The modular detonator of claim 9, wherein the modular detonator is configured for being electrically contactably received within the gun assembly of the perforating gun system without using a wired electrical connection, and the wireless signal-in connector, the wireless through-wire connector, and the wireless ground contact connector together are configured to replace the wired electrical connection and to complete an electrical connection merely by contact.

## REMARKS

The Examiner is respectfully requested to enter the amendments to the claims noted herein, and to consider and examine the application as amended. The Office Action addressed Claims 1-20. In this document, amendments to the claims have been made to secure the issuance of a patent on the allowed claims. Specifically, Claims 4 and 6 have been cancelled and the subject matter of those claims is incorporated into Claim 1 and at least in part into Claim 9, and Claims 12 and 17 have been cancelled and the subject matter of those claims is incorporated into Claim 11.

Claims 1, 2, 5, 9, 11, 14-16, and 18-20 are currently amended. New claims 21-24 have been added. Support for the new claims can be found throughout the specification, and specifically at ¶¶ [0061] and [0066], and FIGS. 27-35B.

Applicant expressly reserves the right to re-introduce and-or re-file unclaimed subject matter. Since there are only 3 independent claims and the total number of claims presented is 20, Applicant believes that no claim fees are required for entry of this amendment. Upon entry of this amendment, Claims 1-3, 5, 7-11, 13-16, and 18-24 remain in the application.

## OBJECTIONS TO THE SPECIFICATION

The Examiner has objected to the Specification for failing to provide proper antecedent basis for the previously-claimed “wireless bulkhead connector portion” (claims 1, 4, 5, 11, and 15), “wireless bulkhead connecting portion” (claim 9), “wireless through wire connecting portion” (claims 1, 2, 9, 11, and 14), and “wireless ground portion” (1, 6, 9, and 11). (Office Action at 2.) Without acquiescing to the Examiner’s objections, and for the purpose of moving this application to immediate allowance, the remaining claims are currently amended, where applicable, to recite: a “wireless signal-in connector” in place of a “wireless bulkhead connector portion” and a “wireless bulkhead connecting portion”; a “wireless through wire connector” in place of a “wireless through wire connecting portion”; and, a “wireless ground contact connector” in place of a “wireless ground portion.” Support for the amendments can be found, for example, at ¶¶ [0061], [0066], and [0073], and Figures 27-30, 35A, and 35B.

Applicant respectfully submits that the indicated claim amendments obviate the Examiner’s objections to the Specification, without materially changing the scope of the claims.

The indicated claim amendments are intended to clarify the claim terms finding additional express support in the Specification. In addition, without acquiescing to the Examiner's interpretations of the previous claim terms forming the basis of the Examiner's objections, Applicant respectfully submits that the indicated claim amendments render moot the Examiner's interpretations of those terms.

Withdrawal of the objections to the Specification is respectfully requested.

## **PATENTABILITY OF THE CLAIMS**

### **ALLOWABLE SUBJECT MATTER**

Applicant thanks the Examiner for the indication of allowability of Claims 6 and 17. The subject matter of Claim 6, including intervening Claim 4, has been incorporated into Claim 1, and the subject matter of Claim 17, including intervening claim 12, has been incorporated into Claim 11. As Claims 6 and 17 have now been placed into independent form viz-a-viz Claims 1 and 12, respectively, those independent claims are believed to be in condition for immediate allowance.

While Applicant agrees that original Claims 6 and 17 contain allowable subject matter, Applicant respectfully submits that the allowable subject matter of the original claims is not limited to the subject matter noted in the Examiner's statement of reasons for the indication of allowable subject matter ("wherein at least a portion of the bulkhead is contained within a tandem seal adapter, and the wireless ground portion is in wireless electrical contact with the tandem seal adapter," and "performing steps (a), (c), and (d) is performed before transporting the perforation gun system, and step (b) is performed at the wellbore site" (Office Action at 9)). For example, allowable subject matter may be found variously in the claimed detonator including the claimed connectors/connecting portions in original Claims 1, 9, and 11, and/or in the combination of the claimed detonator in the claimed perforating gun (Claim 1) and method (Claim 11). Allowable subject matter may further be found in those elements by themselves or in certain combinations with other features of the independent claims or the various dependent claims that depend therefrom.

As Applicant is moving this application to immediate allowance on the basis of original Claims 6 and 17, Applicant is not addressing all, or any particular, alternative subject matter that

Applicant believes is allowable, and Applicant disagrees with any suggestion that the allowable subject matter of the original claims is limited to the Examiner's indication of allowable subject matter.

#### CLAIM REJECTIONS UNDER 35 U.S.C. §102(a)

Claims 9 and 10 stand rejected under 35 U.S.C. § 102(a)(1), as allegedly being anticipated by U.S. Patent No. US 6,752,083 B1, Lerche et al. ("Lerche"). Without acquiescing to the Examiner's rejections, and for the purpose of moving this application to immediate allowance, Claim 9 is currently amended to incorporate, in part, certain subject matter from Claim 6 that the Examiner has found allowable. Claim 9 now recites:

A modular detonator, comprising:  
a detonator body containing detonator components;  
a wireless signal-in connector;  
a wireless through wire connector;  
a wireless ground contact connector;  
a signal-in wire electrically connecting at least in part the wireless signal-in connector to at least one of the detonator components; and,  
an insulator electrically isolating the wireless signal-in connector from the wireless through wire connector, wherein  
the wireless signal-in connector is configured for making wireless electrical contact with an electrical contact of a bulkhead assembly contained at least in part within a tandem seal adapter when the modular detonator is received within a gun assembly of a perforating gun system, and  
the wireless ground contact connector is configured for making wireless electrical contact with the tandem seal adapter when the modular detonator is received within the gun assembly of the perforating gun system.

Applicant respectfully submits that Claim 9 is allowable for at least the same reasons as original Claim 6, as indicated by the Examiner. Claim 10 depends from Claim 9 and is allowable for at least the same reasons. Withdrawal of these rejections is respectfully requested.

New Claims 23 and 24 depend from Claim 9 and are allowable for at least the same reasons.

Claims 1, 2, 4, 5, 7, 11-16, 19 and 20 stand rejected under 35 U.S.C. § 102(a)(2), as allegedly being anticipated by U.S. Patent No. US 9,677,363 B2, Schacherer et al. ("Schacherer"). Without acquiescing to the Examiner's rejections, and for the purpose of moving this application to immediate allowance, Claim 1 has been amended to incorporate the allowable subject matter of

Claim 6 and intervening Claim 4, and Claim 11 has been amended to incorporate the allowable subject matter of Claim 17 and intervening Claim 12. Claims 2, 5, and 7 depend from Claim 1 and are allowable for at least the same reasons as Claim 1. Claims 13-16, 19, and 20 depend from Claim 11 and are allowable for at least the same reasons as Claim 11. Withdrawal of these rejections is respectfully requested.

New Claims 21 and 22 depend from Claim 1 and are allowable for at least the same reasons as Claim 1.

#### CLAIM REJECTIONS UNDER 35 U.S.C. §103

Claims 3 and 8 stand rejected under 35 U.S.C. § 103, as allegedly being unpatentable over Schacherer as applied to Claims 1 and 7, and further in view of U.S. Patent No. 10,190,398 B2, Goodman et al. (“Goodman”). Applicant does not acquiesce to the Examiner’s rejections, although Applicant does not necessarily disagree with the Examiner’s noted deficiencies in the cited art. For the purpose of moving this application to immediate allowance, Claim 1 has been amended as discussed above. Claims 3 and 8 depend from Claim 1 and are allowable for at least the same reasons. Withdrawal of these rejections is respectfully requested.

Claim 18 stands rejected under 35 U.S.C. § 103, as allegedly being unpatentable over Schacherer as applied to claim 12, and further in view of U.S. Patent No. 8,695,506 B2, Lanclos (“Lanclos”). Applicant does not acquiesce to the Examiner’s rejection, although Applicant does not necessarily disagree with the Examiner’s noted deficiencies in the cited art. For the purpose of moving this application to immediate allowance, Claim 11 has been amended as discussed above. Claim 18 depends from Claim 11 and is allowable for at least the same reasons. Withdrawal of this rejection is respectfully requested.

#### EXAMINER’S CONCLUSION

Applicant does not necessarily agree with the Examiner’s conclusion (Office Action at 10) that the cited art listed in form PTO-892, attached to the Office Action, is pertinent to Applicant’s disclosure.

## CONCLUSIONS

In view of the foregoing remarks, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for allowance. Favorable action is respectfully requested.

Applicant reserves all rights and arguments with respect to all such other limitations and distinctions not expressly noted above. Moreover, to the extent that any claim amendments made above constitute a narrowing of the scope of the claimed subject matter, such narrowing should not be construed as admitting the merits of any of the claim rejections. Applicant's failure (if at all) to expressly address above any particular statement or argument by the Examiner should not be construed as an admission or acquiescence that such statement or argument is accurate or proper.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact Applicant's undersigned representative at the below listed telephone number.

It is not believed that any fees are required for this Amendment. Please charge any deficiency or credit any overpayment to Deposit Account Number 600151, with reference to the above-referenced attorney docket number. The undersigned attorney may be contacted at the number below to facilitate the resolution of any matters.

Respectfully submitted,

          /Jason M. Rockman/            
Jason M. Rockman  
Registration No.: 63,473

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May 21, 2019

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

<b>TRANSMITTAL FORM</b>  <i>(to be used for all correspondence after initial filing)</i>	Application Number	16/359,540
	Filing Date	03/20/2019
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	SEMICK, Joshua T
Total Number of Pages in This Submission	13	Attorney Docket Number DMC007USCon3

<b>ENCLOSURES (Check all that apply)</b>		
<input type="checkbox"/> Fee Transmittal Form <input type="checkbox"/> Fee Attached <input checked="" type="checkbox"/> Amendment/Reply <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input type="checkbox"/> Information Disclosure Statement  <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Reply to Missing Parts/ Incomplete Application <input type="checkbox"/> Reply to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition <input type="checkbox"/> Petition to Convert to a Provisional Application <input type="checkbox"/> Power of Attorney, Revocation <input type="checkbox"/> Change of Correspondence Address <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Request for Refund <input type="checkbox"/> CD, Number of CD(s) _____ <input type="checkbox"/> Landscape Table on CD	<input type="checkbox"/> After Allowance Communication to TC <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input type="checkbox"/> Other Enclosure(s) (please identify below):
<input type="text"/> Remarks		

<b>SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT</b>			
Firm Name	Moyles IP, LLC		
Signature	/Jason M. Rockman/		
Printed name	Jason M. Rockman		
Date	May 21, 2019	Reg. No.	63473

<b>CERTIFICATE OF TRANSMISSION/MAILING</b>			
I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:			
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	36066157
<b>Application Number:</b>	16359540
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	9246
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM
<b>First Named Inventor/Applicant Name:</b>	David C. Parks
<b>Customer Number:</b>	81796
<b>Filer:</b>	Jason Marshall Rockman
<b>Filer Authorized By:</b>	
<b>Attorney Docket Number:</b>	DMC007USCon3
<b>Receipt Date:</b>	21-MAY-2019
<b>Filing Date:</b>	20-MAR-2019
<b>Time Stamp:</b>	15:21:37
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	no
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### File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		DMC007USCon3_OA_Reply.pdf	116817  d401b9398e28c5d92de0c3a5f659493f5b1 dd370	yes	11

Multipart Description/PDF files in .zip description			
	Document Description	Start	End
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	11

**Warnings:**

**Information:**

2	Transmittal Letter	DMC007USCon3_Transmittal_Letter_Post_Filing_SB21.pdf	232682	no	2
			f45cd793c44261aaa52ef9e367c57232aaec028d		

**Warnings:**

**Information:**

<b>Total Files Size (in bytes):</b>		349499
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**New Applications Under 35 U.S.C. 111**

**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.**

**National Stage of an International Application under 35 U.S.C. 371**

**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.**

**New International Application Filed with the USPTO as a Receiving Office**

**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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<b>PATENT APPLICATION FEE DETERMINATION RECORD</b> Substitute for Form PTO-875	Application or Docket Number 16/359,540	Filing Date 03/20/2019	<input type="checkbox"/> To be Mailed
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ENTITY:  LARGE  SMALL  MICRO

**APPLICATION AS FILED - PART I**

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *		x \$ 100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *		x \$ 460 =	
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

**APPLICATION AS AMENDED - PART II**

		(Column 1)		(Column 2)	(Column 3)	RATE (\$)	ADDITIONAL FEE (\$)
<b>AMENDMENT</b>	05/21/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	x \$ 100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0	x \$ 460 =	0
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))							
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
						TOTAL ADD'L FEE	0
<b>AMENDMENT</b>		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		
	Total (37 CFR 1.16(i))	*	Minus	**	=	x \$ 0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x \$ 0 =	
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))							
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
						TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.						LIE	
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".						/TARA A WASHINGTON/	
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".							
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.							

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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
Row 1: 16/359,540, 03/20/2019, David C. Parks, DMC007USCon3, 9246
Row 2: 81796, 7590, 05/03/2019, Moyles IP, LLC, 1 Enterprise Drive, Suite 428, Shelton, CT 06484
Row 3: EXAMINER SEMICK, JOSHUA T
Row 4: ART UNIT 3641, PAPER NUMBER
Row 5: NOTIFICATION DATE 05/03/2019, DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@moylesip.com
lmoyles@moylesip.com



### DETAILED CORRESPONDENCE

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

#### *Priority*

2. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119 (a)-(d). The certified copy has been filed in parent Application No. 14/904788, filed on 13 January 2016.

#### *Specification*

3. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

**Claims 1, 4, 5, 11 and 15** – the phrase “wireless bulkhead connector portion” cannot be found in the specification. For purposes of examination it will be interpreted as the disclosed “bulkhead connector element 118” ¶[0073].

**Claim 9**– the phrase “wireless bulkhead connecting portion” cannot be found in the specification. For purposes of examination it will be interpreted as the disclosed “bulkhead connector element 118” ¶[0073].

**Claims 1, 2, 9, 11 and 14** – the phrase “wireless through wire connecting portion” cannot be found in the specification. For purposes of examination it will be interpreted as the disclosed “through wire connector element 112” ¶[0073].

**Claims 1, 6, 9 and 11** – the phrase “wireless ground portion” cannot be found in the specification. For purposes of examination it will be interpreted as the disclosed “ground contact element 114” ¶[0073].

#### *Claim Rejections - 35 USC § 102*

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

(a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

5. **Claims 9 and 10** are rejected under 35 U.S.C. 102(a)(1) as being anticipated by US 6,752,083 B1 to Lerche et al. (“Lerche”).

Regarding **claim 9**, Lerche discloses a modular detonator (**22**, Fig. 5, reproduced below with examiner’s annotations) comprising:

a detonator body (comprising main housing **150** and booster housing **160**) containing detonator components (at least voltage multiplier **102**, see Fig. 2);

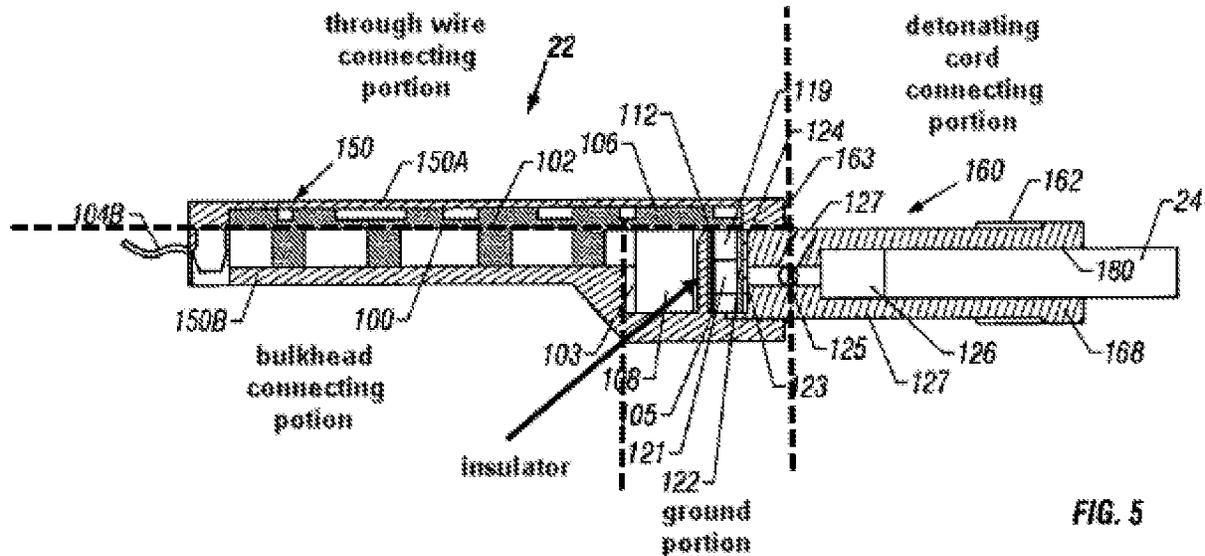
a wireless bulkhead connecting portion (annotated below, defined by the left portion of bottom housing 150B);

a wireless through wire connecting portion (annotated below, defined by top housing 150A);

a wireless ground portion (annotated below, defined by the right portion of bottom housing 150B);

a signal-in wire **104B** electrically connecting at least in part the wireless bulkhead connecting portion (annotated below) to at least one of the detonator components (voltage multiplier 102, the connection is best seen in Fig. 2); and

an insulator (the “insulation layer... e.g., a polyimide layer such as KAPTON.RTM. or Pyralin” of support structure 110, 3:8-15) electrically isolating the bulkhead connecting portion (annotated below) from the through wire connecting portion (annotated below).



Regarding **claim 10**, Lerche further discloses a detonating cord connecting portion (annotated above), wherein the detonating cord connecting portion (annotated above) is sided to retain a detonating cord **24** and positioned to energetically couple (via at least booster explosive 126) the detonating cord **24** to the detonator **22**.

6. **Claims 1, 2, 4, 5, 7, 11-16, 19 and 20** are rejected under 35 U.S.C. 102(a)(2) as being anticipated by US 9,677,363 B2 to Schacherer et al. ("Schacherer").

Regarding **claims 1, 2, 11 and 14**, Schacherer discloses a perforating gun (well tool system **12**, Fig. 1, reproduced below with examiner's annotations) and method for assembling the same, comprising:

an outer gun carrier (comprising outer housing **26** and connectors **28, 30**, Fig. 5, reproduced below with examiner's annotations);

a charge holder (annotated below) positioned within the outer gun carrier (comprising **26**) and including a detonating cord (**22**, see Fig. 1) connected to the charge holder (annotated below) and at least one shaped charge **24**; and

a detonator (comprising **60, 40, 38, 32, 76, 48, 46**, see Figs. 4 and 5, reproduced below with examiner's annotations) contained entirely within the outer gun carrier (comprising **30**), the detonator

Art Unit: 3641

(comprising **60, 40, 38, 32, 76, 48, 46**) including a detonator body (annotated below) containing detonator components (at least firing module **32**),

a wireless bulkhead connector portion (comprising **64**),

a wireless through wire connecting portion (comprising **66**), and

a wireless ground portion **46**,

a through wire (comprising **34**, see Fig. 5) for relaying an electrical signal along a length of the charge holder (annotated below), wherein the through wire **34** is a wire and the wireless through wire connection portion (comprising **66**) is in electrical contact with the through wire **34**; and

an insulator (see Fig. 3, annotated below, wherein the insulator is the material positioned between electrical contacts 64, 66 and connectors 68, 70 to facilitate conductive signal paths from 66 to 70 and from 64 to 68 respectively) electrically isolating the wireless bulkhead connector portion **64** from the wireless through wire connecting portion **66**.

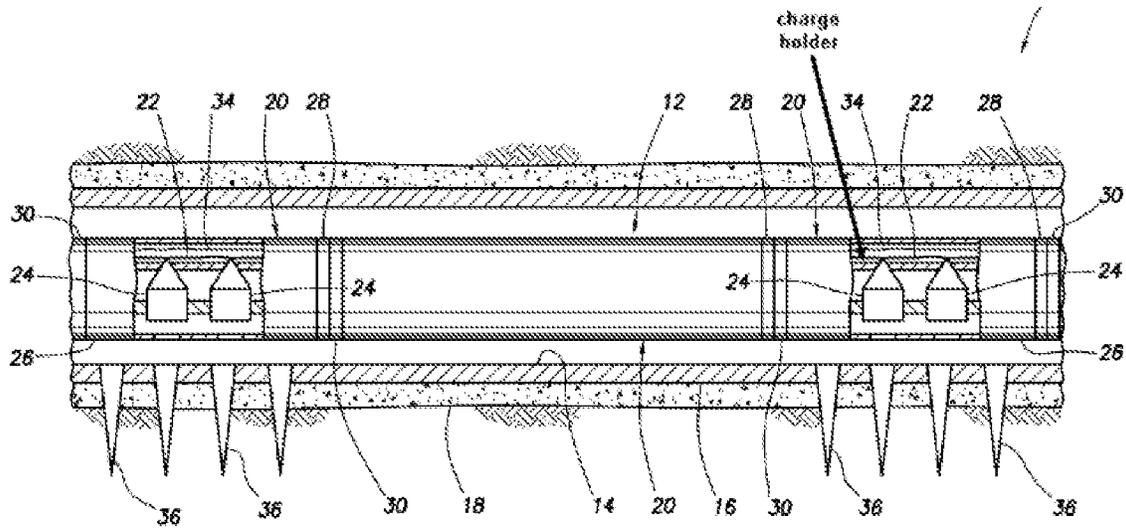


FIG. 1

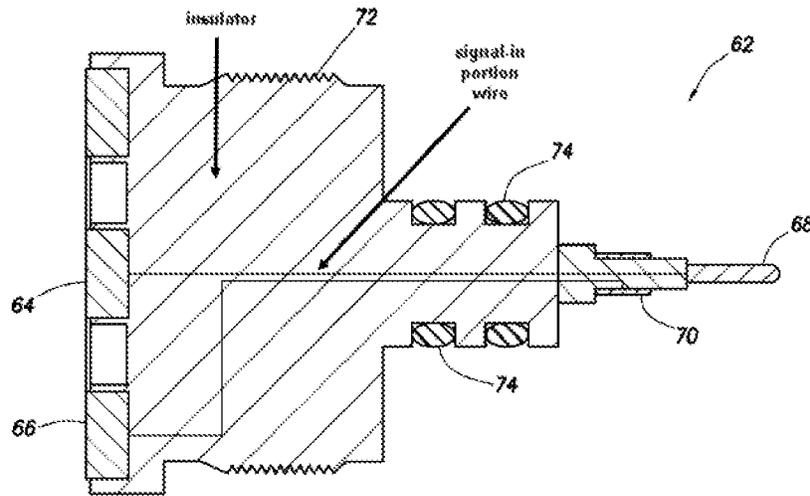


FIG. 3

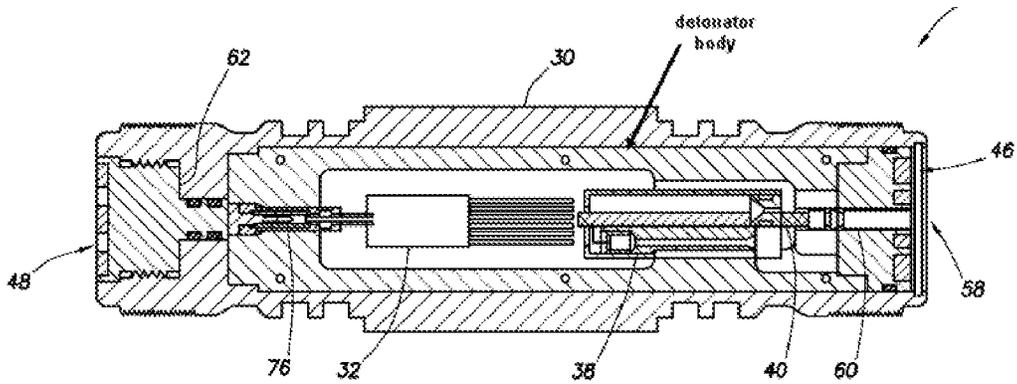
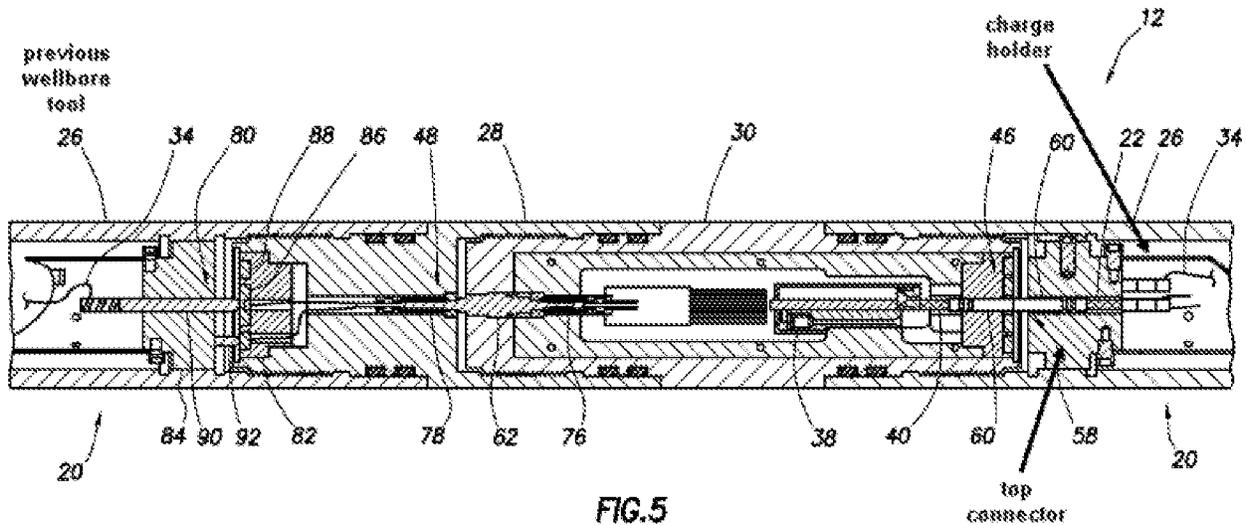


FIG. 4



Regarding **claim 4**, Schacherer further discloses a bulkhead (connector **84**, see Fig. 5), wherein the bulkhead **84** includes a contact pin **92** in wireless electrical contact with the wireless bulkhead connector portion (comprising **64**, **66**).

Regarding **claims 5 and 15**, Schacherer further discloses wherein the contact pin **92** transfers an electrical signal from a previous wellbore tool (annotated above, Fig. 5) to the wireless bulkhead connector portion (comprising **64**, **66**).

Regarding **claims 7 and 12**, Schacherer further discloses a top connector/detonating cord connecting portion (annotated above, Fig. 5), wherein the detonator (comprising **60**) is positioned within a hollow channel of the top connector (see Fig. 5).

Regarding **claim 13**, Schacherer further discloses wherein detonator component **60** attached to cord **22** is pushed (or inserted) into the hollow channel of the top connector (annotated above).

Regarding **claim 16**, Schacherer further discloses that assembly of each of the explosive assemblies **20** and connectors **30** takes place prior to transporting the assemblies to the wellbore site (3:45-58).

Regarding **claim 19**, Schacherer further discloses assembling a first set of components (the uppermost set of 20 + 30 shown in Fig. 1) and a second set of components (the lowermost set of 20 + 30 shown in Fig. 1).

Regarding **claim 20**, Schacherer further discloses wherein the detonator further includes a signal-in portion wire (annotated above, Fig. 3) electrically connecting at least in part the wireless bulkhead connecting portion **64** to at least one of the detonator components **32**.

***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

8. **Claims 3 and 8** are rejected under 35 U.S.C. 103 as being unpatentable over Schacherer as applied to claims 1 and 7 above (see ¶7), and further in view of US 10,190,398 B2 to Goodman et al. ("Goodman").

Regarding **claims 3 and 8**, Schacherer is silent regarding the charge holder or the top connector being an injection molded part. However, Goodman teaches a detonator structure (**36**, Fig. 2) for perforating guns (Fig. 1), the detonator having a housing **38** made by injection molding (3:29-33). Therefore, it would have been obvious to one of ordinary skill in the art prior to the effective filing date of the claimed invention to modify Schacherer to have either the charge holder or the top connector be an injection molded part, as taught by Goodman, in order to utilize a known process that is suitable for making subcomponents of perforating guns.

9. **Claim 18** is rejected under 35 U.S.C. 103 as being unpatentable over Schacherer as applied to claims 12 above (see ¶7), and further in view of US 8,695,506 B2 to Lanclos ("Lanclos").

Regarding claim 18, Schacherer is silent regarding the step of performing a continuity test. However, Lanclos teaches a method of verifying detonator connection of a perforating gun (abstract), the method involving confirming electrical continuity through the detonator (abstract and 2:6-11). Therefore, it would have been obvious to one of ordinary skill in the art prior to the effective filing date of the claimed invention to modify Schacherer to include the step of performing a continuity test, as taught by Lanclos, in order to ensure that the system is ready for detonation (2:6-11).

***Allowable Subject Matter***

10. **Claims 6 and 17** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

11. The following is a statement of reasons for the indication of allowable subject matter:

Regarding **claim 6**, the prior art fails to anticipate or make obvious (in the context of the pertinent claims) wherein at least a portion of the bulkhead is contained within a tandem seal adapter, and the wireless ground portion is in wireless electrical contact with the tandem seal adapter.

Schacherer is considered to most relevant known prior art who discloses a bulkhead **84** that is contained within an outer housing **26** of the perforating gun and there is no disclosure of the outer housing **26** in electrical contact with the wireless ground portion **46**.

Regarding **claim 17**, the prior art fails to anticipate or make obvious (in the context of the pertinent claims) performing steps (a), (c), and (d) is performed before transporting the perforation gun system, and step (b) is performed at the wellbore site. Schacherer is considered to most relevant known prior art who discloses performing the claimed steps (including step (b)) prior to transporting to the wellbore site (3:45-58).

**Conclusion**

12. Prior art not relied upon but considered pertinent to applicant's disclosure is cited in the attached PTO-892 form.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSHUA T SEMICK whose telephone number is (571)272-5274. The examiner can normally be reached on M-F: 7AM to 4PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Troy Chambers can be reached on (571)272-6874. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSHUA T SEMICK/  
Examiner, Art Unit 3641

**Notice of References Cited**

Application/Control No. 16/359,540	Applicant(s)/Patent Under Reexamination Parks et al.	
Examiner JOSHUA T SEMICK	Art Unit 3641	Page 1 of 1

**U.S. PATENT DOCUMENTS**

*		Document Number Code-Number-Kind Code	Country Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-10190398-B2		01-2019	Goodman; Kenneth	E21B43/1185	1/1
*	B	US-9518454-B2		12-2016	Current; Peter J.	E21B43/11	1/1
*	C	US-8695506-B2		04-2014	Lanclos; Ronald	E21B43/1185	102/206
*	D	US-6752083-B1		06-2004	Lerche; Nolan C.	E21B43/1185	102/202.5
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	J						
	K						
	L						
	M						

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*		Document Number Code-Number-Kind Code	Country Code	Date MM-YYYY	Country	Name	CPC Classification
	N						
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	R						
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**NON-PATENT DOCUMENTS**

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
 Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<b><i>Search Notes</i></b> 	<b>Application/Control No.</b> 16/359,540	<b>Applicant(s)/Patent Under Reexamination</b> Parks et al.
	<b>Examiner</b> JOSHUA T SEMICK	<b>Art Unit</b> 3641

CPC - Searched*		
Symbol	Date	Examiner
E21B43/1185, 43/11852, 43/11855	04/26/2019	JTS
E21B43/117	04/26/2019	JTS

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
searched inventor names in DAV	04/26/2019	JTS
searched Assignee in EAST	04/26/2019	JTS
E21B43/1185, 43/11852, 43/11855 - searched entirety	04/26/2019	JTS
E21B43/117 - text searched	04/26/2019	JTS
E21B43/117-11855	04/29/2019	JTS
citation searched	04/29/2019	JTS

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/JOSHUA T SEMICK/ Examiner, Art Unit 3641	
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 Doc description: Information Disclosure Statement (IDS) Filed

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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	16359540
	Filing Date	2019-03-20
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	Not yet assigned
	Attorney Docket Number	DMC007USCon3

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Application Number		16359540
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First Named Inventor	David C. Parks et al.	
Art Unit		3641
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1	AUSTIN POWDER COMPANY, A -140 F & Block, Detonator & Block Assembly, 2 pgs
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Examiner Signature	/JOSHUA T SEMICK/	Date Considered	04/29/2019
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<sup>1</sup> See Kind Codes of USPTO Patent Documents at [www.USPTO.GOV](http://www.USPTO.GOV) or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.

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( Not for submission under 37 CFR 1.99)

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Art Unit	3641		
Examiner Name	Not yet assigned		
Attorney Docket Number	DMC007USCon3		

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

**OR**

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

**SIGNATURE**

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jason M. Rockman/	Date (YYYY-MM-DD)	2019-03-25
Name/Print	Jason M. Rockman	Registration Number	63473

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. / J. T. S. /

## EAST Search History

## EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	1	us-4598775-\$.did.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 08:38
S2	1	us-9581422-\$.did.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 08:42
S4	1	us-4860653-\$.did.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 08:55
S3	1	us-4884506-\$.did.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 08:55
S5	1	us-6006833-\$.did.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 08:56
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		"5703319"   "5775426"   "5816343"   "6006833"   "6012525"   "6085659"   "6112666"   "6305287"   "6354374"   "6418853"   "6651747"   "6739265"   "6742602"   "7193527"   "7278491"   "7347278"   "7568429"   "7762172"   "7762351"   "7778006"   "7810430"   "7908970"   "7929270"   "8066083"   "8069789"   "8074737"   "8157022"   "8181718"   "8182212"   "8186259"   "8256337"   "8395878"   "8451137"   "8695506"   "8875787"   "8881816"   "9080433"   "9494021"   "9581422"   "9605937"   "9677363"   "9689223").PN.				
S7	95	S1 or S2 or S3 or S4 or S5 or S6	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 10:41
S8	2281	E21B43/1185-11855.cpc.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 10:50
S9	135	S8 and wireless	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/25 14:30
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S12	60	dynaenergetics.as.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/26 08:18
S13	39	(hunting adj titan).as.	US- PGPUB;	OR	ON	2019/04/26 08:35

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S17	1	us-4884506-\$.did.	US-	OR	ON	2019/04/26

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S23	57	S22 and injection adj mold\$4	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/26 18:18
S22	2582	E21B43/117.cpc.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/26 18:18
S26	40	S22 and (plastic or polymer) near10 (housing or holder)	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/26 18:25
S27	2	S26 and injection adj mold\$4	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/26 18:29
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S30	9	"45992233".FMID.	US- PGPUB; USPAT; FPRS	OR	ON	2019/04/29 09:07
S29	1	us-20140033939-\$.did.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 09:07
S32	1	us-20020013081-\$.did.	US- PGPUB; USPAT;	OR	ON	2019/04/29 09:09

			FPRS; EPO; JPO			
S31	1	us-6752083-\$.did.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 09:09
S33	1	us-8875787-\$.did.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 09:10
S34	1	us-20160273902-\$.did.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 09:11
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S37	184	S36 and (detonator or initiator).ti.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 09:18
S36	4574	E21B43/117-11855.cpc.	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 09:18
S38	9	"35788316".FMID.	US- PGPUB; USPAT; FPRS	OR	ON	2019/04/29 10:52
S41	15	S39 and (signal or electrica\$5) near5 wire	US- PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 10:54
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L5	4574	E21B43/117-11855.cpc.	US-PGPUB; USPAT; FPRS; EPO; JPO	OR	ON	2019/04/29 14:07
L7	93	"10077641"   "20020020320"   "20020062991"   "20030000411"   "20030001753"   "20050178282"   "20050194146"   "20070158071"   "20080149338"   "20080173204"   "20080264639"   "20090050322"   "20100230104"   "20120199031"   "20120242135"   "20120247769"   "20120247771"   "20120298361"   "20130008639"   "20130118342"   "20150226044"   "20160061572"   "20160084048"   "20160168961"   "20170030693"   "2358466"   "2889775"   "3170400"   "3246707"   "3374735"   "3504723"   "3859921"   "4007790"   "4058061"   "4182216"   "4491185"   "4496008"   "4574892"   "4598775"   "4747201"   "4776393"   "4790383"   "4889183"   "5027708"   "5052489"   "5088413"   "5105742"   "5159145"   "5322019"   "5347929"   "5436791"   "5703319"   "5775426"   "5816343"   "6006833"   "6012525"   "6085659"   "6112666"   "6305287"   "6354374"   "6418853"   "6651747"   "6739265"   "6742602"   "7193527"   "7278491"   "7347278"   "7568429"   "7762172"   "7762351"   "7778006"   "7810430"   "7908970"   "7929270"   "8066083"   "8069789"   "8074737"   "8157022"   "8181718"   "8182212"   "8186259"   "8256337"   "8395878"   "8451137"   "8695506"   "8875787"   "8881816"   "9080433"   "9494021"   "9581422"   "9605937"   "9677363"   "9689223").PN.	US-PGPUB; USPAT	OR	ON	2019/04/29 14:33

## EAST Search History (Interference)

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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number		
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	First Named Inventor	David C. Parks et al.	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	DMC007USCon3	

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Examiner Initial*	Cite No	Patent Number	Kind Code <sup>1</sup>	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Art Unit		
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Attorney Docket Number	DMC007USCon3	

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	1	2001059401	WO	A1	2001-08-16	INCO Limited		
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7	85107897	CN	A	1986-09-10	SCHLUMBERGER OVERSEAS S.A
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**NON-PATENT LITERATURE DOCUMENTS**

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T <sup>5</sup>
	1	DYNAENERGETICS, Selection Perforating Switch, Product Information Sheet, May 27, 2011, 1 pg.	
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First Named Inventor	David C. Parks et al.	
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Attorney Docket Number	DMC007USCon3	

7	DYNAENERGETICS, DYNAslect Electronic Detonator 0015 SFDE RDX 1.4S, Product Information, December 16, 2011, 1 pg.	<input type="checkbox"/>
8	DYNAENERGETICS, DYNAslect Electronic Detonator 0015 SFDE RDX 1.4B, Product Information, December 16, 2011, 1 pg.	<input type="checkbox"/>

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<sup>1</sup> See Kind Codes of USPTO Patent Documents at [www.USPTO.GOV](http://www.USPTO.GOV) or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	David C. Parks et al.	
Art Unit		
Examiner Name		
Attorney Docket Number	DMC007USCon3	

**CERTIFICATION STATEMENT**

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

**OR**

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

**SIGNATURE**

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jason M. Rockman/	Date (YYYY-MM-DD)	2019-03-20
Name/Print	Jason M. Rockman	Registration Number	63473

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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.**

## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. / J. T. S. /



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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Table with columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO., EXAMINER, ART UNIT, PAPER NUMBER, NOTIFICATION DATE, DELIVERY MODE. Contains application details for David C. Parks, DMC007USCon3, 9246, Examiner, Art Unit 3641, Notification Date 04/18/2019, Delivery Mode ELECTRONIC.

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@moylesip.com
lmoyles@moylesip.com

<b><i>Decision Granting Request for Prioritized Examination (Track I)</i></b>	<b>Application No.</b> 16/359,540	<b>Applicant(s)</b> Parks et al.	
	<b>Examiner</b> CHERYL P GIBSON BAYLOR	<b>Art Unit</b> OPET	<b>AIA (First Inventor to File) Status</b> Yes

1. THE REQUEST FILED 20 March 2019 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

- A.  for an original nonprovisional application (Track I).
- B.  for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

- A. filing a **petition for extension of time** to extend the time period for filing a reply;
- B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims**, or a multiple dependent claim;
- C. filing a **request for continued examination** ;
- D. filing a notice of appeal;
- E. filing a request for suspension of action;
- F. mailing of a notice of allowance;
- G. mailing of a final Office action;
- H. completion of examination as defined in 37 CFR 41.102; or
- I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to CHERYL GIBSON BAYLOR at (571 )272-3213. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/CHERYL GIBSON BAYLOR/  
Paralegal Specialist, OPET

**PATENT APPLICATION FEE DETERMINATION RECORD**

Substitute for Form PTO-875

Application or Docket Number  
16/359,540

**APPLICATION AS FILED - PART I**

(Column 1) (Column 2)

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A
TOTAL CLAIMS (37 CFR 1.16(j))	20	minus 20 = *
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))		

**SMALL ENTITY**

RATE(\$)	FEE(\$)
N/A	
N/A	
N/A	
TOTAL	

**OR OTHER THAN SMALL ENTITY**

RATE(\$)	FEE(\$)
N/A	300
N/A	660
N/A	760
x 100 =	0.00
x 460 =	0.00
	0.00
	0.00
TOTAL	1720

\* If the difference in column 1 is less than zero, enter "0" in column 2.

**APPLICATION AS AMENDED - PART II**

(Column 1) (Column 2) (Column 3)

AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total (37 CFR 1.16(j))	*	Minus	**	=
Independent (37 CFR 1.16(h))	*	Minus	***	=	
Application Size Fee (37 CFR 1.16(s))					
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					

**SMALL ENTITY**

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

**OR OTHER THAN SMALL ENTITY**

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

(Column 1) (Column 2) (Column 3)

AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total (37 CFR 1.16(j))	*	Minus	**	=
Independent (37 CFR 1.16(h))	*	Minus	***	=	
Application Size Fee (37 CFR 1.16(s))					
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					

**SMALL ENTITY**

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

**OR OTHER THAN SMALL ENTITY**

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

\* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

\*\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.



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Table with 7 columns: APPLICATION NUMBER, FILING or 371(c) DATE, GRP ART UNIT, FIL FEE REC'D, ATTY,DOCKET.NO, TOT CLAIMS, IND CLAIMS. Row 1: 16/359,540, 03/20/2019, 3641, 1720, DMC007USCon3, 20, 3

CONFIRMATION NO. 9246

FILING RECEIPT

81796
Moyles IP, LLC
1 Enterprise Drive, Suite 428
Shelton, CT 06484



Date Mailed: 04/09/2019

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections

Inventor(s)

David C. Parks, Calgary, CANADA;
Frank Haron Preiss, Bonn, GERMANY;
Liam McNelis, Bonn, GERMANY;
Eric Mulhern, Edmonton, CANADA;
Thilo Scharf, Letterkenny, IRELAND;

Applicant(s)

DynaEnergetics GmbH & Co. KG, Troisdorf, GERMANY;

Assignment For Published Patent Application

DynaEnergetics GmbH & Co. KG, Troisdorf, GERMANY
JDP Engineering and Machine Inc, Calgary, CANADA

Power of Attorney: The patent practitioners associated with Customer Number 81796

Domestic Priority data as claimed by applicant

This application is a CON of 15/920,812 03/14/2018
which is a CON of 15/617,344 06/08/2017
which is a DIV of 15/287,309 10/06/2016 PAT 9702680
which is a DIV of 14/904,788 01/13/2016 PAT 9494021
which is a 371 of PCT/CA2014/050673 07/16/2014

Foreign Applications (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.)
CANADA 2821506 07/18/2013

Permission to Access Application via Priority Document Exchange: Yes

**Permission to Access Search Results:** Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

**If Required, Foreign Filing License Granted:** 04/05/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/359,540**

**Projected Publication Date:** 07/18/2019

**Non-Publication Request:** No

**Early Publication Request:** No

**Title**

PERFORATION GUN COMPONENTS AND SYSTEM

**Preliminary Class**

102

**Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:** No

**PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES**

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

**LICENSE FOR FOREIGN FILING UNDER  
Title 35, United States Code, Section 184  
Title 37, Code of Federal Regulations, 5.11 & 5.15**

**GRANTED**

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

**NOT GRANTED**

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	16359540
	Filing Date	2019-03-20
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	Not yet assigned
	Attorney Docket Number	DMC007USCon3

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**INFORMATION DISCLOSURE  
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( Not for submission under 37 CFR 1.99)

Application Number		16359540
Filing Date		2019-03-20
First Named Inventor	David C. Parks et al.	
Art Unit		3641
Examiner Name	Not yet assigned	
Attorney Docket Number		DMC007USCon3

1	AUSTIN POWDER COMPANY, A –140 F & Block, Detonator & Block Assembly, 2 pgs
2	OWEN OIL TOOLS & PACIFIC SCIENTIFIC; Side Block for Side Initiation, 1 pg
3	SIPO, Office Action dated 06/27/2018: See Office Action for CN App. No. 201580011132.7, which is in the same family as PCT App. No. PCT/US2015/18906, 9 pgs. & 5 pgs.
4	AMIT GOVIL, Selective Perforation: A Game Changer in Perforating Technology - Case Study, presented at the 2012 European and West African Perforating Symposium, Schlumberger, Nov. 7-9. 2012, 14 pgs.
5	DYNAENERGETICS, DYNAslect System, information downloaded from website, July 3, 2013, 2 pgs., <a href="http://www.dynaenergetics.com/">http://www.dynaenergetics.com/</a>
6	GB INTELLECTUAL PROPERTY OFFICE, Search Report for App. No. GB 1700625.5, which is in the same family as US9494021, dated 7/07/2017, 5 pgs.
7	International Search Report and Written Opinion of International Application No. PCT/US2015/018906, July 10, 2015, 12 pgs
8	DYNAENERGETICS, Gun Assembly, Products Summary Sheet, May 7, 2004, 1 pg.
9	GB INTELLECTUAL PROPERTY OFFICE, Office Action dated 02/27/2018, See Office Action for App. No. GB 1717516.7, which is the same family as PCT App. No. PCT/CA2014/050673, 6 pg
10	DYNAENERGETICS, Selective Perforating Switch, information downloaded from website, July 3, 2013, 2 pgs., <a href="http://www.dynaenergetics.com/">http://www.dynaenergetics.com/</a>
11	HUNTING TITAN, Wireline Top Fire Detonator Systems, Product Information Sheet, 1 pg.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		16359540
Filing Date		2019-03-20
First Named Inventor	David C. Parks et al.	
Art Unit		3641
Examiner Name	Not yet assigned	
Attorney Docket Number		DMC007USCon3

12	HUNTING TITAN INC., Petition for Inter Parties Review of US Patent No. 9581422, filed Feb. 16, 2018, 93 pgs.
13	DYNAENERGETICS GMBH & CO. KG, Patent Owner's Response to Hunting Titan's Petition for Inter Parties Review, filed Dec. 6, 2018, 73 pgs.
14	DYNAENERGETICS GMBH & CO. KG, Patent Owner's Motion to Amend, filed Dec. 6, 2018, 53 pgs.
15	U.S. PATENT TRIAL AND APPEAL BOARD, Institution of Inter Partes Review, Case IPR2018-00600, issued on Aug. 21, 2018, 9 pgs.
16	International Written Opinion of International Application No. PCT/CA2014/050673, mailed October 9, 2014, 4 pgs
17	International Search Report of International Application No. PCT/CA2014/050673, mailed October 9, 2014, 3 pgs.
18	UK Examination Report of United Kingdom Patent Application No. GB1600085.3, which is in the same family as JS9494021, mailed March 9, 2016, 1 pg.
19	FIIP, Search Report dated 02/01/2018, in Russian: See Search Report for RU App. No. 2016104882/03, which is in the same family as PCT App. No. PCT/CA2014/050673, 7 pgs.
20	FIIP, Search Report dated 02/01/2018, in English See Search Report for RU App. No. 2016104882/03, which is in the same family as PCT App. No. PCT/CA2014/050673, 4 pages
21	Norwegian Industrial Property Office, Office Action for NO Patent App. No. 20160017, which is in the same family as PCT App No PCT/CA2014/050673, dated 6/15/2017, 3 pgs.
22	JET RESEARCH CENTER INC., Red RF Safe Detonators Brochure, 2008, 2 pgs., www.jetresearch.com

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		16359540
Filing Date		2019-03-20
First Named Inventor	David C. Parks et al.	
Art Unit	3641	
Examiner Name	Not yet assigned	
Attorney Docket Number	DMC007USCon3	

23	JET RESEARCH CENTER INC., JRC Catalog, 36 pgs., www.jetresearch.com
24	HORIZONTAL WIRELINE SERVICES, Presentation of a completion method of shale demonstrated through an example of Marcellus Shale, Pennsylvania, USA, Presented at 2012 International Perforating Symposium (26-28 April 2012), 17 pages
25	SMYLIE, New Safe and Secure Detonators for the Industry's consideration, Presented at Explosives Safety & Security Conference Marathon Oil Co, Houston, Feb. 23-24, 2005, 20 pages
26	SCHLUMBERGER, Combining and Customizing Technologies for Perforating Horizontal Wells in Algeria, Presented at 2011 MENAPS Middle East and North Africa Perforating Symposium, Nov. 28-30, 2011, 20 pages
27	BAKER HUGHES, Long Gun Deployment Systems IPS-12-28, Presented at 2012 International Perforating Symposium, April 26-28, 2011, 11 pages
28	OWEN OIL TOOLS, Recommended Practice for Oilfield Explosive Safety, Presented at 2011 MENAPS Middle East and North Africa Perforating Symposium, Nov. 28-30, 2011, 6 pages
29	Norwegian Industrial Property Office, Search Report for NO Patent App. No. 20160017, which is in the same family as PCT App No PCT/CA2014/050673, dated 6/15/2017, 2 pgs.

If you wish to add additional non-patent literature document citation information please click the Add button

**EXAMINER SIGNATURE**

Examiner Signature	<input type="text"/>	Date Considered	<input type="text"/>
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\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> See Kind Codes of USPTO Patent Documents at [www.USPTO.GOV](http://www.USPTO.GOV) or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.

<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	16359540
	Filing Date	2019-03-20
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	Not yet assigned
	Attorney Docket Number	DMC007USCon3

**CERTIFICATION STATEMENT**

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

**OR**

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

**SIGNATURE**

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jason M. Rockman/	Date (YYYY-MM-DD)	2019-03-25
Name/Print	Jason M. Rockman	Registration Number	63473

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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.**

## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

**PATENT COOPERATION TREATY**

From the INTERNATIONAL SEARCHING AUTHORITY

To: LISA J. MOYLES, ESQ.  
 MOYLES AND TREMBLAY LAW, LLC  
 970 BEAVER DAM ROAD  
 STRATFORD, CT 06614

**PCT**

NOTIFICATION OF TRANSMITTAL OF  
 THE INTERNATIONAL SEARCH REPORT AND  
 THE WRITTEN OPINION OF THE INTERNATIONAL  
 SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing (day/month/year)	
Applicant's or agent's file reference DMC014WO	<b>FOR FURTHER ACTION</b> See paragraphs 1 and 4 below
International application No. PCT/US 15/16906	International filing date (day/month/year) 05 March 2015 (05.03.2015)
Applicant DYNAENERGETICS GMBH & CO. KG	

1.  The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.  
**Filing of amendments and statement under Article 19:**  
 The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46).  
**When?** The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.  
**How?** Directly in the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes, 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70  
 For more detailed instructions, see *PCT Applicant's Guide, International Phase, paragraphs 9.004 - 9.011.*
2.  The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.
3.  With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
  - the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
  - no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.
4. **Reminders**  
 The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.  
 Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.3).  
 Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see [www.wipo.int/pct/en/texts/time\\_limits.html](http://www.wipo.int/pct/en/texts/time_limits.html) and the *PCT Applicant's Guide, National Chapters*.  
 Within 19 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45bis.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide, International Phase, paragraphs 8.006-8.012.*

Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/LIS Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8309	Authorized officer  Lee W. Young  PCT Helpdesk: 571-272-4020 Telephone No. PCT OSP: 571-272-7774  Hunting Titan, Inc. Ex. 1008
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference DMCO14WO	FOR FURTHER ACTION	see Form PCT/ISA/210 as well as, where applicable, item 5 below.
International application No. PCT/US 15/18806	International filing date (day/month/year) 05 March 2015 (05.03.2015)	(Earliest) Priority Date (day/month/year) 07 March 2014 (07.03.2014)
Applicant DYNAENERGETICS GMBH & CO. KG		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of:

the international application in the language in which it was filed.

a translation of the international application into \_\_\_\_\_ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b.  This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c.  With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2.  Certain claims were found unsearchable (see Box No. II).

3.  Unity of invention is lacking (see Box No. III).

4. With regard to the title,

the text is approved as submitted by the applicant.

the text has been established by this Authority to read as follows:

5. With regard to the abstract,

the text is approved as submitted by the applicant.

the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 6

as suggested by the applicant.

as selected by this Authority, because the applicant failed to suggest a figure.

as selected by this Authority, because this figure better characterizes the invention.

b.  none of the figures is to be published with the abstract.

Hunting Titan, Inc.  
Ex. 1008

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/18906

**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.: 5-9 and 17  
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:  
--- See extra 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. 1-4 and 10-13.

**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.

Hunting Titan, Inc.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/18906

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 29/02, 43/11, 43/116, 43/117, 43/118, 43/119, 43/263 (2015.01)

CPC - E21B 43/119, 43/11

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - E21B 29/02, 43/11, 43/116, 43/117, 43/118, 43/119, 43/263 (2015.01)

CPC - E21B 43/119, 43/11

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

CPC - E21B 29/02, 43/116, 43/117, 43/263

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

Patbase; Google Patents; Google Scholar; Google Web; Espacenet; Search Terms: arm\*, body\*, borehole\*, cas\*, center\*, central\*, clip\*, closed end, compress\*, cyind\*, deflect\*, deform\*, detour\*, downhole\*, explo\*, ground\*, head\*, hous\*, leg\*, locat\*, perforat\*, position\*, protrusion\*, retain\*, rib\*, secur\*, snap\*, wellbore\*, wireless\*

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,889,163 A (Sommers et al.) 28 December 1989 (26.12.1989), Figs. 1-3A, col. 1, ln. 6-8, col. 3, ln. 47-66	1-4 and 10-13
A	US 4,058,061 A (Mansur Jr. et al.) 15 November 1977 (15.11.1977), Fig. 1, col. 3, ln. 44-56	1-4 and 10-13
A	US 2013/0118342 A1 (Tessier) 16 May 2013 (16.05.2013), Fig. 5	1-4 and 10-13

 Further documents are listed in the continuation of Box C.

\* 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

"Z" document member of the same patent family

Date of the actual completion of the international search

23 June 2015 (23.06.2015)

Date of mailing of the international search report

10 JUL 2015

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-272-8300

Authorized officer:

Lee W. Young

Hunting Titan, Inc.

Ex. 1008

Pg. 135

PCT Helpdesk: 571-272-4000  
PCT OSP: 571-272-7774

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/16906

Continuation of Ser. No. III - Observations where unity of invention is lacking

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. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-4 and 10-13, directed to a detonator positioning device and perforating gun using the device.

Group II: Claims 14-16, directed to a method of assembling a perforating gun assembly while using a semiwired electrical connection.

The inventions listed as Groups I-II do not relate to a single inventive concept under PCT Rule 13.1 because under PCT Rule 13.2 they lack the same or corresponding technical features for the following reasons:

#### Special Technical Features

Group I includes the special technical features of a cylindrical body comprising an open end, a closed end, and a central bore adapted for receiving the detonator, the central bore extending along at least some of a length of the cylindrical body, the central bore including an enlarged bore portion adjacent the open end of the cylindrical body, a plurality of arms extending toward the open end of the cylindrical body and at least partially enclosing the enlarged bore portion of the central bore, each of the plurality of arms adapted to retain a detonator head of the detonator when the detonator is positioned within the enlarged bore portion of the central bore, and a plurality of legs extending from the cylindrical body and toward the closed end of the cylindrical body, each of the plurality of legs adapted to position the cylindrical body in the perforating gun assembly that are not required by Group II.

Group II includes the special technical features of positioning a ground connector biasing member at a base of the central bore, positioning a line-out connector biasing member at a base of an enlarged portion of the central bore, positioning a terminal for receiving a single line-out wire adjacent the lineout connector biasing member, and a ground portion of the housing electrically contacts the ground connector biasing member, and positioning a head of the detonator within the enlarged portion of central bore such that a line-out portion of the detonator electrically contacts the terminal, and a line-in contact-initiating pin electrically contacts a line-in portion of the detonator that are not required by Group I.

Groups I-II share the technical feature of a detonator positioning device within a perforating gun assembly, the detonator device comprising a central bore, and positioning a detonator within the central bore such that a housing of the detonator extends along at least a portion of the central bore.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 4,574,892 A to Grigar et al. (hereinafter "Grigar") which discloses a detonator positioning device (50) within a perforating gun assembly (Fig. 1; col. 3, ln. 21-25), the detonator device (76) comprising a central bore (Figs. 1-2; col. 4, ln. 56; 'detonator housing 76 is hollow'), and positioning a detonator (detonator cap 82) within the central bore such that a housing of the detonator extends along at least a portion of the central bore (Figs. 1-2).

Claims 1 and 13 of Group I and Group II share the technical feature of a wireless detonator. However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 2009/0050322 A1 to Hill et al. (hereinafter "Hill") which discloses a wireless detonator (para [0015], 'a perforating system configured to initiate perforating gun detonation by transmitting wireless signals from a portion of the perforating string selectively to individual perforating guns or sets of perforating guns').

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding technical feature.

Note: Claims 5-9 and 17 are dependent claims that are not drafted in accordance with the second and third sentences of Rule 6.4(a).

PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To: LISA J. MOYLES, ESQ.  
MOYLES AND TREMBLAY LAW, LLC  
970 BEAVER DAM ROAD  
STRATFORD, CT 06614

PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing (day/month/year) **10 JUL 2015**

Applicant's or agent's file reference: **DMCD14WO**  
FOR FURTHER ACTION  
See paragraph 2 below

International application No. <b>PCT/US 15/18906</b>	International filing date (day/month/year) <b>05 March 2015 (05.03.2015)</b>	Priority date (day/month/year) <b>07 March 2014 (07.03.2014)</b>
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International Patent Classification (IPC) or both national classification and IPC  
IPC(8) - **E21B 29/02, 43/11, 43/116, 43/117, 43/1185, 43/119, 43/263 (2015.01)**  
CPC - **E21B 43/119, 43/11**

Applicant **DYNAENERGETICS GMBH & CO. KG**

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 4bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 56.1 bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-6300	Date of completion of this opinion <b>23 June 2015 (23.06.2015)</b>	Authorized officer:  Lee W. Young Hunting Titan, Inc. PCT Helpdesk: 571-273-4300 PCT QSP: 571-273-7774 Ex. 1008 Pg. 137
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WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 15/18906

Box No. 1 Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:
  - the international application in the language in which it was filed.
  - a translation of the international application into \_\_\_\_\_ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2.  This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(s)).
3.  With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
  - a.  forming part of the international application as filed:
    - in the form of an Annex C/ST.25 text file.
    - on paper or in the form of an image file.
  - b.  furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
  - c.  furnished subsequent to the international filing date for the purposes of international search only:
    - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
    - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4.  In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 15/18906

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions: whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.

claims Nos. 5-8 and 17

because:

the said international application, or the said claims Nos. \_\_\_\_\_ relate to the following subject matter which does not require an international search (*specify*):

the description, claims or drawings (*indicate particular elements below*) of said claims Nos. 5-8 and 17 are so unclear that no meaningful opinion could be formed (*specify*):

Claims 5-9 and 17 are dependent claims and are not drafted in accordance with the second and third sentences of Rule 8.4(a).

the claims, or said claims Nos. \_\_\_\_\_ are so inadequately supported by the description that no meaningful opinion could be formed (*specify*):

no international search report has been established for said claims Nos. 5-9 and 17

a meaningful opinion could not be formed without the sequence listing, the applicant did not, within the prescribed time limit:

furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13ter.1(a) or (b).

See Supplemental Box for further details.

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 15/18906

Box No. IV Lack of unity of invention

1.  in response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:
- paid additional fees.
  - paid additional fees under protest and, where applicable, the protest fee.
  - paid additional fees under protest but the applicable protest fee was not paid.
  - not paid additional fees.

2.  This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is:

complied with.

not complied with for the following reasons:

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. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-4 and 10-13, directed to a detonator positioning device and perforating gun using the device.

Group II: Claims 14-16, directed to a method of assembling a perforating gun assembly while using a semiwired electrical connection.

The inventions listed as Groups I-II do not relate to a single inventive concept under PCT Rule 13.1 because under PCT Rule 13.2 they lack the same or corresponding technical features for the following reasons:

Special Technical Features

Group I includes the special technical features of a cylindrical body comprising an open end, a closed end, and a central bore adapted for receiving the detonator, the central bore extending along at least some of a length of the cylindrical body, the central bore including an enlarged bore portion adjacent the open end of the cylindrical body, a plurality of arms extending toward the open end of the cylindrical body and at least partially enclosing the enlarged bore portion of the central bore, each of the plurality of arms adapted to retain a detonator head of the detonator when the detonator is positioned within the enlarged bore portion of the central bore, and a plurality of legs extending from the cylindrical body and toward the closed end of the cylindrical body, each of the plurality of legs adapted to position the cylindrical body in the perforating gun assembly that are not required by Group II.

Group II includes the special technical features of positioning a ground connector biasing member at a base of the central bore, positioning a line-out connector biasing member at a base of an enlarged portion of the central bore, positioning a terminal for receiving a single line-out wire adjacent the lineout connector biasing member, and a ground portion of the housing electrically contacts the ground connector biasing member, and positioning a head of the detonator within the enlarged portion of central bore such that a line-out portion of the detonator electrically contacts the terminal, and a line-in contact-initiating pin electrically contacts a line-in portion of the detonator that are not required by Group I.

Groups I-II share the technical feature of a detonator positioning device within a perforating gun assembly, the detonator device comprising a central bore, and positioning a detonator within the central bore such that a housing of the detonator extends along at least a portion of the central bore.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 4,574,862 A to Grigar et al. (hereinafter "Grigar") which discloses a detonator positioning device (50) within a perforating gun assembly (Fig. 1, col. 3, ln. 21-25), the detonator device (75) comprising a central bore (Figs. 1-2; col. 4, ln. 59, "detonator housing 75 is hollow"), and positioning a detonator (detonator cap 82) within the central bore such that a housing of the detonator extends along at least a portion of the central bore (Figs. 1-2).

Claims 1 and 13 of Group I and Group II share the technical feature of a wireless detonator. However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 2005/0050322 A1 to Hill et al. (hereinafter "Hill") which discloses a wireless detonator (para [0015], "a perforating system configured to initiate perforating gun detonation by transmitting wireless signals from a portion of the perforating string selectively in individual perforating guns or sets of perforating guns").

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding technical feature.

Note: Claims 5-9 and 17 are dependent claims that are not drafted in accordance with the second and third sentences of Rule 6.4(a).

4. Consequently, this opinion has been established in respect of the following parts of the international application:

all parts.

the parts relating to claims Nos. 1-4 and 10-13

Hunting Titan, Inc.

Ex. 1008

Pg. 140

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 15/18806

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-4 and 10-13	YES
	Claims	None	NO
Inventive step (IS)	Claims	1-4 and 10-13	YES
	Claims	None	NO
Industrial applicability (IA)	Claims	1-4 and 10-13	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-4 and 10-13 meet the criteria as set forth by PCT Articles 33(2)-(3) as having novelty and an inventive step because the prior art fails to teach or fairly suggest the claimed subject matter. The most similar prior art is exemplified by US 4,889,183 A to Sommers et al. (hereinafter 'Sommers'), US 4,058,061 A to Mansur Jr. et al. (hereinafter 'Mansur') and US 2013/00118342 A1 (Tassaroli)

Regarding claim 1, Sommers discloses a detonator positioning device for positioning a wireless detonator (14) in a perforating gun assembly (Fig. 1; col. 1, ln. 6-9), the device comprising: a cylindrical body (16) comprising an open end (Fig. 2A), and a central bore adapted for receiving the detonator (Figs. 2A and 3A), the central bore extending along at least some of a length of the cylindrical body (Fig. 2A), a plurality of arms (46) extending toward the open end of the cylindrical body (Figs. 2A-2B), each of the plurality of arms adapted to retain a detonator head of the detonator when the detonator is positioned within the bore portion of the central bore (Fig. 3A; col. 3, ln. 47-66), and a plurality of legs (44) extending from the cylindrical body (Figs. 2A-2B) and each of the plurality of legs adapted to position the cylindrical body in the perforating gun assembly (Fig. 1; col. 3, ln. 47-66) but Sommers does not specifically disclose the cylindrical body comprising a closed end, the central bore including an enlarged bore portion adjacent the open end of the cylindrical body, the plurality of arms at least partially enclosing the enlarged bore portion of the central bore, and the plurality of legs extending toward the closed end of the cylindrical body.

Mansur discloses a detonator positioning device (Fig. 1), the device comprising: a cylindrical body (33) comprising an open end (bottom of 33 in Fig. 1), a closed end (top of 33 in Fig. 1), and a central bore adapted for receiving the detonator (34, 35, 36), the central bore extending along at least some of a length of the cylindrical body (Fig. 1), the central bore including an enlarged bore portion adjacent the open end of the cylindrical body (Fig. 1; Note bore portion at bottom of 33 is wider than tapered bore at top of 33), a plurality of legs (45) extending from the cylindrical body and toward the closed end of the cylindrical body (Fig. 1), each of the plurality of legs adapted to position the cylindrical body in the perforating gun assembly (Fig. 1; col. 3, ln. 44-66).

Tassaroli discloses the cylindrical body comprising a closed end (Fig. 6), the plurality of arms (501, 502) at least partially enclosing the bore portion of the central bore (Fig. 6).

However, none of Sommers, Mansur, nor Tassaroli disclose or provide a motivation to combine the detonator positioning device including the cylindrical body comprising a closed end, the central bore including an enlarged bore portion adjacent the open end of the cylindrical body, the plurality of arms at least partially enclosing the enlarged bore portion of the central bore, and the plurality of legs extending toward the closed end of the cylindrical body. Furthermore, such change to the detonator positioning device of Sommers as modified by Mansur would require the modification of a modifier.

Therefore, claim 1 meets the criteria as set forth by PCT Articles 33(2)-(3) as having novelty and an inventive step because the prior art fails to teach or fairly suggest the claimed subject matter.

Claims 2-4 are dependent upon claim 1 and therefore meet the criteria as set forth by PCT Articles 33(2)-(3) as having novelty and an inventive step for the reasons described above.

--- See supplemental box ---

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 16/18906

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:  
Box V.2 - Citations and explanations

Regarding claim 10, Sommers discloses a detonator positioning device for positioning a detonator (14) in a perforating gun assembly (Fig. 1; col. 1, ln. 6-9), the device comprising:  
a cylindrical body (16), the assembled cylindrical body comprising an open end (Fig. 2A), and a central bore adapted for receiving the detonator (Figs. 2A and 2A), the central bore extending along at least some of a length of the assembled cylindrical body (Fig. 2A),  
a plurality of arms (46) extending inward the open end of the assembled cylindrical body (Figs. 2A-2B) and each of the plurality of arms comprising a retainer adapted to retain a detonator head of the detonator positioned within the enlarged bore portion of the central bore (Fig. 1; col. 3, ln. 47-66), and  
a plurality of legs (44) extending from the assembled cylindrical body (Fig. 2A-2B), each of the plurality of legs comprising a protrusion extending away from the assembled cylindrical body and adapted for positioning the assembled cylindrical body in the perforating gun assembly (Fig. 1; col. 3, ln. 47-66) but Sommers does not specifically disclose a multi-part cylindrical body comprising at least a first part and a second part, wherein the first part is removably connected to the second part of the cylindrical body to form an assembled cylindrical body, each of the first part and the second part including at least a first portion and a second portion, the assembled cylindrical body comprising a closed end, the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body, a plurality of arms at least partially enclosing the enlarged bore portion of the central bore, a plurality of legs extending outward of the assembled cylindrical body

Mansur discloses a detonator positioning device (Fig. 1), the device comprising:  
a cylindrical body (33), the cylindrical body comprising an open end (bottom of 33 in Fig. 1), a closed end (top of 33 in Fig. 1), and a central bore adapted for receiving the detonator (34, 35, 36), the central bore extending along at least some of a length of the assembled cylindrical body (Fig. 1), the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body (Fig. 1; Note bore portion at bottom of 33 is wider than tapered bore at top of 33),  
a plurality of legs (45) extending from the assembled cylindrical body and toward the closed end of the assembled cylindrical body (Fig. 1), adapted for positioning the assembled cylindrical body in the perforating gun assembly (Fig. 1; col. 3, ln. 44-56).

Tassarali discloses the cylindrical body comprising a closed end (Fig. 6), and a plurality of arms (501, 502) at least partially enclosing the bore portion of the central bore (Fig. 6).

However, none of Sommers, Mansur, nor Tassarali disclose or provide a motivation to combine the detonator positioning device including a multi-part cylindrical body comprising at least a first part and a second part, wherein the first part is removably connected to the second part of the cylindrical body to form an assembled cylindrical body, each of the first part and the second part including at least a first portion and a second portion, the assembled cylindrical body comprising a closed end, the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body, a plurality of arms at least partially enclosing the enlarged bore portion of the central bore, a plurality of legs extending outward the closed end of the assembled cylindrical body. Furthermore, such change to the detonator positioning device of Sommers as modified by Mansur would require the modification of a modifier.

Therefore, claim 10 meets the criteria as set forth by PCT Articles 33(2)-(3) as having novelty and an inventive step because the prior art fails to teach or fairly suggest the claimed subject matter.

Claims 11-12 are dependent upon claim 10 and therefore meet the criteria as set forth by PCT Articles 33(2)-(3) as having novelty and an inventive step for the reasons described above.

— See supplemental box —

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/US 15/18906

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of  
Box V.2 - Citations and explanations

Regarding claim 13, Sommers discloses a perforating gun assembly comprising a detonator positioning device and a wireless detonator (Fig. 1; col. 1, ln. 6-9), the assembly comprising:

a detonator (14), and

a detonator positioning device for positioning the detonator in a perforating gun assembly (Fig. 1; col. 1, ln. 6-9), the device comprising: a cylindrical body (18) the assembled cylindrical body comprising an open end (Fig. 2A), and a central bore adapted for receiving the detonator (Figs. 2A and 3A), the central bore extending along at least some of a length of the assembled cylindrical body (Fig. 2A), a plurality of arms (46) extending toward the open end of the assembled cylindrical body (Fig. 2A) and each of the plurality of arms comprising a retainer adapted to retain a detonator head of the detonator when positioned within the enlarged bore portion of the central bore (Fig. 1; col. 3, ln. 47-55), and

a plurality of legs (44) extending from the assembled cylindrical body (Figs. 2A-2B), each of the plurality of legs comprising a protrusion extending away the assembled cylindrical body and adapted for positioning the assembled cylindrical body in the perforating gun assembly (Fig. 1; col. 3, ln. 47-55) but Sommers does not specifically disclose a multi-part cylindrical body comprising at least a first part and a second part, wherein the first part is removably connected to the second part of the cylindrical body to form an assembled cylindrical body, each of the first part and the second part including at least a first portion and a second portion, the cylindrical body comprising a closed end, the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body, a plurality of arms at least partially enclosing the enlarged bore portion of the central bore, a plurality of legs extending toward the closed end of the assembled cylindrical body.

Mansur discloses a detonator positioning device (Fig. 1) the assembly comprising:

a detonator (34, 35, 36), and

a detonator positioning device for positioning the detonator (Fig. 1), the device comprising:

a cylindrical body (33), the assembled cylindrical body comprising an open end (bottom of 33 in Fig. 1), a closed end (top of 33 in Fig. 1), and a central bore adapted for receiving the detonator (Fig. 1), the central bore extending along at least some of a length of the assembled cylindrical body (Fig. 1), the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body (Fig. 1; note bore portion at bottom of 33 is wider than tapered bore at top of 33),

a plurality of legs (45) extending from the assembled cylindrical body and toward the closed end of the assembled cylindrical body (Fig. 1), each of the plurality of legs comprising a protrusion and adapted for positioning the assembled cylindrical body in the perforating gun assembly (Fig. 1; col. 3, ln. 44-58).

Tassaroli discloses the cylindrical body comprising a closed end (Fig. 6), and a plurality of arms (501, 502) at least partially enclosing the bore portion of the central bore (Fig. 6).

However, none of Sommers, Mansur, nor Tassaroli disclose or provide a motivation to combine a multi-part cylindrical body comprising at least a first part and a second part, wherein the first part is removably connected to the second part of the cylindrical body to form an assembled cylindrical body, each of the first part and the second part including at least a first portion and a second portion, the cylindrical body comprising a closed end, the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body, a plurality of arms at least partially enclosing the enlarged bore portion of the central bore, a plurality of legs extending toward the closed end of the assembled cylindrical body. Furthermore, such changes to the detonator positioning device of Sommers as modified by Mansur would require the modification of a modifier.

Therefore, claim 13 meets the criteria as set forth by PCT Articles 33(2)-(3) as having novelty and an inventive step because the prior art fails to teach or fairly suggest the claimed subject matter.

Claims 1-4 and 10-13 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>CWCAS-299PCT</b>	<b>FOR FURTHER ACTION</b> see Form PCT/ISA/220 as well as, where applicable, item 5 below	
International application No. <b>PCT/CA2014/050673</b>	International filing date ( <i>day/month/year</i> ) 16 July 2014 (16-07-2014)	(Earliest) Priority date ( <i>day/month/year</i> ) 18 July 2013 (18-07-2013)
Applicant DYNAENERGETICS GMBH & CO. KG ET AL		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

- the international application in the language in which it was filed.
- a translation of the international application into \_\_\_\_\_ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b.  This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c.  With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2.  **Certain claims were found unsearchable** (see Box No. II).

3.  **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

- as suggested by the applicant.
- as selected by this Authority, because the applicant failed to suggest a figure.
- as selected by this Authority, because this figure better characterizes the invention.

b.  none of the figures is to be published with the abstract.

## INTERNATIONAL SEARCH REPORT

International application No.

**PCT/CA2014/050673**A. CLASSIFICATION OF SUBJECT MATTER  
IPC: *E21B 43/116* (2006.01)

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
*E21B 43/116* (2006.01)

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

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

TotalPatent, Questel-Orbit (Fampat)

(Keywords: gun, perforating, charge, holder, cord, detonator, explosive)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4598775 A (VANN, R. R., et al.) 08 July 1986 (08-07-1986) *Abstract; Figs. 1-9; Col. 1, line 10 – Col. 7, line 36; Claims*	1 to 8, 10, 17, 19, 20 to 22, 24
A	US 7762351 B2 (VIDAL, M.) 27 July 2010 (27-07-2010) *Whole document*	1 to 26
A	US 2008149338 A1 (GOODMAN, K., et al.) 26 June 2008 (26-06-2008) *Whole document*	1 to 26
A	US 2012298361A1 (SAMPSON, T. W.) 29 November 2012 (29-11-2012) *Whole document*	1 to 26

 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  
23 September 2014 (23-09-2014)Date of mailing of the international search report  
09 October 2014 (09-10-2014)Name and mailing address of the ISA/CA  
Canadian Intellectual Property Office  
Place du Portage I, C114 - 1st Floor, Box PCT  
50 Victoria Street  
Gatineau, Quebec K1A 0C9  
Facsimile No.: 001-819-953-2476

Authorized officer

Colin Watts (819) 934-9085

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.

**PCT/CA2014/050673**

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US 4598775 A	08 July 1986 (08-07-1986)	None	
US 7762351 B2	27 July 2010 (27-07-2010)	US2010089643A1 MX2011003709A WO2010043941A1	15 April 2010 (15-04-2010) 25 May 2011 (25-05-2011) 22 April 2010 (22-04-2010)
US 2008149338 A1	26 June 2008 (26-06-2008)	US2008149338A1 US7762331B2 AU2007338622A1 AU2007338622B2 BRPI0720365A2 CA2673082A1 CN101454635A GB0910392D0 GB2457208A GB2457208B MX2009006516A NO20092492A RU2009128048A RU2434122C2 US2010252323A1 WO2008079481A1	26 June 2008 (26-06-2008) 27 July 2010 (27-07-2010) 03 July 2008 (03-07-2008) 06 September 2012 (06-09-2012) 01 July 2014 (01-07-2014) 03 July 2008 (03-07-2008) 10 June 2009 (10-06-2009) 29 July 2009 (29-07-2009) 12 August 2009 (12-08-2009) 15 June 2011 (15-06-2011) 10 July 2009 (10-07-2009) 16 September 2009 (16-09-2009) 27 January 2011 (27-01-2011) 20 November 2011 (20-11-2011) 07 October 2010 (07-10-2010) 03 July 2008 (03-07-2008)
US 2012298361 A1	29 November 2012 (29-11-2012)	US2012298361A1 WO2012162308A2 WO2012162308A3	29 November 2012 (29-11-2012) 29 November 2012 (29-11-2012) 28 March 2013 (28-03-2013)

**PATENT COOPERATION TREATY**

From the  
INTERNATIONAL SEARCHING AUTHORITY

**PCT**

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:  
WILSON, CRAIG  
c/o Craig Wilson and Company  
5100 Orbitor Drive, Suite 202  
MISSISSAUGA, Ontario  
Canada, L4W 4Z4

Date of mailing 9 October 2014 (09-10-2014)  
(day/month/year)

Applicant's or agent's file reference  
**CWCAS-299PCT**

**FOR FURTHER ACTION**

See paragraph 2 below

International application No.

**PCT/CA2014/050673**

International filing date (day/month/year)

16 July 2014 (16-07-2014)

Priority date (day/month/year)

18 July 2013 (18-07-2013)

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

IPC: **E21B 43/116** (2006.01)

Applicant

DYNAENERGETICS GMBH & CO. KG ET AL

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

**2. FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/CA  
Canadian Intellectual Property Office  
Place du Portage I, C114 - 1st Floor, Box PCT  
50 Victoria Street  
Gatineau, Quebec K1A 0C9  
Facsimile No.: 001-819-953-2476

Date of completion of this opinion

24 September 2014 (24-09-2014)

Authorized officer

Colin Watts (819) 934-9085

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.

**PCT/CA2014/050673**

Box No. I

Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

- the international application in the language in which it was filed.
- a translation of the international application into \_\_\_\_\_ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2.  This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

a. (means)

- on paper
- in electronic form

b. (time)

- in the international application as filed.
- together with the international application in electronic form
- subsequently to this Authority for the purposes of search

4.  In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement		
1. Statement			
Novelty (N)	Claims	6, 8, 9, 11 to 16, 18, 21 to 23, 25, and 26	YES
	Claims	1 to 5, 7, 10, 17, 19, 20, and 24	NO
Inventive step (IS)	Claims	9, 11 to 16, 23, 25, and 26	YES
	Claims	1 to 8, 10, 17, 19, 20, 21, 22, and 24	NO
Industrial applicability (IA)	Claims	1 to 26	YES
	Claims	NONE	NO
2. Citations and explanations:			
D1: US 4598775 A (VANN, R. R., et al.) 08 July 1986 (08-07-1986)			
D2: US 7762351 B2 (VIDAL, M.) 27 July 2010 (27-07-2010)			
D3: US 2008149338 A1 (GOODMAN, K., et al.) 26 June 2008 (26-06-2008)			
D4: US 2012298361A1 (SAMPSON, T. W.) 29 November 2012 (29-11-2012)			
D1 discloses a perforating gun assembly wherein a plurality of charge holders are stacked in a gun carrier, and are configured such that they can be stacked at a desired orientation with respect to adjacent charge holders.			
D2 discloses a perforation gun having a plurality of charge holders stacked in a gun assembly, with multiple charges placed in each holder and a plate-shaped charge holder engaging adjacent charge holders by means of slots in the ends of the plates, resulting in charge holders placed at different orientations.			
D3 discloses a process for assembling a perforating gun using a number of loading tubes having shaped charges therein at different orientations, and stacking a plurality of such loading tubes within a gun carrier.			
D4 discloses a perforation string comprising a plurality of guns stacked in a gun carrier and connected by means of connectors.			
The inventive concept in the instant application is considered to lie in the use of a charge holder configured to be stacked to form a gun assembly, wherein the charge holder has a rotation coupling that allows it to be stacked at a selectable orientation with respect to adjacent charge holders or a top or bottom connector.			
<b>Novelty (N)</b>			
The subject matter of claims 1 to 5, 7, 10, 17, 19, 20, and 24 is considered to lack novelty and thus does not comply with <b>Article 33(2) of the PCT</b> . Document D1 discloses a perforation gun system having an outer gun carrier, top connector, a plurality of stackable charge holders, detonation cord, and bottom connector (e.g. figs. 5, 8, 9). The charge holders are shown as triangular in cross-section, allowing for stacking in three different orientations with respect to adjacent charge holders, but may have more sides to provide for further configurations (e.g. col. 3, lines 14 to 27). Each charge holder engages the adjacent charge holders by means of a plurality of protrusions, and the edges of the charge holder rest against the inner surface of the gun carrier to centralize the charges therein.			
The subject matter of claims 6, 8, 9, 11 to 16, 18, 21 to 23, 25, and 26 is considered to be novel and thus complies with <b>Article 33(2) of the PCT</b> , as the features claimed therein are not explicitly disclosed in the prior art.			
<b>Inventive Step (IS)</b>			
The subject matter of claims 1 to 8, 10, 17, 19, 20 to 22, and 24 are considered to lack an inventive step and thus do not comply with <b>Article 33(3) of the PCT</b> . The subject matter of claims 1 to 5, 7, 10, 17, 19, 20, and 24 lacks novelty, as discussed above, and therefore is considered to also lack an inventive step. The further features of claims 6, 8, 21, and 22, such as using a wireless push-in detonator with spring loaded connectors, or steps such as pushing the assembled components together, checking continuity, or threading subs together are considered to be within the purview			
(Continued in Supplemental Box)			

**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V.

...of the person skilled in the art as they are features and steps common to perforation gun assemblies and the assembling thereof into strings.

The subject matter of claims 9, 11 to 16, 23, 25, and 26 is considered to comprise an inventive step and therefore complies with **Article 33(3) of the PCT**, as the prior art does not lead the person skilled in the art to combine the claims features with the gun assembly of the preceding claims.

**Industrial Applicability (IA)**

The subject matter of claims 1 to 26 is considered to be industrially applicable and therefore complies with **Article 33(4) of the PCT**.

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

<b>TRANSMITTAL FORM</b>  <i>(to be used for all correspondence after initial filing)</i>	Application Number	16/359,540
	Filing Date	03/20/2019
	First Named Inventor	David C. Parks et al.
	Art Unit	3641
	Examiner Name	Not yet assigned
Total Number of Pages in This Submission	432	Attorney Docket Number DMC007USCon3

<b>ENCLOSURES (Check all that apply)</b>		
<input type="checkbox"/> Fee Transmittal Form <input type="checkbox"/> Fee Attached <input type="checkbox"/> Amendment/Reply <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input checked="" type="checkbox"/> Information Disclosure Statement  <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Reply to Missing Parts/ Incomplete Application <input type="checkbox"/> Reply to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition <input type="checkbox"/> Petition to Convert to a Provisional Application <input type="checkbox"/> Power of Attorney, Revocation <input type="checkbox"/> Change of Correspondence Address <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Request for Refund <input type="checkbox"/> CD, Number of CD(s) _____ <input type="checkbox"/> Landscape Table on CD	<input type="checkbox"/> After Allowance Communication to TC <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input checked="" type="checkbox"/> Other Enclosure(s) (please identify below): Non patent literature
Remarks Supplemental Information Disclosure Statement		

<b>SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT</b>			
Firm Name	Moyles IP, LLC		
Signature	/Jason M. Rockman/		
Printed name	Jason M. Rockman		
Date	March 25, 2019	Reg. No.	63473

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	35516786
<b>Application Number:</b>	16359540
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	9246
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM
<b>First Named Inventor/Applicant Name:</b>	David C. Parks
<b>Customer Number:</b>	81796
<b>Filer:</b>	Jason Marshall Rockman
<b>Filer Authorized By:</b>	
<b>Attorney Docket Number:</b>	DMC007USCon3
<b>Receipt Date:</b>	25-MAR-2019
<b>Filing Date:</b>	
<b>Time Stamp:</b>	16:44:11
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	no
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### File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	DMC007USCon3_IDS_SB08A.pdf	1036469  <small>daa8e145fe84287583355732225016e1be257e46</small>	no	6

### Warnings:

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Pg. 153

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2	Other Reference-Patent/App/Search documents	DMC007GB_Search_Exam_Report_7Jul17.pdf	1516855	no	5
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3	Other Reference-Patent/App/Search documents	DMC007GBDiv2_Office_Action.pdf	2086014	no	6
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4	Other Reference-Patent/App/Search documents	DMC007NO_NIPO_office_action_15Jun17.pdf	80189	no	3
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5	Other Reference-Patent/App/Search documents	DMC007NO_NIPO_search_report_15Jun17.pdf	15174	no	2
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8	Other Reference-Patent/App/Search documents	DMC014US_Search_Report_and_Written_Opinion_PCTUS2015018906.pdf	10250849 cd88e98f54cd85f2100291d5e7a8b33c088a2eb6	no	12
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9	Non Patent Literature	NPL_4_MENAPS_11_04_Recommended_Practice_for_Oilfield_Explosive_Safety.pdf	2789363 172e5343d5cfe2f69779907c68709166d4fb2c55	no	6
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10	Non Patent Literature	NPL_9-MENAPS-11-15-Combining-and-Customizing-Technologies-for-Perforating-HZ-Wells-in-Algeria.pdf	2445228 9c1aee4a2912c7dde0055dc3fac0aec7eed89a73	no	20
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11	Non Patent Literature	NPL_Austin_Powder_Company_A_140_F_Detonator_and_Block.pdf	119494 5a53a6678b05bb1bfdec468c5a546d34421c0b3a	no	2
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13	Other Reference-Patent/App/Search documents	NPL_DMC014CN_1st_Office_Action_in_Chinese_27Jun18.pdf	407349 6d4d7236902be33b507eb4fb4f8668d26e3b9318	no	5
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14	Other Reference-Patent/App/Search documents	NPL_DMC014CN_Office_Action_in_English.pdf	359506 7b86a8bde8f8028b0da5cd77fcd9e63b91ed890	no	9
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<b>Information:</b>					

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20	Non Patent Literature	NPL_IPS_12_28_Long_Gun_Deployment_Systems.pdf	1056891	no	11
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21	Non Patent Literature	NPL_JRC_Catalog.pdf	1909006	no	36
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22	Non Patent Literature	NPL_New-and-Safe-Detonators-for-the-Industrys-Consideration.pdf	1478228 5a58cf5af605f7fc06a722eb60c28c78ac2a069d	no	20
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<b>Information:</b>					
23	Other Reference-Patent/App/Search documents	NPL_Patent_Owner_DynaEnergetics_Motion_to_Amend.pdf	606376 6eb5d0a9ed01212ac3a0bbbc3996d8a8ef8b9450	no	53
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<b>Information:</b>					
24	Other Reference-Patent/App/Search documents	NPL_Patent_Owner_DynaEnergetics_Response_to_Petition.pdf	1535267 b00bf468ca5fe34ce8d5e36855ce08701022d695	no	73
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25	Other Reference-Patent/App/Search documents	NPL_Petition_for_Inter_Parties_Review_422.pdf	5512709 fb877dc80cd215d270d53077bcf9efed4aedfa229	no	93
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26	Non Patent Literature	NPL_Red_RF_Safe_Detonators.pdf	345463 dec8a078f0abe845fd007e0c074fc44e8f14bfd	no	2
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28	Non Patent Literature	NPL_Selective_Perforation_a_game_changer_in_perforating_technology.pdf	1610823 829629297cdc3e410e3394c63b2ccc6dc0e902b6e	no	14

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**Warnings:****Information:**

30	Other Reference-Patent/App/Search documents	NPL_UK_Exam_Report.pdf	51753	no	1
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31	Other Reference-Patent/App/Search documents	NPL_Written_Opinion_CA2014050673.pdf	502507	no	4
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32	Transmittal Letter	DMC007USCon3_Transmittal_Form_Post_Filing_SB021.pdf	232916	no	2
			78ab5311eff9488435415f06c69fb57f70889d8c		

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<b>Total Files Size (in bytes):</b>	42819725
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**New International Application Filed with the USPTO as a Receiving Office**

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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b>  <i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>	Attorney Docket No.	DMC007USCon3
	First Named Inventor	David C. Parks et al.
	Title	PERFORATION GUN COMPONENTS AND SYSTEM
	Priority Mail Express® Label No.	

<b>APPLICATION ELEMENTS</b> <i>See MPEP chapter 600 concerning utility patent application contents.</i>	<b>Commissioner for Patents</b> <b>P.O. Box 1450</b> <b>Alexandria, VA 22313-1450</b>
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<p>1. <input checked="" type="checkbox"/> <b>Fee Transmittal Form</b> (PTO/SB/17 or equivalent)</p> <p>2. <input type="checkbox"/> <b>Applicant asserts small entity status.</b> See 37 CFR 1.27</p> <p>3. <input type="checkbox"/> <b>Applicant certifies micro entity status.</b> See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.</p> <p>4. <input checked="" type="checkbox"/> <b>Specification</b> [Total Pages <u>21</u>] Both the claims and abstract must start on a new page. (See MPEP § 608.01(a) for information on the preferred arrangement)</p> <p>5. <input checked="" type="checkbox"/> <b>Drawing(s)</b> (35 U.S.C. 113) [Total Sheets <u>18</u>]</p> <p>6. <b>Inventor's Oath or Declaration</b> [Total Pages <u>5</u>] (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))</p> <p>a. <input type="checkbox"/> Newly executed (original or copy)</p> <p>b. <input checked="" type="checkbox"/> A copy from a prior application (37 CFR 1.63(d))</p> <p>7. <input checked="" type="checkbox"/> <b>Application Data Sheet</b> * See note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent)</p> <p>8. <b>CD-ROM or CD-R</b> in duplicate, large table, or Computer Program (Appendix)</p> <p><input type="checkbox"/> Landscape Table on CD</p> <p>9. <b>Nucleotide and/or Amino Acid Sequence Submission</b> (if applicable, items a. – c. are required)</p> <p>a. <input type="checkbox"/> Computer Readable Form (CRF)</p> <p>b. <input type="checkbox"/> Specification Sequence Listing on:</p> <p>i. <input type="checkbox"/> CD-ROM or CD-R (2 copies); or</p> <p>ii. <input type="checkbox"/> Paper</p> <p>c. <input type="checkbox"/> Statements verifying identity of above copies</p>	<p style="text-align: center;"><b>ACCOMPANYING APPLICATION PAPERS</b></p> <p>10. <input checked="" type="checkbox"/> <b>Assignment Papers</b> (cover sheet &amp; document(s)) Name of Assignee <u>DynaEnergetics GmbH &amp; Co. KG</u> <u>JDP Engineering &amp; Machine Inc.</u></p> <p>11. <input checked="" type="checkbox"/> <b>37 CFR 3.73(c) Statement</b> <input checked="" type="checkbox"/> <b>Power of Attorney</b> (when there is an assignee)</p> <p>12. <input type="checkbox"/> <b>English Translation Document</b> (if applicable)</p> <p>13. <input checked="" type="checkbox"/> <b>Information Disclosure Statement</b> (PTO/SB/08 or PTO-1449) <input checked="" type="checkbox"/> Copies of citations attached</p> <p>14. <input type="checkbox"/> <b>Preliminary Amendment</b></p> <p>15. <input type="checkbox"/> <b>Return Receipt Postcard</b> (MPEP § 503) (Should be specifically itemized)</p> <p>16. <input type="checkbox"/> <b>Certified Copy of Priority Document(s)</b> (if foreign priority is claimed)</p> <p>17. <input type="checkbox"/> <b>Nonpublication Request</b> Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.</p> <p>18. <input checked="" type="checkbox"/> <b>Other:</b> <u>Track One Request</u></p> <p>_____</p> <p>_____</p> <p>_____</p>
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**\*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).

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Signature	<u>/Jason M. Rockman/</u>	Date	<u>March 20, 2019</u>
Name (Print/Type)	<u>Jason M. Rockman</u>	Registration No. (Attorney/Agent)	<u>63473</u>

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN  
APPLICATION DATA SHEET (37 CFR 1.76)**

<b>Title of Invention</b>	<b>PERFORATION GUN COMPONENTS AND SYSTEM</b>
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As the below named inventor, I hereby declare that:

This declaration is directed to:  The attached application, or  
 United States application or PCT international application number \_\_\_\_\_  
 filed on \_\_\_\_\_

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

**WARNING:**

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

**LEGAL NAME OF INVENTOR**

Inventor: David C. Parks Date (Optional): OCTOBER 21, 2016  
 Signature: 

**Note:** An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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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**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

<b>Title of Invention</b>	<b>PERFORATION GUN COMPONENTS AND SYSTEM</b>
---------------------------	--

As the below named inventor, I hereby declare that:

This declaration is directed to:  The attached application, or  
 United States application or PCT international application number \_\_\_\_\_  
filed on \_\_\_\_\_

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

**WARNING:**

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2036 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2036 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

**LEGAL NAME OF INVENTOR**

Inventor: Liam McNelis Date (Optional): 27<sup>th</sup> Oct. 2016

Signature: [Handwritten Signature]

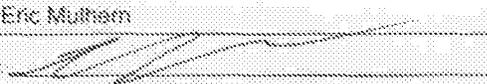
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/D1 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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. 102 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute 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 (include 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 1456, Alexandria, VA 22310-1456. DO NOT SEND PAPER OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1456, Alexandria, VA 22313-1456.

If you need assistance in completing the form, call 1-800-PTO-6196 and select option 2.

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**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

<b>Title of Invention</b>	<b>PERFORATION GUN COMPONENTS AND SYSTEM</b>
As the below named inventor, I hereby declare that:	
This declaration is directed to: <input checked="" type="checkbox"/> The attached application, or	
<input type="checkbox"/> United States application or PCT international application number _____	
Filed on: _____	
The above identified application was made or authorized to be made by me.	
I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.	
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.	
<b>WARNING:</b>	
Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identify theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2035 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a certain application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2035 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
<b>LEGAL NAME OF INVENTOR</b>	
Inventor	<u>Eric Mulham</u>
Signature	
Date (Optional)	<u>OCT 24 2016</u>

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/SB/21 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is so free (and by the USPTO is processed) an application. Confidentiality is governed by 35 U.S.C. 320 and 37 CFR 1.11 and 1.14. The collection is intended to ease 1 minute 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 1462, Alexandria, VA 22313-1462. DO NOT SEND FREE OR UNCOMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1462, Alexandria, VA 22313-1462.  
If you need assistance in completing this form, call 1-800-PTO-4188 and select option 2.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM
--------------------	---------------------------------------

As the below named inventor, I hereby declare that:

This declaration is directed to:  The attached application, or  
 United States application or PCT international application number \_\_\_\_\_  
 filed on \_\_\_\_\_

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

**WARNING:**

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LEGAL NAME OF INVENTOR

Inventor: Thilo Scharf Date (Optional): 17/OCT/2016

Signature: *Thilo Scharf*

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

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

## 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/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	
First Named Inventor	David C. Parks et al.
Title	PERFORATION GUN COMPONENTS AND SYSTEM
Art Unit	
Examiner Name	
Attorney Docket Number	DMC007USCon3

**SIGNATURE of Applicant or Patent Practitioner**

Signature	/Jason M. Rockman/	Date (Optional)	
Name	Jason M. Rockman	Registration Number	63473
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.*

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

## 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:

81796

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):

DynaEnergetics GmbH & Co. KG

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

Ian Grieves

Date (Optional)

Name

Ian Grieves

Title

President of DynaEnergetics

**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.*

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

**STATEMENT UNDER 37 CFR 3.73(c)**

Applicant/Patent Owner: DynaEnergetics GmbH & Co. KG

Application No./Patent No.: \_\_\_\_\_ Filed/Issue Date: \_\_\_\_\_

Titled: PERFORATION GUN COMPONENTS AND SYSTEM

DynaEnergetics GmbH & Co. KG, a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose one of options 1, 2, 3 or 4 below):

- 1.  The assignee of the entire right, title, and interest.
- 2.  An assignee of less than the entire right, title, and interest (check applicable box):
  - The extent (by percentage) of its ownership interest is \_\_\_\_\_%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
  - There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Empty rectangular box for providing names of other parties in option 2.

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

- 3.  The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Empty rectangular box for providing names of other parties in option 3.

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

- 4.  The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose one of options A or B below):

- A.  An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.
- B.  A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

2. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(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.*

**STATEMENT UNDER 37 CFR 3.73(c)**

3. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

4. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

5. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

6. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

Additional documents in the chain of title are listed on a supplemental sheet(s).

As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature

*Ian Grieves*  
\_\_\_\_\_  
Ian Grieves

Printed or Typed Name

February 25, 2019

Date

President of DynaEnergetics

Title or Registration Number

<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> ( Not for submission under 37 CFR 1.99)	Application Number	
	Filing Date	
	First Named Inventor	David C. Parks et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	DMC007USCon3

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code <sup>1</sup>	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	3504723	A	1970-04-07	K.V. Cushman et al.	
	2	4182216	A	1980-01-08	DeCaro	
	3	4574892	A	1986-03-11	Grigar et al	
	4	5027708	A	1991-07-02	Gonzalez, Manual T.	
	5	5088413	A	1992-02-18	Huber, Klaus B.	
	6	5105742	A	1992-04-21	Sumner, Cyril R	
	7	5347929	A	1994-09-20	Lerche, Nolan C. et al	
	8	6085659	A	2000-07-11	Beukes et al.	

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	David C. Parks et al.	
Art Unit		
Examiner Name		
Attorney Docket Number	DMC007USCon3	

9	6418853	B1	2002-07-16	Duguet et al.
10	7193527	B2	2007-03-20	Hall, David R
11	7347278	B2	2008-03-25	Lerche et al.
12	7568429	B2	2009-08-04	Hummel et al.
13	7762172	B2	2010-07-27	Li et al.
14	7778006	B2	2010-08-17	Stewart et al.
15	7810430	B2	2010-10-12	Chan et al.
16	7929270	B2	2011-04-19	Hummel et al.
17	8069789	B2	2011-12-06	Hummel et al.
18	8074737	B2	2011-12-13	Hill et al.
19	8157022	B2	2012-04-17	Bertoja et al.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	David C. Parks et al.	
Art Unit		
Examiner Name		
Attorney Docket Number	DMC007USCon3	

20	8182212	B2	2012-05-22	Parcell, Jason W.
21	8256337	B2	2012-09-04	Hill, Freeman L.
22	8395878	B2	2013-03-12	Stewart et al.
23	8875787	B2	2014-11-04	Tassaroli, Carlos Jose
24	8881816	B2	2014-11-11	Glenn et al.
25	8695506	B2	2014-04-15	Lanclos, Ronald
26	9080433	B2	2015-07-14	Lanclos, et al.
27	9581422	B2	2017-02-28	Preiss et al.
28	9689223	B2	2017-06-27	Schacherer et al.
29	9677363	B2	2017-06-13	Schacherer et al.
30	8181718	B2	2012-05-22	Burleson et al.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	David C. Parks et al.	
Art Unit		
Examiner Name		
Attorney Docket Number	DMC007USCon3	

31	8186259	B2	2012-05-29	Burleson et al.
32	8451137	B2	2013-05-28	Bonavides et al.
33	9605937	B2	2017-03-28	Eitschberger et al.
34	4598775	A	1986-07-08	Vann et al.
35	4747201	A	1988-05-31	Donovan et al.
36	5775426	A	1998-07-07	Snider et al.
37	5816343	A	1998-10-06	Markel et al.
38	6006833	A	1999-12-28	Burleson et al.
39	7762351	B2	2010-07-27	Vidal
40	8066083	B2	2011-11-29	Hales et al.
41	4496008	A	1985-01-29	Pottier et al.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	David C. Parks et al.	
Art Unit		
Examiner Name		
Attorney Docket Number	DMC007USCon3	

42	7278491	B2	2007-10-09	Scott
43	4790383	A	1988-12-13	Savage et al.
44	10077641	B2	2018-09-18	Rogman et al.
45	9494021	B2	2016-11-15	Parks et al.
46	2358466	A	1944-09-19	E. A. MILLER
47	3374735	A	1968-03-26	L. K. MOORE
48	4007790	A	1977-02-15	Henning
49	4058061	A	1977-11-15	Mansur, Jr. et al.
50	4491185	A	1985-01-01	McClure
51	4889183	A	1989-12-26	Sommers et al.
52	5159145	A	1992-10-27	Carisella et al.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	David C. Parks et al.	
Art Unit		
Examiner Name		
Attorney Docket Number	DMC007USCon3	

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Application Number		
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First Named Inventor	David C. Parks et al.	
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Signature	/Jason M. Rockman/	Date (YYYY-MM-DD)	2019-03-20
Name/Print	Jason M. Rockman	Registration Number	63473

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PREISS, FRANK, DE;

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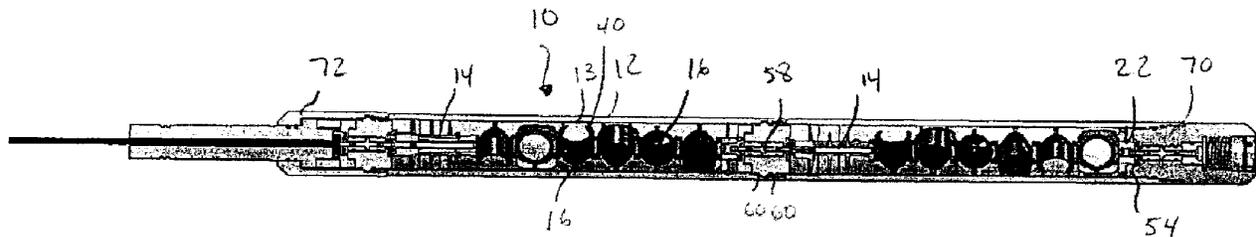
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(54) Titre : MECANISME ET COMPOSANTES DE FUSIL A PERFORATION

(54) Title: PERFORATION GUN COMPONENTS AND SYSTEM



(57) **Abrégé/Abstract:**

A perforation gun system based on combinations of basic components including a top connector, a self-centralizing charge holder system and a bottom connector that can double as a spacer. Any number of spacers can be used with any number of holders for any desired specific metric or imperial shot density, phase and length gun system. A perforation gun system kit as well as a method of assembling a perforation gun system is also disclosed.

(71) Demandeurs(suite)/Applicants(continued): MCNELIS, LIAM, DE; MULHERN, ERIC, CA; SCHARF, THILO, DE

**ABSTRACT**

A perforation gun system based on combinations of basic components including a top connector, a self-centralizing charge holder system and a bottom connector that can double as a spacer. Any number of spacers can be used with any number of holders for any desired specific metric or imperial shot density, phase and length gun system. A perforation gun system kit as well as a method of assembling a perforation gun system is also disclosed.

## PERFORATION GUN COMPONENTS AND SYSTEM

### Field of the Invention

The invention generally relates to perforation gun systems. More particularly, the invention relates to various perforation gun components that can be modularly assembled into a perforation gun system, the assembled perforated gun system itself, a perforation gun system kit, and a method for assembling a perforation gun system.

### 10 Background of the Invention

Perforation gun systems are used in well bore perforating in the oil and natural gas industries to tie a bore hole with a storage horizon within which a storage reservoir of oil or natural gas is located.

A typical perforation gun system consists of an outer gun carrier, arranged in the interior of which there are perforators-usually hollow or projectile charges-that shoot radially outwards through the gun carrier after detonation. Penetration holes remain in the gun carrier after the shot.

20

In order to ignite the perforators, there is a detonating cord leading through the gun carrier that is coupled to a detonator.

Different perforating scenarios often require different phasing and density of charges or gun lengths. Moreover, it is sometimes desirable that the perforators shooting radially outwards from the gun carrier be oriented in different directions along the length of the barrel. Therefore, phasing may be required between different guns along the length.

30

Onsite assembly of perforation gun systems may also be problematic under certain conditions as there are certain safety hazards inherent to the assembly of perforation guns due to the explosive nature of certain of its sub-components, including the detonator and the detonating cord.

There is thus a need for a perforation gun system, which by virtue of its design and components would be able to address at least one of the above-mentioned needs, or overcome or at least minimize at least one of the above-mentioned drawbacks.

### **Summary of the Invention**

The object of the invention is to provide a perforation gun system that addresses at least one of the above-mentioned needs.

- 10 According to the invention, there is provided a perforation gun system having an outer gun carrier and comprising:
- a top connector;
  - at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
  - a detonation cord connected to the top connector and to each stackable charge holder;
  - at least one bottom connector for terminating the detonation cord in the gun system; and
  - a detonator energetically coupled to the detonation cord,

- 20 wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a rotation coupling for providing a selectable clocking rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

In some embodiments, the bottom connector may double as a spacer for spacing a plurality of stackable charge holders, and may either act as a metric dimensioned spacer or as an imperial dimensioned spacer for any specific metric or imperial shot density, phase and length gun system.

- 30 According to another aspect of the invention, there is also provided a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:
- a top connector;

- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

According to another aspect of the invention, there is also provided a method for assembling a perforation gun system, comprising the steps of:

(a) providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;

(b) assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;

(c) running the detonation cord into a bottommost bottom connector;

- (d) assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;
- (e) running connecting wire between the bottommost bottom connector and the top connector;
- (f) clicking the detonation cord into capturing projections provided in each of the charge holders;
- (g) running the detonation cord into the top connector;
- (h) cutting the detonator cord; and
- (i) installing charges into each of the charge holders.

10

A number of optional steps that are detailed below may be added to the above-described steps of the method.

According to another aspect of the invention, there is also provided a top connector for a perforation gun system comprising:

- a coupler for providing energetic coupling between a detonator and a detonating cord;
- at least one directional locking fin for locking the top connector within a gun carrier;
- 20 -a rotation coupling for providing a selectable clocking rotation between the top connector, and a charge holder

wherein the top connector is configured to receive electrical connections therethrough.

According to another aspect of the invention, there is also provided a stackable charge holder for a perforation gun system having an outer gun carrier, the charge holder comprising:

- a charge receiving structure for receiving a single shaped charge;
- a plurality of projections for centralizing the shaped charge within the gun carrier; and
- 30 -at least one rotation coupling for providing a selectable clocking rotation between the charge holder and an adjacent component in the perforation gun system;

wherein a pair of the plurality of projections is configured for capturing a detonation cord traversing the charge holder.

According to another aspect of the invention, there is also provided a bottom connector for a perforation gun system comprising:

- a terminating structure arranged for terminating a detonation cord in the gun system;
- a plurality of wings for axially locking the bottom connector to a snap ring fixed in the carrier.
- a rotation coupling for providing a selectable clocking rotation between the bottom connector and a charge holder;

10 wherein the rotation coupling is arranged such that bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.

### **Brief Description of the Drawings**

These and other objects and advantages of the invention will become apparent upon reading the detailed description and upon referring to specific embodiments thereof that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, exemplary embodiments of the invention will be described and explained with additional specificity and detail through the use of the accompanying  
20 drawings in which:

Figure 1 is a side cut view of a perforation gun system according to an embodiment of the invention.

Figure 2 is a side view of a top connector, bottom connector and stackable charge holders of a perforation gun system in accordance with another embodiment of the invention.

30 Figure 3 is a side view of a top connector, bottom connector and stackable charge holders of a perforation gun system in accordance with another embodiment of the invention.

Figure 4 is a front perspective view of a bottom connector in accordance with an embodiment of the invention.

Figure 5 is a rear perspective view of the bottom connector shown in Figure 4.

Figure 6 is a front view of a stackable charge holder in accordance with an embodiment of the invention.

Figure 7 is a front perspective view of the stackable charge holder shown in Figure 6.

10

Figure 8 is a rear perspective view of the stackable charge holder shown in Figure 6.

Figure 9 is a bottom view of the stackable charge holder shown in Figure 6.

Figure 10 is a top view of the stackable charge holder shown in Figure 6.

Figure 11 is a bottom view of a half-portion of a top connector in accordance with an embodiment of the invention.

20 Figure 12 is a side view of the half-portion of the top connector shown in Figure 11.

Figure 13 is a top perspective view of the half-portion of the top connector shown in Figure 11.

Figure 14 is a bottom perspective view of the half-portion of the top connector shown in Figure 11.

Figure 15 is a perspective view of a top connector in accordance with an embodiment of the invention.

30

Figure 16 is a front end view of the top connector shown in Figure 15.

Figure 17 is a rear end view of the top connector shown in Figure 15.

Figure 18 is a rear perspective view of the top connector shown in Figure 15.

Figure 19 is an enlarged detailed side cut view of a portion of the perforation gun system including a bulkhead and stackable charge holders shown in Figure 1.

Figure 20 is a perspective view of a bottom sub of a gun system in accordance with an embodiment of the invention.

10 Figure 21 is a side view of a gun carrier of a gun system in accordance with an embodiment of the invention.

Figure 22 is a side cut view of the gun carrier shown in Figure 21.

Figure 23 is a side view of a top sub of a gun system in accordance with an embodiment of the invention.

Figure 24 is a side cut view of the top sub shown in Figure 23.

20 Figure 25 is a side view of a tandem seal adapter of a gun system in accordance with an embodiment of the invention.

Figure 26 is a perspective view of the tandem seal adapter shown in Figure 25.

Figure 27 is a perspective view of a detonator in accordance with an embodiment of the invention.

Figure 28 is a detailed perspective view of the detonator shown in Figure 27.

30 Figure 29 is another detailed perspective view of the detonator shown in Figure 27.

Figure 30 is another detailed perspective view of the detonator shown in Figure 27.

Figure 31 is another detailed perspective view of the detonator shown in Figure 27, with a crimp sleeve.

Figure 32 is a detailed side view of a tandem seal adapter and detonator in accordance with another embodiment of the invention.

Figure 33 is a side cut view of a portion of a perforation gun system illustrating the configuration of the top sub in accordance with another embodiment of the invention.

Figure 34 is a side cut view of a portion of a perforation gun system illustrating the configuration of the bottom sub in accordance with another embodiment of the invention.

10

Figures 35A and 35B are electrical schematic views of a detonator and of wiring within a perforated gun system in accordance with another embodiment of the invention.

### **Detailed Description of the Invention**

20

In the following description and accompanying figures, the same numerical references refer to similar elements throughout the figures and text. Furthermore, for the sake of simplicity and clarity, namely so as not to unduly burden the figures with several reference numbers, only certain figures have been provided with reference numbers, and components and features of the invention illustrated in other figures can be easily inferred therefrom. The embodiments, geometrical configurations, and/or dimensions shown in the figures are preferred for exemplification purposes only. Various features, aspects and advantages of the embodiments will become more apparent from the following detailed description.

30

Moreover, although the invention was primarily designed for well bore perforating, for example, it may also be used in other perforating scenarios or in other fields, as apparent to a person skilled in the art. For this reason, expressions such as "gun system", etc., as used herein should not be taken as to limit the scope of the invention and includes all other kinds of materials, objects and/or purposes with which the invention could be used and may be useful. Each example or embodiment are provided by way of explanation of the invention, and is not meant as a limitation of the invention and does not constitute a definition of all possible embodiments.

In addition, although the embodiment of the invention as illustrated in the accompanying drawings comprises various components and although the embodiment of the adjustment system as shown consists of certain geometrical configurations as explained and illustrated herein, not all of these components and geometries are essential to the invention and thus should not be taken in their restrictive sense, i.e. should not be taken as to limit the scope of the invention. It is to be understood, as also apparent to a person skilled in the art, that other suitable components and cooperations thereinbetween, as well as other suitable geometrical configurations may be used for the adjustment systems, and corresponding parts, according to the invention, as briefly explained and  
10 as can easily be inferred herefrom by a person skilled in the art, without departing from the scope of the invention.

Referring to Figures 1 to 3, an object of the invention is to provide a perforation gun system 10 having an outer gun carrier 12. The gun system 10 includes a top connector 14. At least one stackable charge holder 16 is provided for centralizing a single shaped charge 18 within the gun carrier 12. A detonation cord 20 is connected to the top connector 14 and to each stackable charge holder 16.

The gun system 10 includes at least one bottom connector 22 for terminating the  
20 detonation cord 20 in the gun system. As better shown in Figure 2, it is also possible that the bottom connector 22 double as or serve the function of a spacer 24 for spacing a plurality of stackable charge holders 16.

The gun system also includes a detonator 26 energetically coupled to the detonation cord 20.

As better shown in Figures 4 to 18, each of the top connector 14, stackable charge holder 16 and bottom connector 22 includes a rotation coupling 30 for providing a  
30 selectable clocking rotation between each of the above-mentioned components.

Hence a user can build multiple configurations of gun systems using various combinations of basic components. A first of these basic components includes a top connector. Another basic component is a single charge holder that centralizes a single shaped charge. The holder is adapted to be stacked and configured into 0, 30, 60, up to

360 degrees or any other combination of these phases for any specified length. Another basic component is a bottom connector that terminates the detonation cord in the gun. The bottom connector may carry as well an electrical connection therethrough. The bottom connector may also double as an imperial measurement stackable spacer to provide any gun shot density up to, for example, 6 shots per foot. Alternately, another bottom connector may be provided or configured to double as a metric measurement stackable spacer to provide any gun shot density up to, for example, 20 shots per meter. Another basic component includes a push-in detonator that does not use wires to make necessary connections. The push-in detonator may use spring-loaded connectors, thus replacing any required wires and crimping.

Therefore, within the self-centralizing charge holder system, any number of spacers can be used with any number of holders for any specific metric or imperial shot density, phase and length gun system.

In an embodiment, only two pipe wrenches are required for assembly on site of the gun system, as no other tools are required.

In an embodiment, the top connector 14 provides energetic coupling between the detonator and detonating cord.

In an embodiment, each of the top connector 14, stackable charge holder 16 and bottom connector 22 are configured to receive electrical connections therethrough.

In an embodiment, all connections are made by connectors, such as spring-loaded connectors, instead of wires, with the exception of the through wire that goes from the top connector 14 to the bottom connector 22, whose ends are connectors.

In an embodiment, components of the assembly may include molded parts, which may also be manufactured to house the wiring integrally, through, for instance, overmolding, to encase the wiring and all connectors within an injection molded part. For example, the charge holder 16 could be overmolded to include the through wire.

In an embodiment, as shown in Figures 4 and 5, each bottom connector 22 includes a plurality of fins 32 for axially locking each bottom connector against a snap ring 54, or an equivalent retainment mechanism to keep the charge holder 16 from sliding out of the bottom of carrier 12 as it is handled. (shown on Figure 1). The bottom connector 22 from a first gun assembly can accommodate or house an electrical connection through a bulkhead assembly 58 to the top connector 14 of a second or subsequent gun assembly, as seen for instance in Figure 19. The top and bottom connector, as well as the spacer, in an embodiment, are made of 15% glass fiber reinforced, injection molding PA6 grade material, commercially available from BASF under its ULTRAMID® brand, and can provide a positive snap connection for any configuration or reconfiguration. As better shown in Figure 5, a terminating means structure 34 is provided to facilitate terminating of the detonation cord. The snap ring 54 is preinstalled on the bottom of the carrier 12. The assembly can thus shoulder up to the snap ring 54 via the bottom connector fins 32.

In an embodiment and as shown in Figures 6 to 10, each stackable charge holder 16 has a plurality of projections 40 resting against an inner surface 13 or diameter of the gun carrier 12 (as shown in Figure 1) and thereby centralizing the shaped charge therewithin. A pair of the plurality of projections 42 may also be configured for capturing the detonation cord (not shown) traversing each stackable charge holder 16. The projections 42 are also used for centralizing the shaped charge within an inner surface of the gun carrier.

In an embodiment, as shown in Figures 11 to 18, the top connector 14 includes at least one directional locking fin 46. Although the use of directional locking fins is described, other methods of directional locking may be used, in order to eliminate a top snap ring that would otherwise be used to lock the assembly. As better shown in Figure 19, the locking fins 46 are engageable with corresponding complementarily-shaped structures 47 housed within the carrier 12, upon a rotation of the top connector 14, to lock the position of the top connector along the length of the carrier 12.

In an embodiment, as better shown in Figure 19, the bottom connector 22 on one end and the top connector 14 on the other end abuts/connects to the bulkhead assembly 58 for grounding the detonator 26 within the gun carrier 12, through grounding means, depicted herein as a tandem seal adapter 48 (see also Figures 25 and 26). The tandem

seal adapter 48 is configured to seal the inner components within the carrier 12 from the outside environment, using sealing means 60 (shown herein as o-rings). Thus, the tandem seal adapter 48 seals the gun assemblies from each other along with the bulkhead 58, and transmits a ground wire to the carrier 12. Hence, the top connector 14 and bulkhead 58 accommodate electrical and ballistic transfer to the charges of the next gun assembly for as many gun assembly units as required, each gun assembly unit having all the components of a gun assembly.

10 In an embodiment, the tandem seal adapter 48 is a two-part tandem seal adapter (not shown) that fully contains the bulkhead assembly 58 (comprised of multiple small parts as shown, for instance, in Fig. 19) and that is reversible such that it has no direction of installation.

In an embodiment and as better shown in Figures 27-31 and 35A, the detonator assembly 26 includes a detonator head 100, a detonator body 102 and a plurality of detonator wires 104, including a through wire 106, a signal-in wire 108 and a ground wire 110. The through wire 106 traverses from the top to the bottom of the perforating gun system 10, making a connection at each charge holder 16. The detonator head 100 further includes a through wire connector element 112 connected to the through wire 20 106 (not shown), a ground contact element 114 for connecting the ground wire 110 to the tandem seal adapter (also not shown), through ground springs 116, and a bulkhead connector element 118 for connecting the signal-in wire 108 to the bulkhead assembly 58 (also not shown). Different insulating elements 120A,120B are also provided in the detonator head 100 for the purpose of insulating the detonator head 100 and detonator wires 104 from surrounding components. As better shown in Figure 31, a crimp sleeve 122 can be provided to cover the detonator head 100 and body 102, thus resulting in a more robust assembly. The above configuration allows the detonator to be installed with minimal tooling and wire connections.

30 In an embodiment as shown in Figures 32, 33 and 35B illustrate a connection and grounding of the above-described detonator assembly 26 through the tandem seal adapter 48 and a pressure bulkhead 124. The bulkhead 124 includes spring connector end interfaces comprising contact pins 126A, 126B, linked to coil springs 128A, 128B. This dual spring pin connector assembly including the bulkhead 124 and coil springs

128A, 128B is positioned within the tandem seal adapter 48 extending from a conductor slug 130 to the bulkhead connector element 118. The dual spring pin connector assembly is connected to the through wire 106 of the detonator assembly 26.

In an embodiment and as better shown in Figures 11 to 18, the top connector 14 may have a split design to simplify manufacturing and aid in assembly. By "split design" what is meant is that the top connector 14 can be formed of two halves - a top half 15A and a bottom half 15B. As better shown in Figures 15 or 18, the top connector 14 may also include a blind hole 47 to contain or house the detonation cord, thus eliminating the need  
10 for crimping the detonation cord during assembly.

In an embodiment and as shown for example in Figures 4 to 18, the rotation coupling 30 may either include a plurality of pins 50 (Figure 5) symmetrically arranged about a central axis of the rotation coupling 30, or a plurality of sockets 52 (Figure 4) symmetrically arranged about the central axis of the rotation coupling 30 and configured to engage the plurality of pins 50 of an adjacent rotation coupling 30.

In another embodiment, the rotation coupling 30 may either include a polygon-shaped protrusion, or a polygon-shaped recess configured to engage the polygon-shaped  
20 protrusion of an adjacent rotation coupling. The polygon can be 12-sided for example for 30 degree increments.

In another embodiment of the invention, the top and bottom subs work with off the shelf running/setting tools as would be understood by one of ordinary skill in the art.

In one embodiment and as shown in Figure 33, the top sub 72 facilitates use of an off the shelf quick change assembly 140 to enable electrical signals from the surface, as well as to adapt perforating gun system to mechanically run with conventional downhole equipment. The quick change assembly 140 may include a threaded adapter 143 to set  
30 an offset distance between an electrical connector 142 and the contact pin 126B extending from the bulkhead assembly 58.

In one embodiment and as shown in Figure 34, the bottom sub 70 may be configured as a sealing plug shoot adapter (SPSA) to be used specifically with this embodiment of the

invention. The SPSA may receive an off the shelf quick change assembly 140 (not shown) and insulator 150 that communicates with a firing head threaded below it (not shown). A setting tool (not shown) may run on the bottom side of the perforating gun.

In an embodiment, final assembly of the tool string requires only two pipe wrenches. No tools are required to install the detonator or any electrical connections.

10 An object of the invention is to also provide a perforation gun system kit having the basic component parts described above and capable of being assembled within an outer gun carrier.

The invention also provides a method for assembling a perforation gun system, to which a certain number of optional steps may be provided. The steps for assembling the gun system for transport include the steps of:

(a) providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier (element 12 in Figures 1, 21 and 22), the kit comprising a combination of:

-a top connector;

20 -at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;

-a detonation cord connectable to the top connector and to each stackable charge holder;

-at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and

-a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation

30 between each of the top connector, at least one stackable charge holder and at least one bottom connector;

(b) assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;

(c) running the detonation cord into a bottommost bottom connector;

- (d) assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;
- (e) running connecting wire between the bottommost bottom connector and the top connector;
- (f) clicking the detonation cord into capturing projections provided in each of the charge holders;
- (g) running the detonation cord into the top connector;
- (h) cutting the detonator cord, if the detonator cord is not precut a predetermined length; and
- 10 (i) installing charges into each of the charge holders.

In an embodiment, the method further includes, prior to transport, the steps of:

- (j) pushing assembled components together to engage all pin connections therebetween; and
- (k) carrying out a continuity test to ensure complete connectivity of the detonating chord.

In an embodiment, on location, to complete the assembly, the method further comprises the steps of

- 20 (l) threading on the previously assembled components a bottom sub (element 70 on Figures 1 and 20);
- (m) installing and connecting the detonator;
- (n) pushing in a tandem seal adapter with o-rings onto the first gun assembly;
- (o) pushing in a bulkhead (element 58 in Figure 19) onto the tandem seal adapter, if the bulkhead and the tandem seal adapter are not pre-assembled;
- (p) threading a subsequent gun assembly onto the first gun assembly or threading a top sub (element 72 in Figures 1, 23 and 24) onto a topmost assembled gun assembly, for connection to a quick change assembly.

- 30 Of course, the scope of the invention should not be limited by the various embodiments set forth herein, but should be given the broadest interpretation consistent with the description as a whole. The components and methods described and illustrated are not limited to the specific embodiments described herein, but rather, features illustrated or described as part of one embodiment can be used on or in conjunction with other

embodiments to yield yet a further embodiment. Further, steps described in the method may be utilized independently and separately from other steps described herein. Numerous modifications and variations could be made to the above-described embodiments without departing from the scope of the invention and claims, as apparent to a person skilled in the art.

In this specification and the claims that follow, reference will be made to a number of terms that have the following meanings. The singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Further, reference to "top," "bottom," "front," "rear," and the like are made merely to differentiate parts and are not necessarily determinative of direction. Similarly, terms such as "first," "second," etc. are used to identify one element from another, and unless otherwise specified are not meant to refer to a particular order or number of elements.

As used herein, the terms "may" and "may be" indicate a possibility of an occurrence within a set of circumstances; a possession of a specified property, characteristic or function; and/or qualify another verb by expressing one or more of an ability, capability, or possibility associated with the qualified verb. Accordingly, usage of "may" and "may be" indicates that a modified term is apparently appropriate, capable, or suitable for an indicated capacity, function, or usage, while taking into account that in some circumstances the modified term may sometimes not be appropriate, capable, or suitable. For example, in some circumstances an event or capacity can be expected, while in other circumstances the event or capacity cannot occur--this distinction is captured by the terms "may" and "may be."

As used in the claims, the word "comprises" and its grammatical variants logically also subtend and include phrases of varying and differing extent such as for example, but not limited thereto, "consisting essentially of" and "consisting of."

Advances in science and technology may make equivalents and substitutions possible that are not now contemplated by reason of the imprecision of language; these variations should be covered by the appended claims. This written description uses examples to disclose the invention, including the best mode, and also to enable any person of ordinary skill in the art to practice the invention, including making and using

any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those of ordinary skill in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

**CLAIMS**

1. A perforation gun system having an outer gun carrier and comprising:
  - a top connector;
  - at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
  - a detonation cord connected to the top connector and to each stackable charge holder;
  - at least one bottom connector for terminating the detonation cord in the gun system; and
  - a detonator energetically coupled to the detonation cord,wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a rotation coupling for providing a selectable clocking rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.
2. The perforation gun system according to claim 1, wherein the at least one bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.
3. The perforation gun system according to claim 2, wherein the at least one bottom connector doubles as a metric-dimensioned spacer.
4. The perforation gun system according to claim 2, wherein the at least one bottom connector doubles as an imperial-dimensioned spacer.
5. The perforation gun system according to any one of claims 1 to 4, wherein the top connector provides energetic coupling between the detonator and the detonating cord.
6. The perforation gun system according to any one of claims 1 to 5, wherein the detonator is a wireless push-in detonator with spring loaded connectors.

7. The perforation gun system according to any one of claims 1 to 6, wherein each of the top connector, the at least one stackable charge holder and the at least one bottom connector are configured to receive electrical connections therethrough.
8. The perforation gun system according to claim 7, wherein the electrical connections between the top connector, the at least one charge holder, the at least one bottom connector and the detonator are spring-loaded quick connections.
9. The perforation gun system according to any one of claims 1 to 8, wherein each  
10 bottom connector comprises a plurality of fins for axially locking each bottom connector to a snap ring.
10. The perforation gun system according to any one of claims 1 to 9, wherein each stackable charge holder comprises a plurality of projections resting against an inner surface of the gun carrier and thereby centralizing the shaped charge therewithin.
11. The perforation gun system according to claim 10, wherein a pair of the plurality of projections is configured for capturing the detonation cord traversing each stackable charge holder.  
20
12. The perforation gun system according to any one of claims 1 to 11, wherein the top connector comprises at least one directional axial locking fin.
13. The perforation gun system according to any one of claims 1 to 12, wherein the top connector comprises a tandem seal adapter for grounding the detonator to the gun carrier.
14. The perforation gun system according to any one of claims 1 to 13, wherein the top connector comprises a blind hole for containing the detonation cord.  
30
15. The perforation gun system according to any one of claims 1 to 14, wherein the top connector is formed by assembling first and second halves of an unassembled top connector.

16. The perforation gun system according to any one of claims 1 to 15, wherein the rotation coupling is selected from the group comprising a plurality of pins symmetrically arranged about a central axis of the rotation coupling, and a plurality of sockets symmetrically arranged about the central axis of the rotation coupling and configured to engage the plurality of pins of an adjacent rotation coupling.

17. The perforation gun system according to any one of claims 1 to 15, wherein the rotation coupling is selected from the group comprising a polygon-shaped protrusion, and a polygon-shaped recess configured to engage the polygon-shaped protrusion of an adjacent rotation coupling.

18. The perforation gun system according to any one of claims 1 to 17, further comprising a material overmolded over wiring and connectors of the top connector, the at least one charge holder, and the at least one bottom connector.

19. A perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

20. A method for assembling a perforation gun system, comprising the steps of:  
(a) providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:  
-a top connector;

- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
  - a detonation cord connectable to the top connector and to each stackable charge holder;
  - at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and
  - a detonator energetically couplable to the detonation cord,
- 10 wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;
- (b) assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;
  - (c) running the detonation cord into a bottommost bottom connector;
  - (d) assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;
  - (e) running connecting wire between the bottommost bottom connector and the
- 20 top connector;
- (f) clicking the detonation cord into capturing projections provided in each of the charge holders;
  - (g) running the detonation cord into the top connector;
  - (h) cutting the detonator cord, if the detonator cord is not precut a predetermined length; and
  - (i) installing charges into each of the charge holders.
21. The method according to claim 20, further comprising the steps of:
- (j) pushing assembled components together to engage all pin connections
- 30 therebetween; and
- (k) carrying out a continuity test.
22. The method according to claim 21, further comprising the steps of:
- (l) threading on the previously assembled components a bottom sub;

- (m) installing and connecting the detonator;
- (n) pushing in a tandem sub with o-rings onto the first gun assembly;
- (o) pushing in a bulkhead onto the tandem sub, if the bulkhead and the tandem seal adapter are not pre-assembled;
- (p) threading a subsequent gun assembly onto the first gun assembly or threading a top sub onto a topmost assembled gun assembly.

23. A top connector for a perforation gun system comprising:

10

- a coupler for providing energetic coupling between a detonator and a detonating cord;
- at least one directional locking fin for locking the top connector within a gun carrier;
- a rotation coupling for providing a selectable clocking rotation between the top connector, and a charge holder

wherein the top connector is configured to receive electrical connections therethrough.

24. A stackable charge holder for a perforation gun system having an outer gun carrier, the charge holder comprising:

20

- a charge receiving structure for receiving a single shaped charge;
- a plurality of projections for centralizing the shaped charge within the gun carrier; and
- at least one rotation coupling for providing a selectable clocking rotation between the charge holder and an adjacent component in the perforation gun system;

wherein a pair of the plurality of projections is configured for capturing a detonation cord traversing the charge holder.

25. The stackable charge holder according to claim 24, wherein the at least one rotation coupling is selected from the group comprising a plurality of pins symmetrically arranged about a central axis of the rotation coupling, and a plurality of sockets

30 symmetrically arranged about the central axis of the rotation coupling and configured to engage the plurality of pins.

26. A bottom connector for a perforation gun system comprising:

-a terminating structure arranged for terminating a detonation cord in the gun system;

-a plurality of wings for axially locking the bottom connector to a snap ring.

-a rotation coupling for providing a selectable clocking rotation between the bottom connector and a charge holder;

wherein the rotation coupling is arranged such that bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.

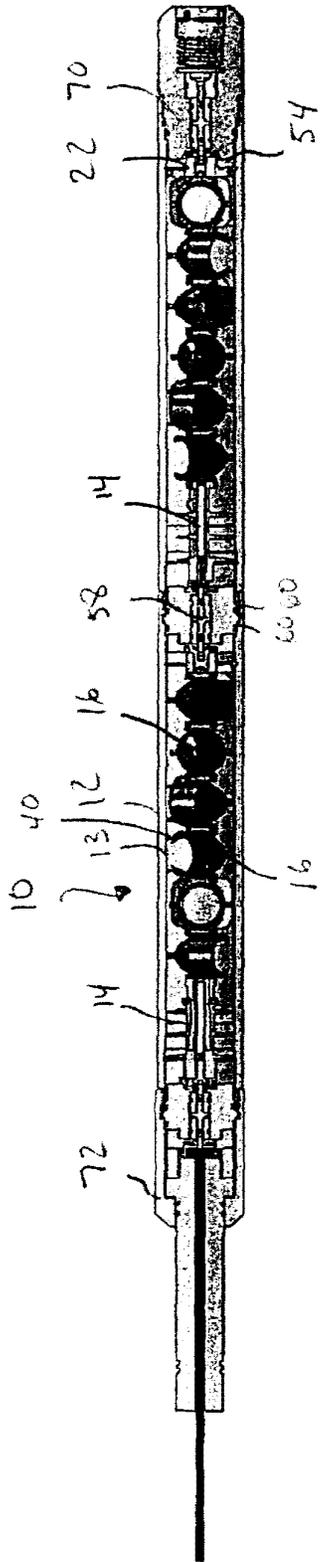


Fig. 1

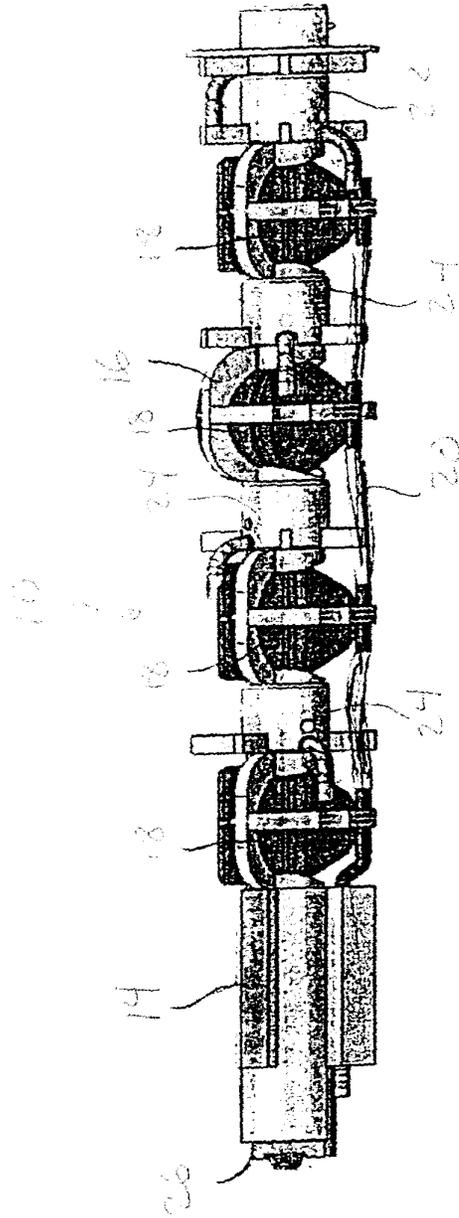


Fig. 2

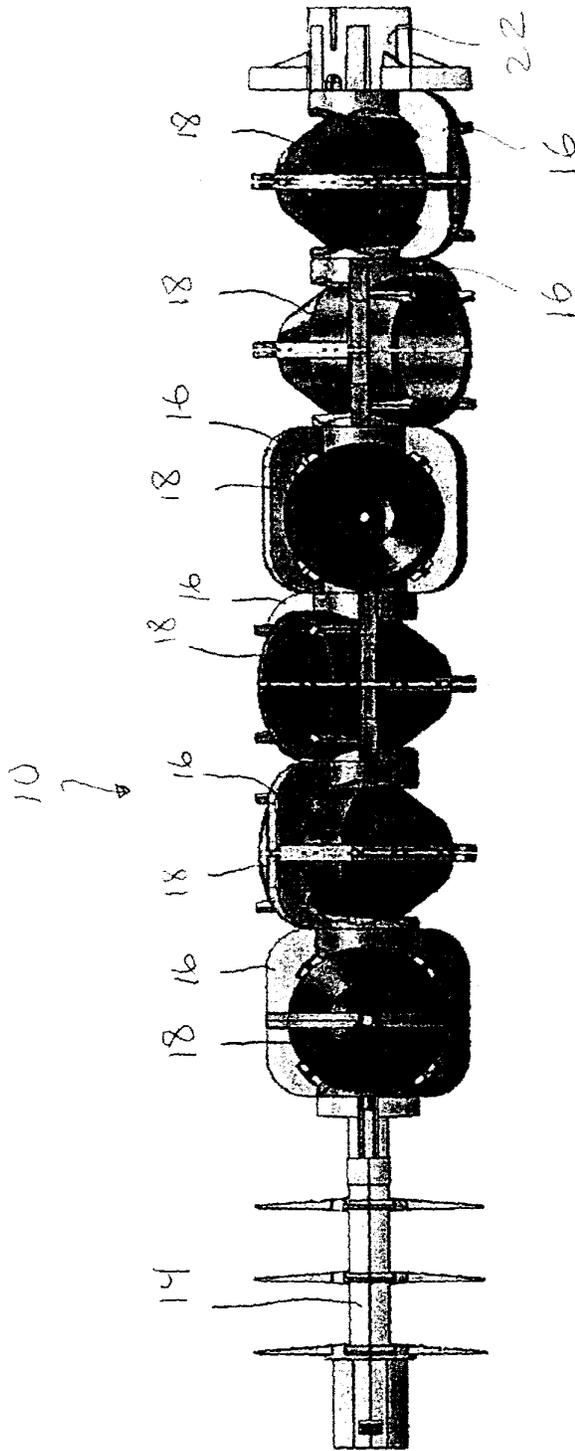


Fig. 3

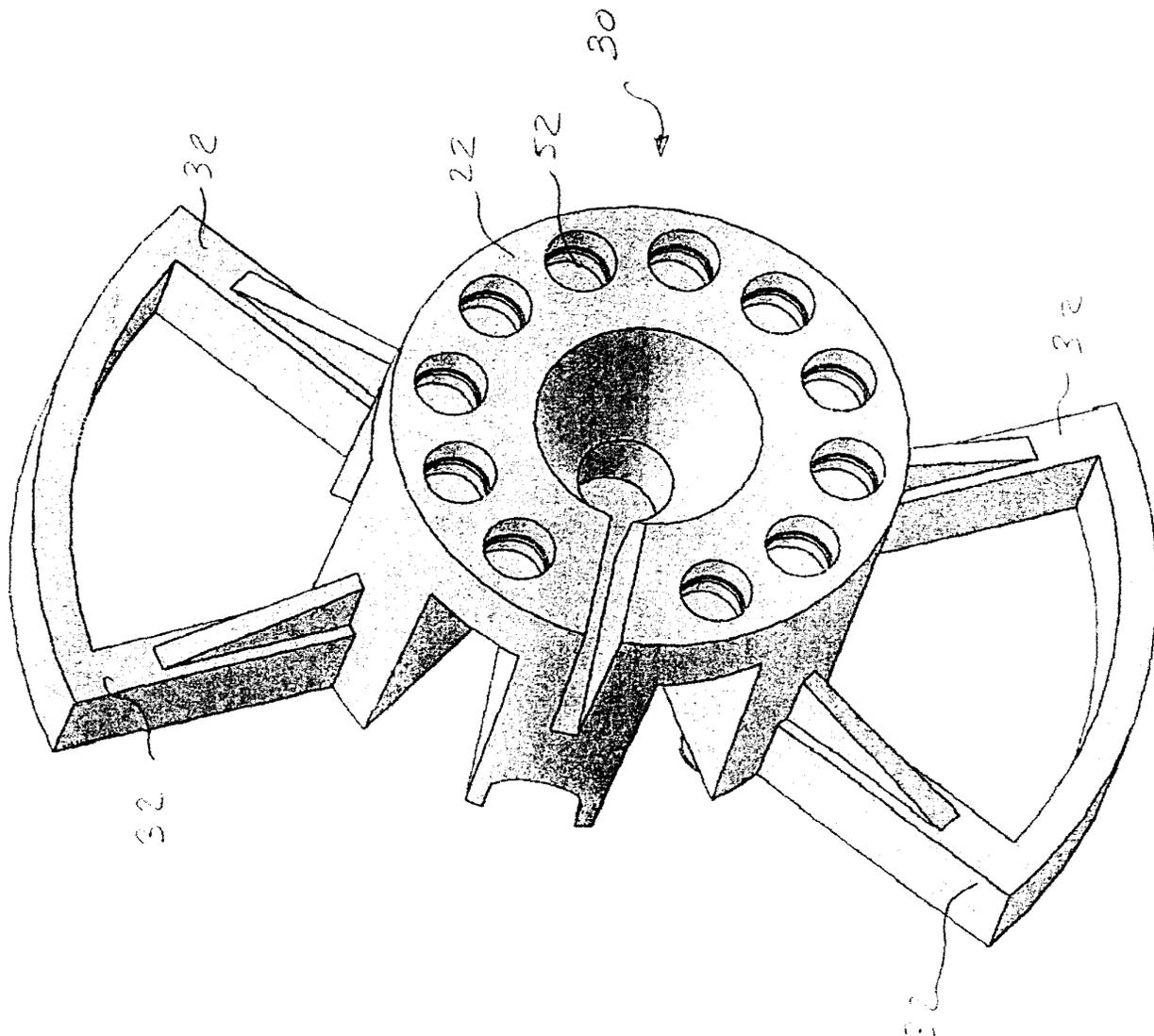


Fig. 4

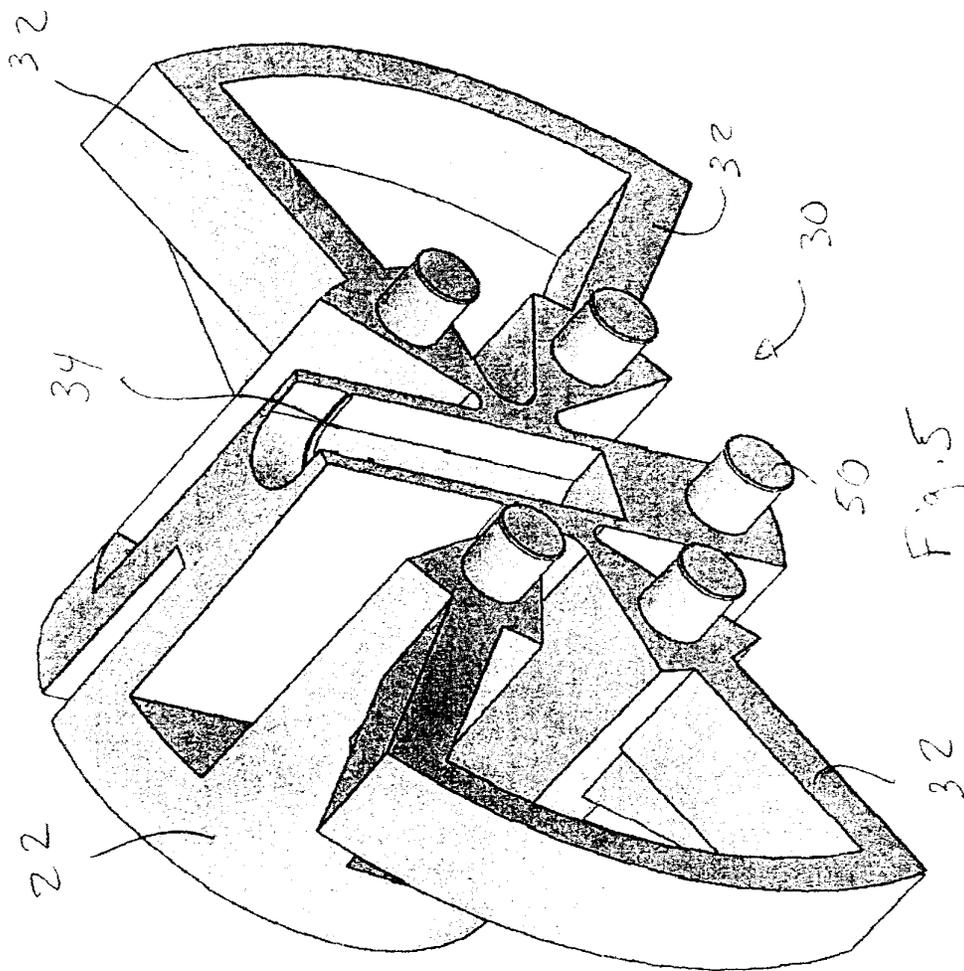
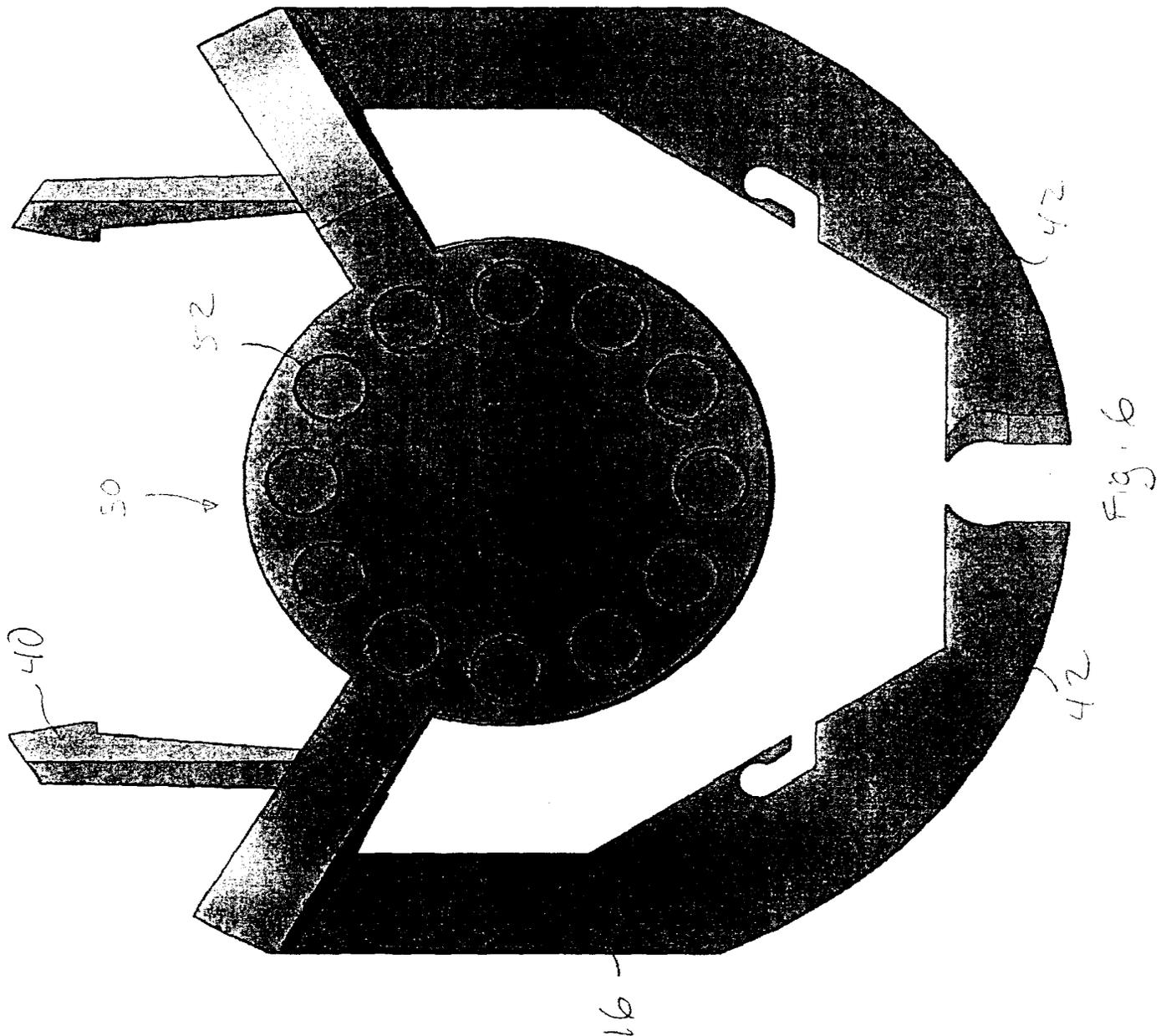
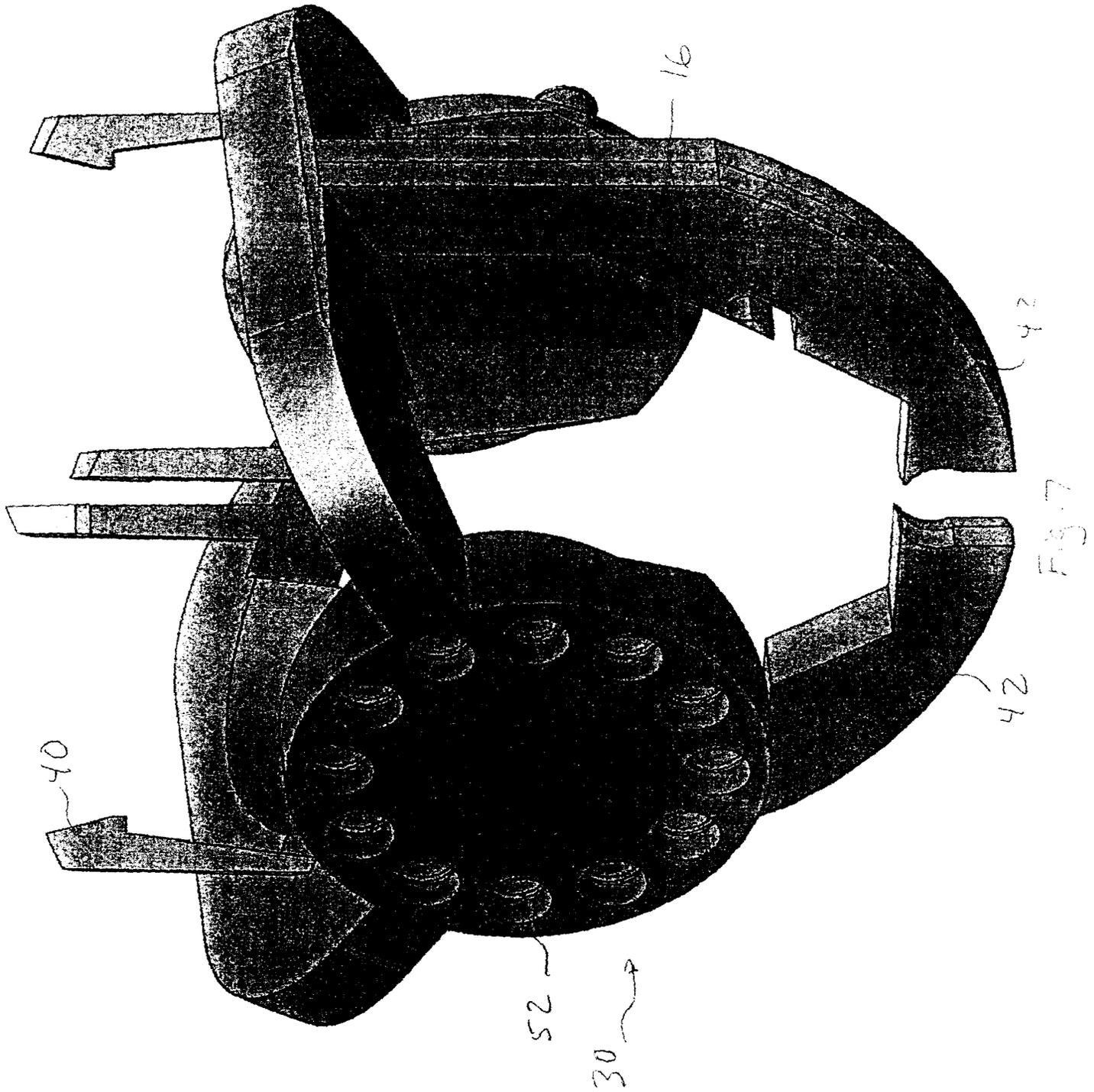


Fig. 5





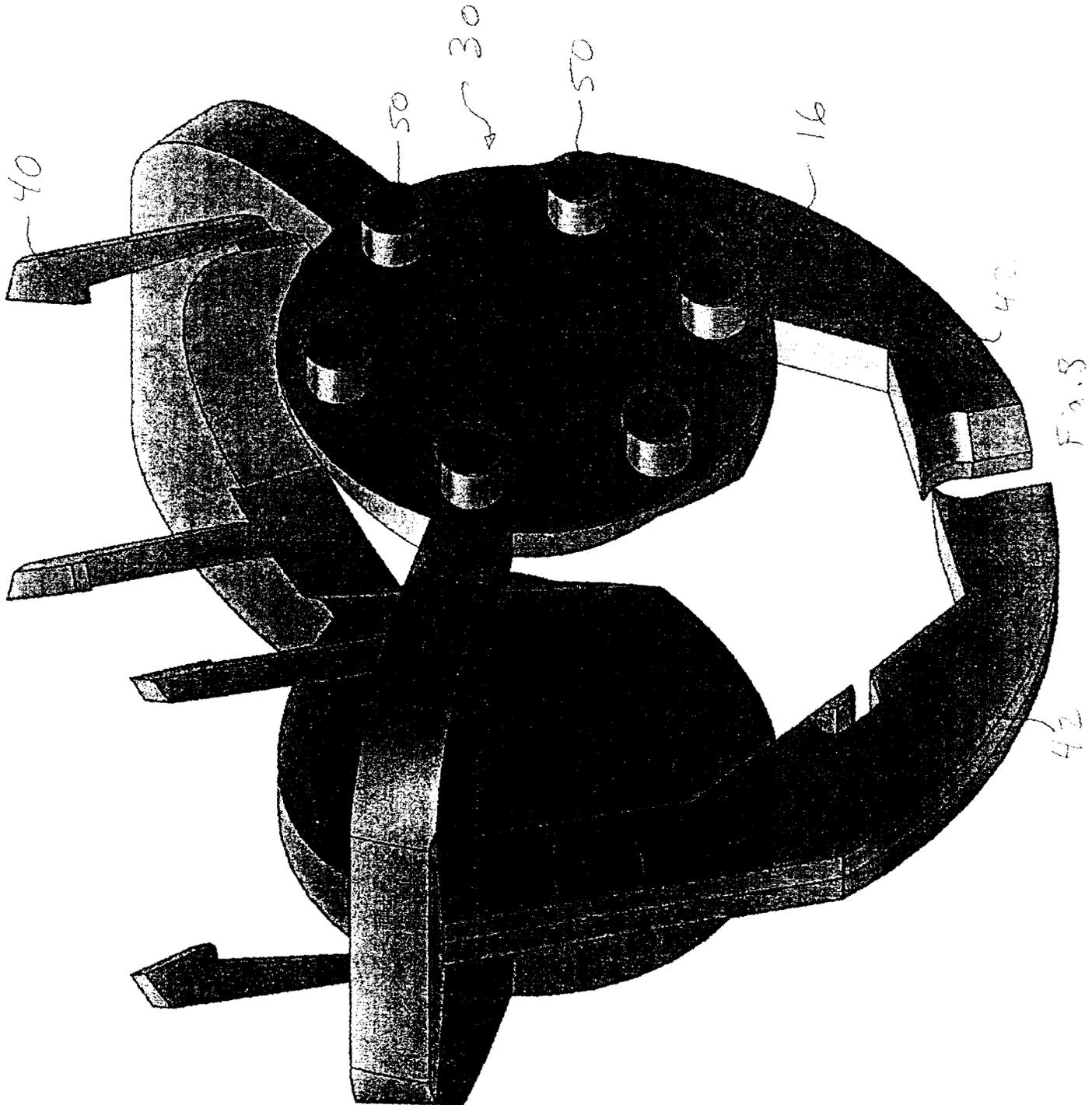


Fig. 8

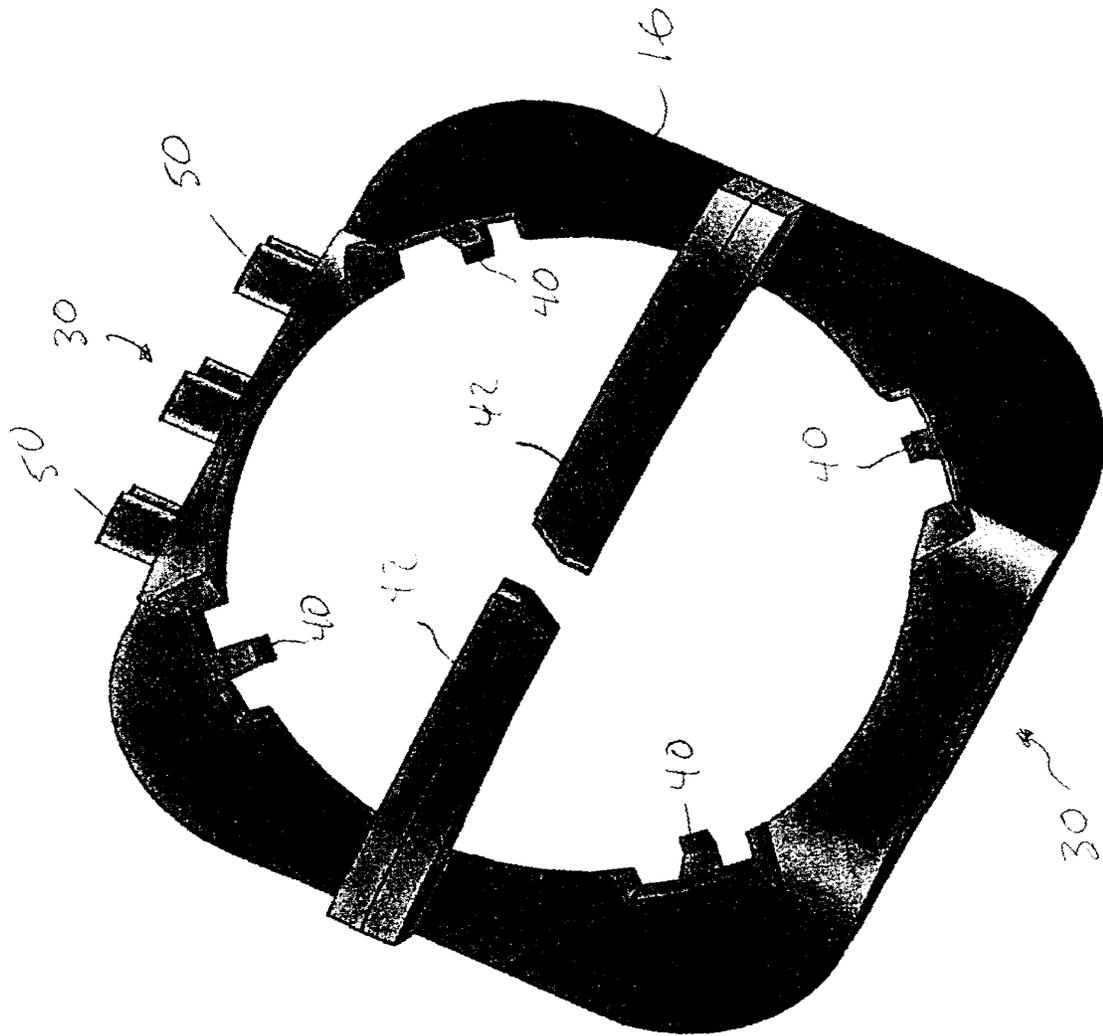


Fig. 9

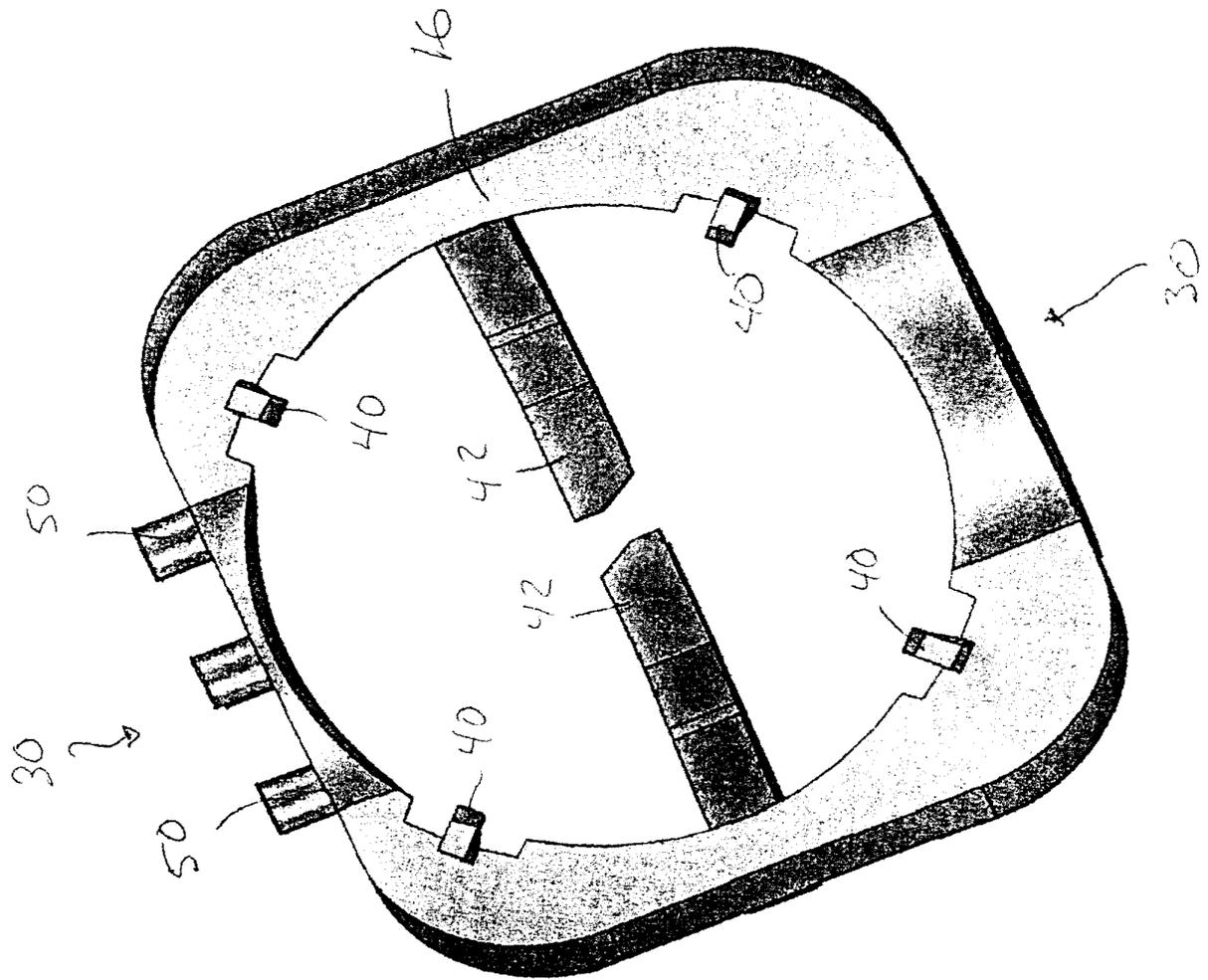


Fig. 10

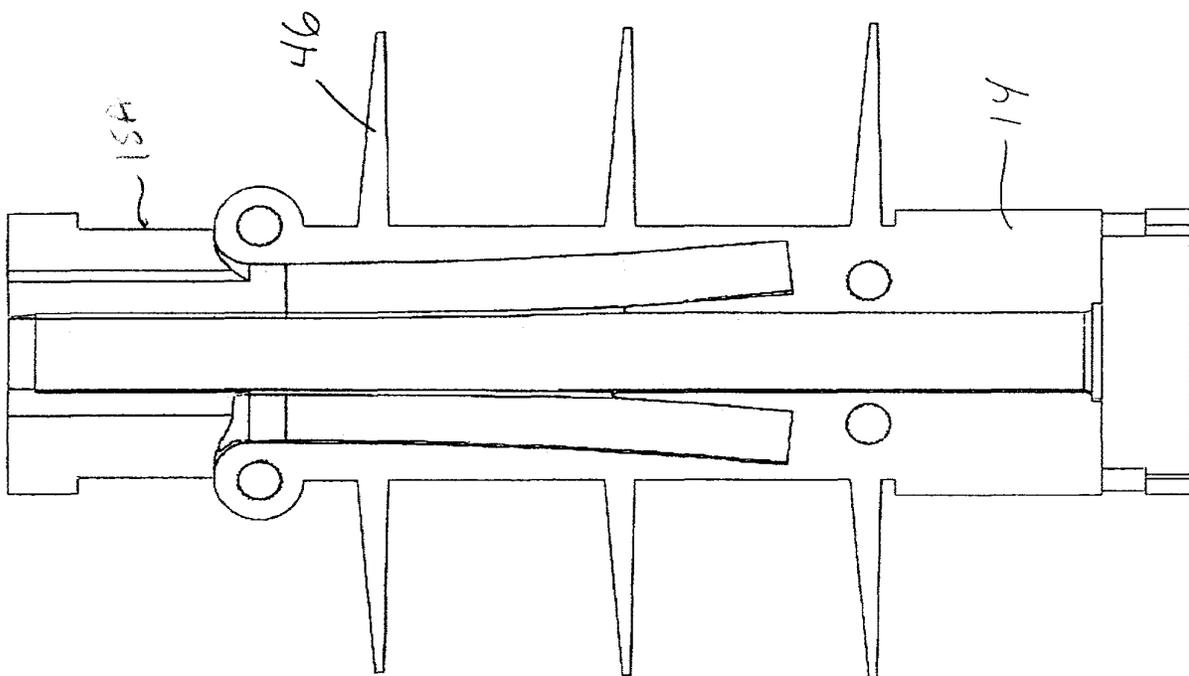


Fig. 11

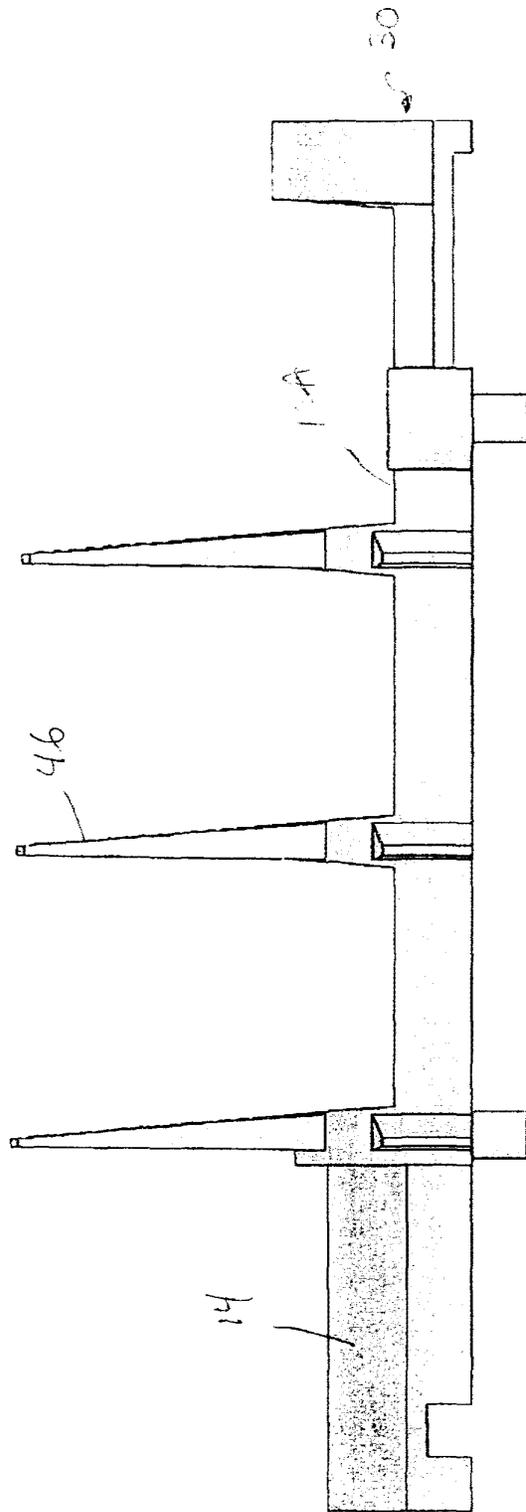


Fig. 12

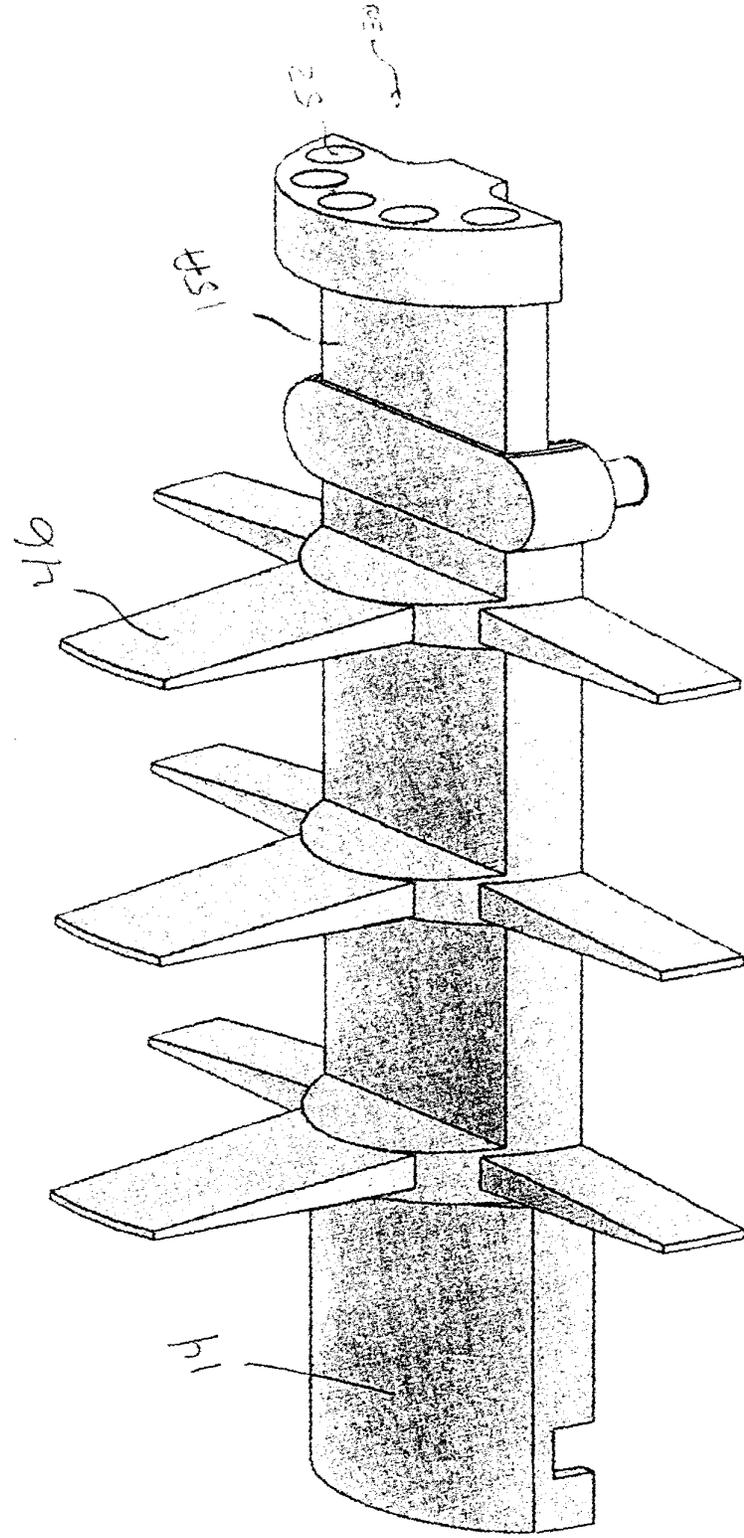


Fig. 13

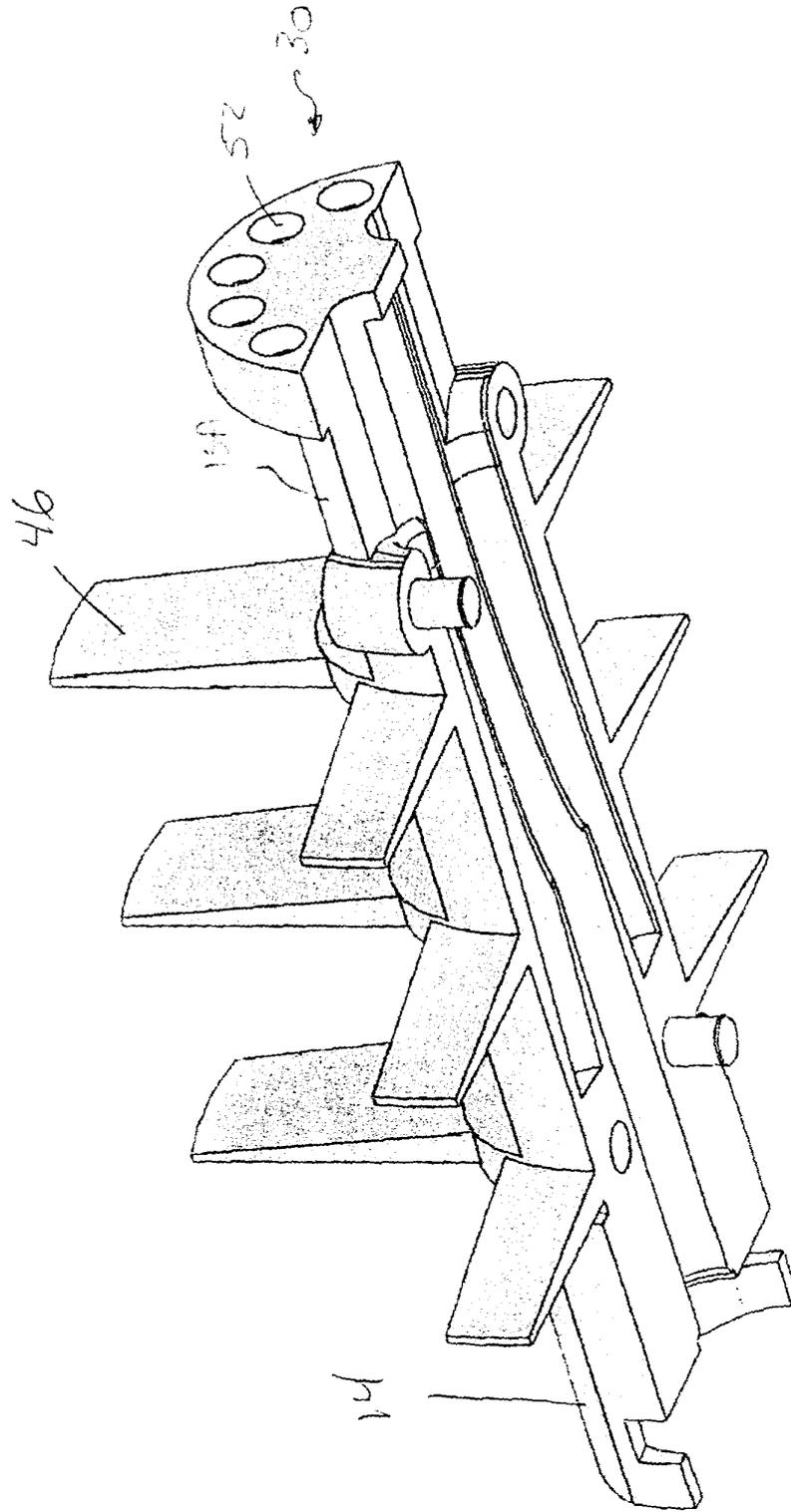


Fig. 14

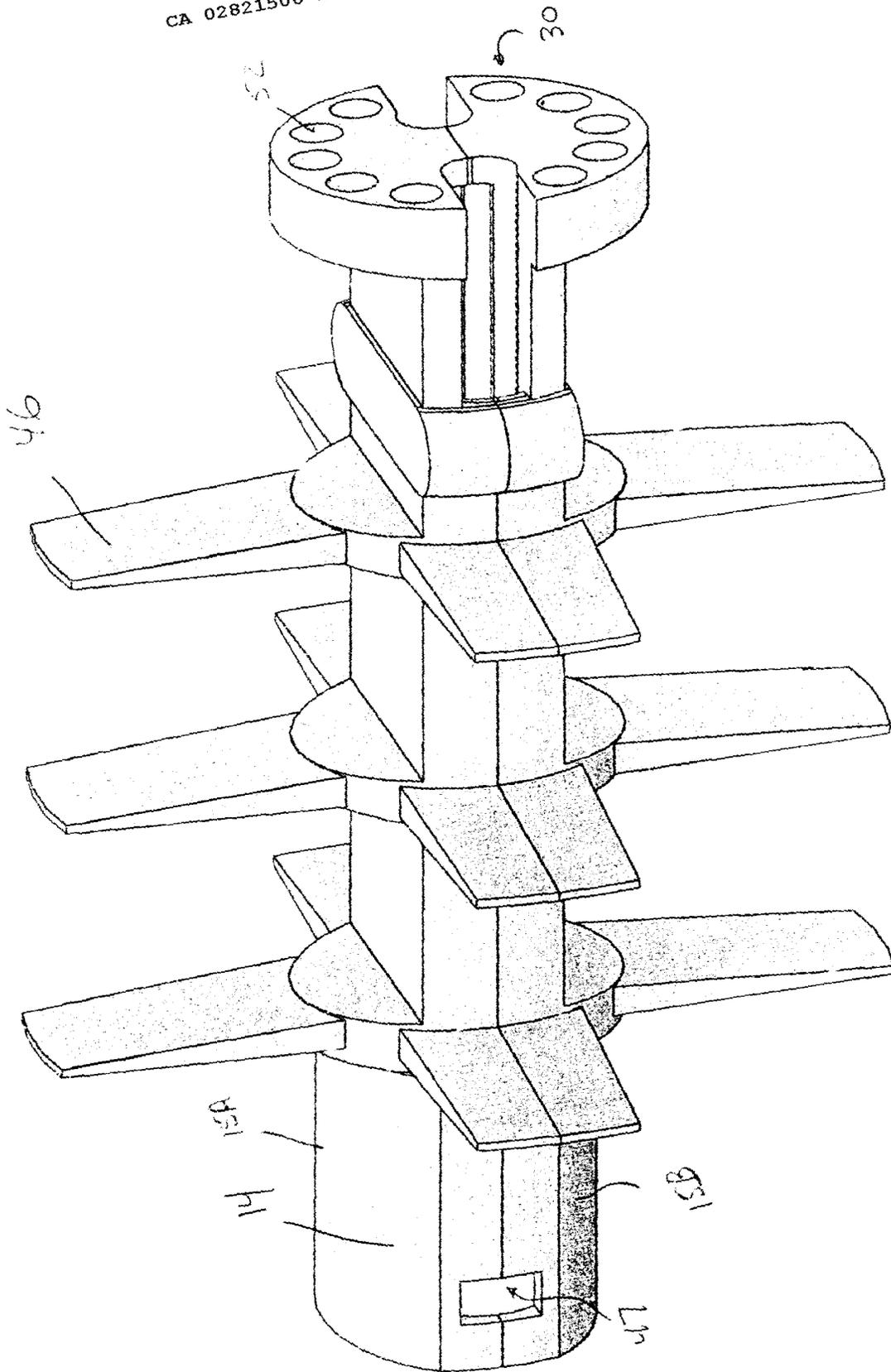


Fig. 15

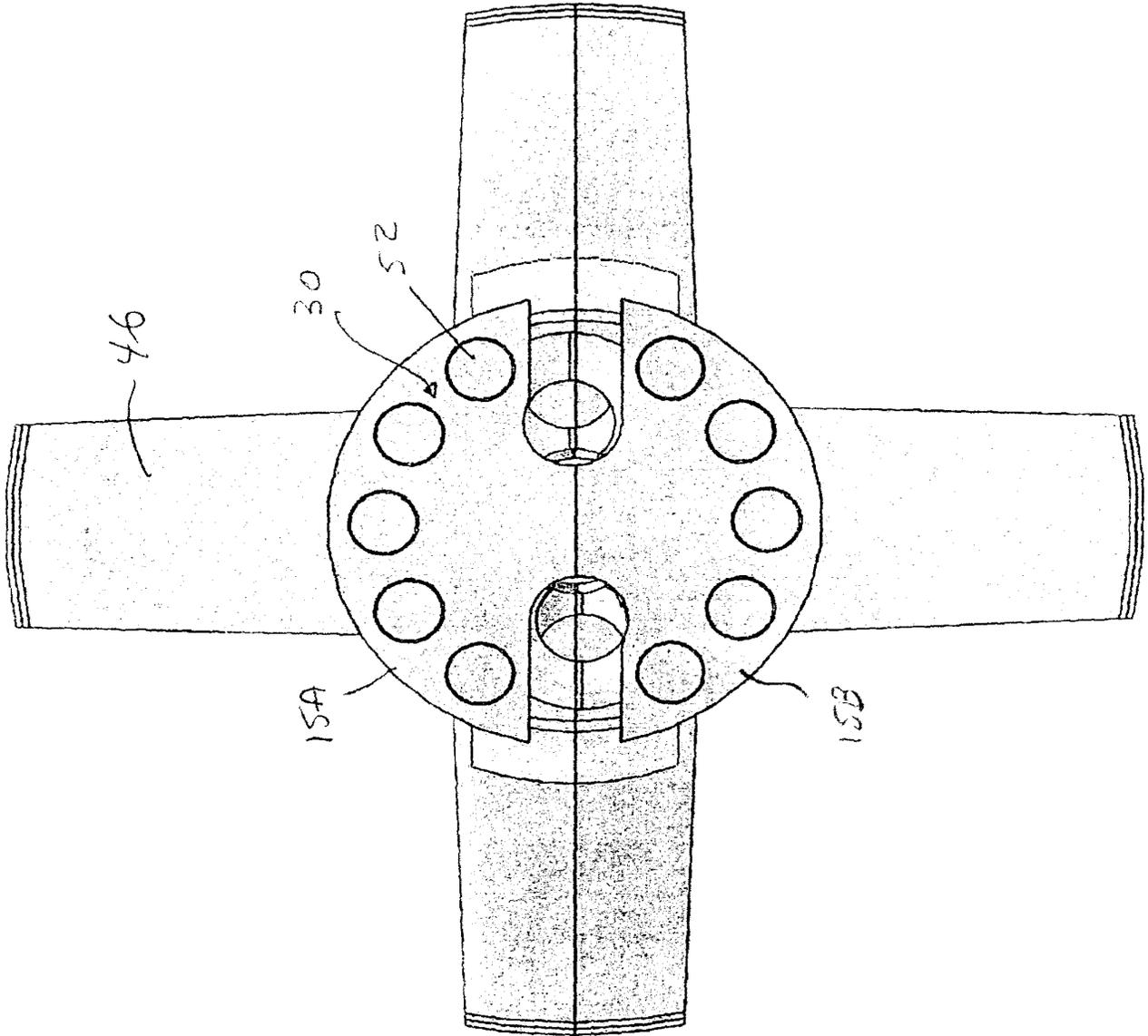


Fig. 16

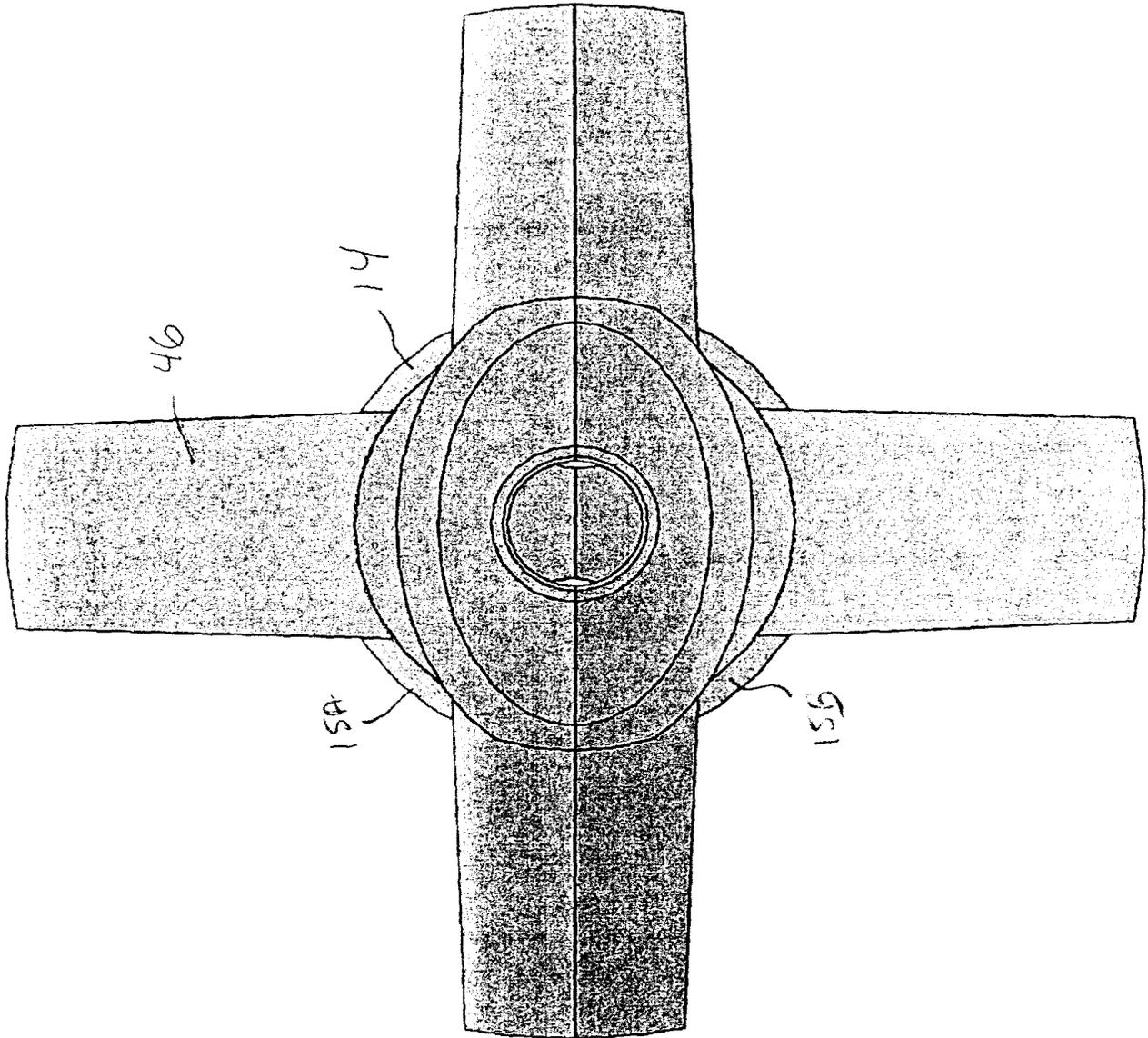


FIG. 17

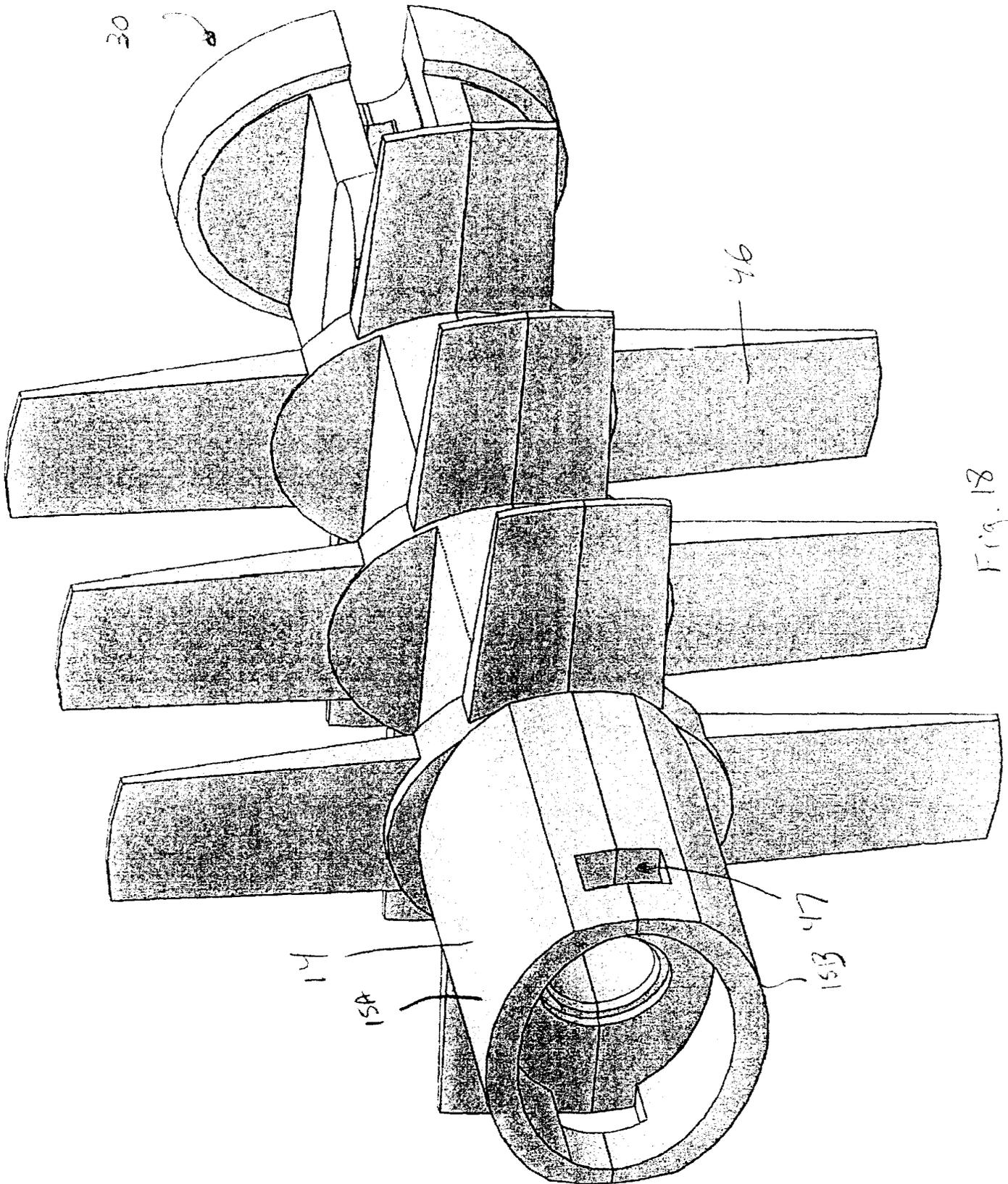


Fig. 18

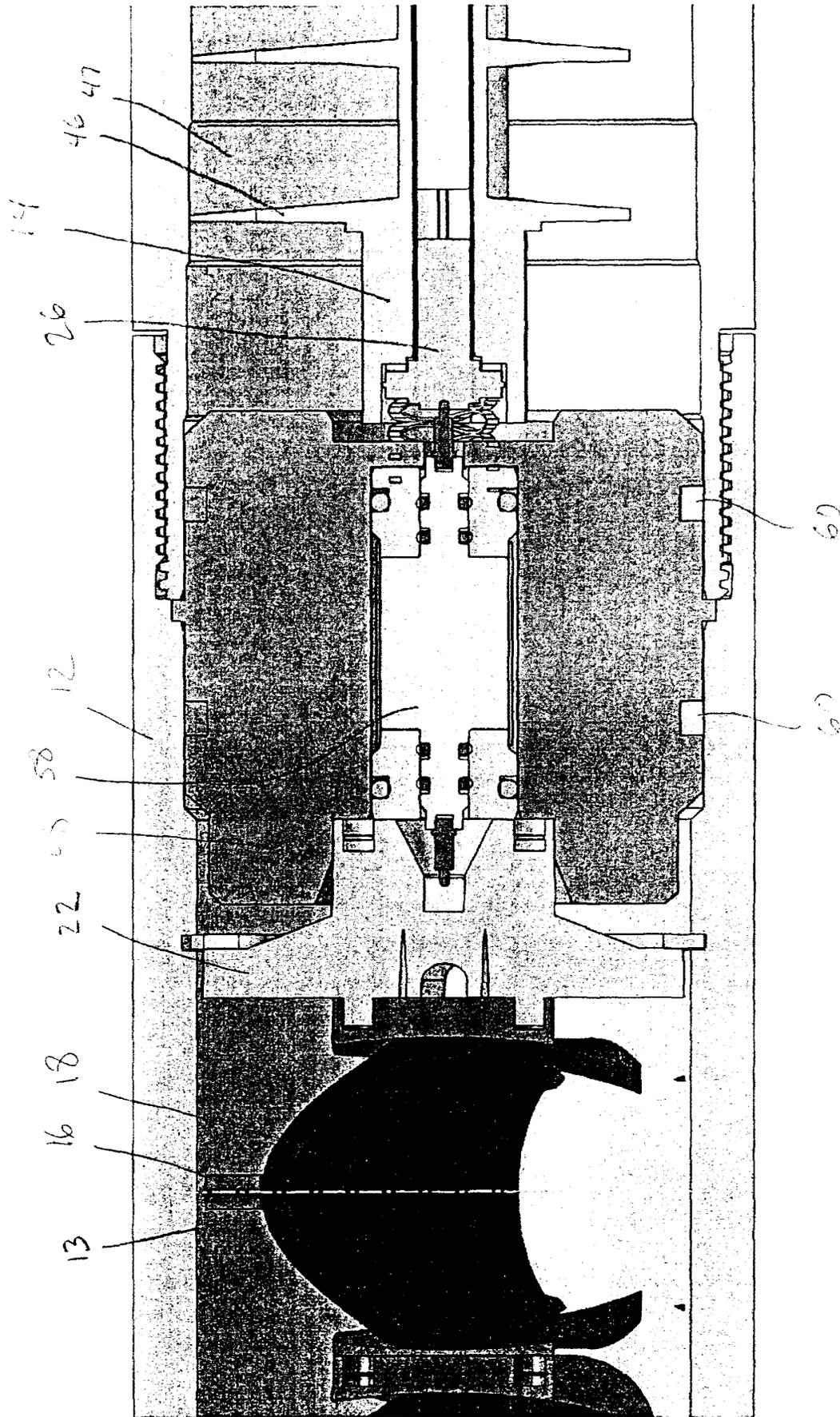


Fig. 19

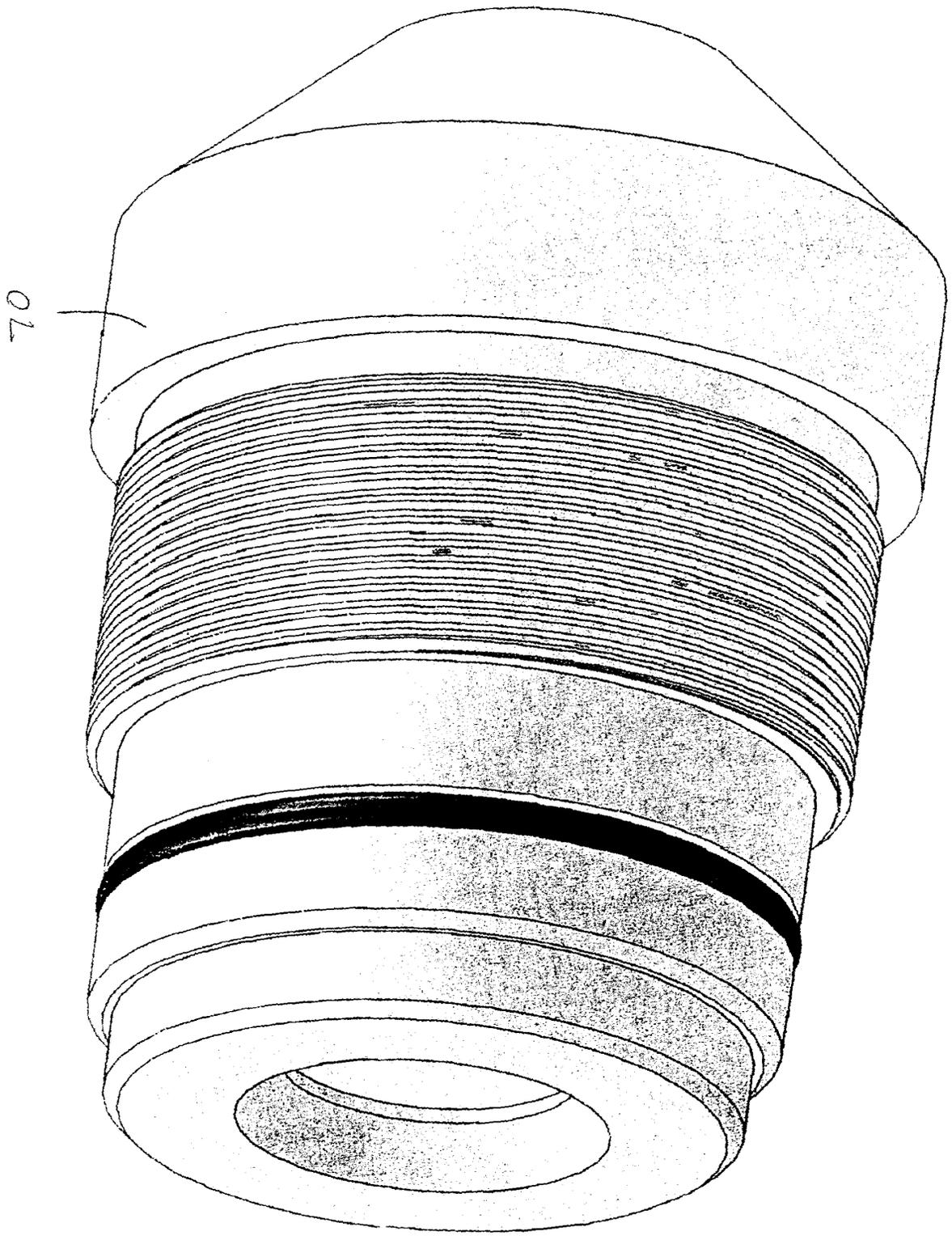


Fig. 10

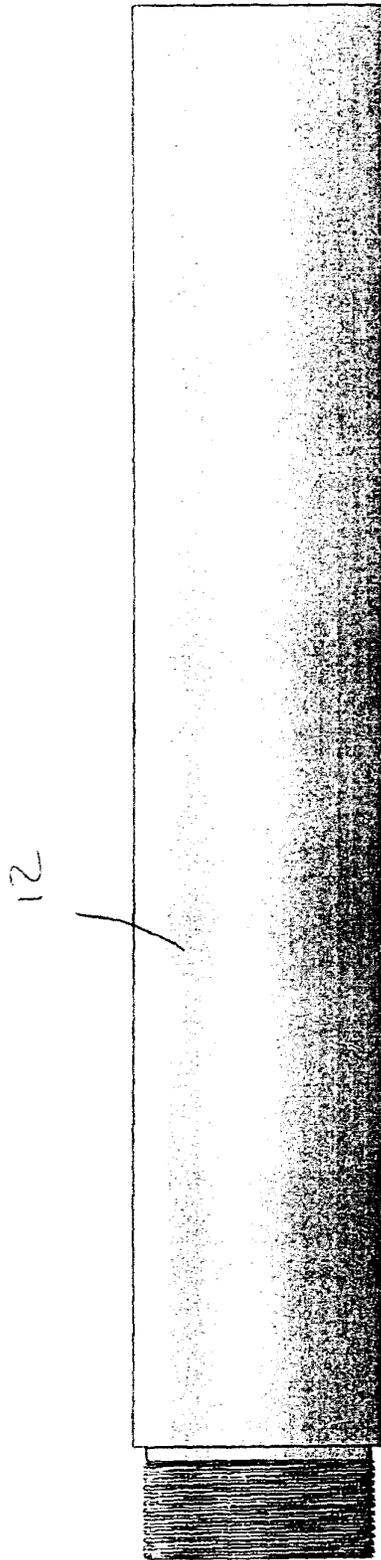


Fig. 21

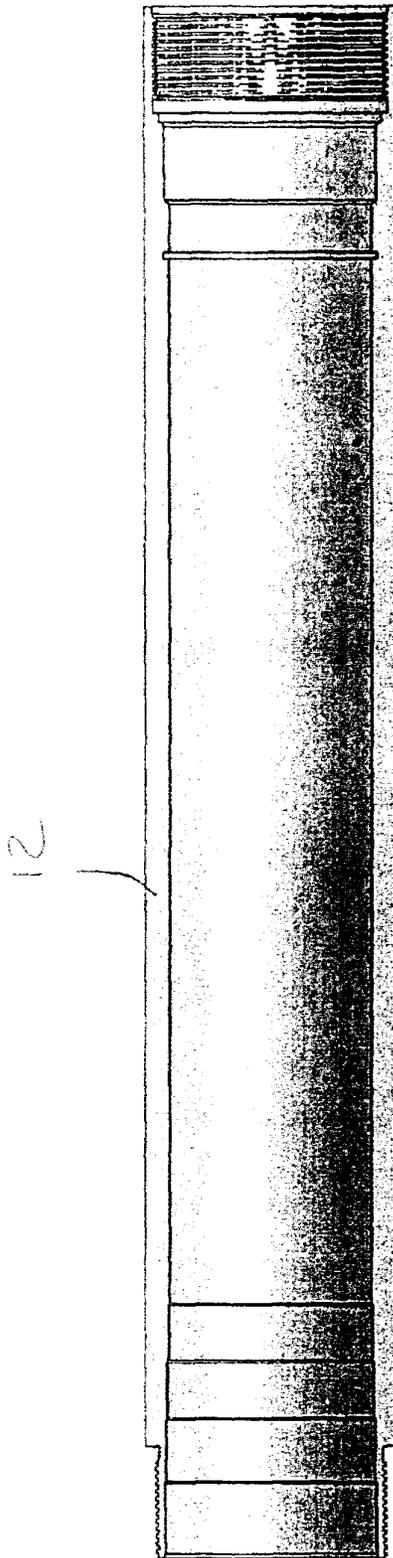


Fig. 22

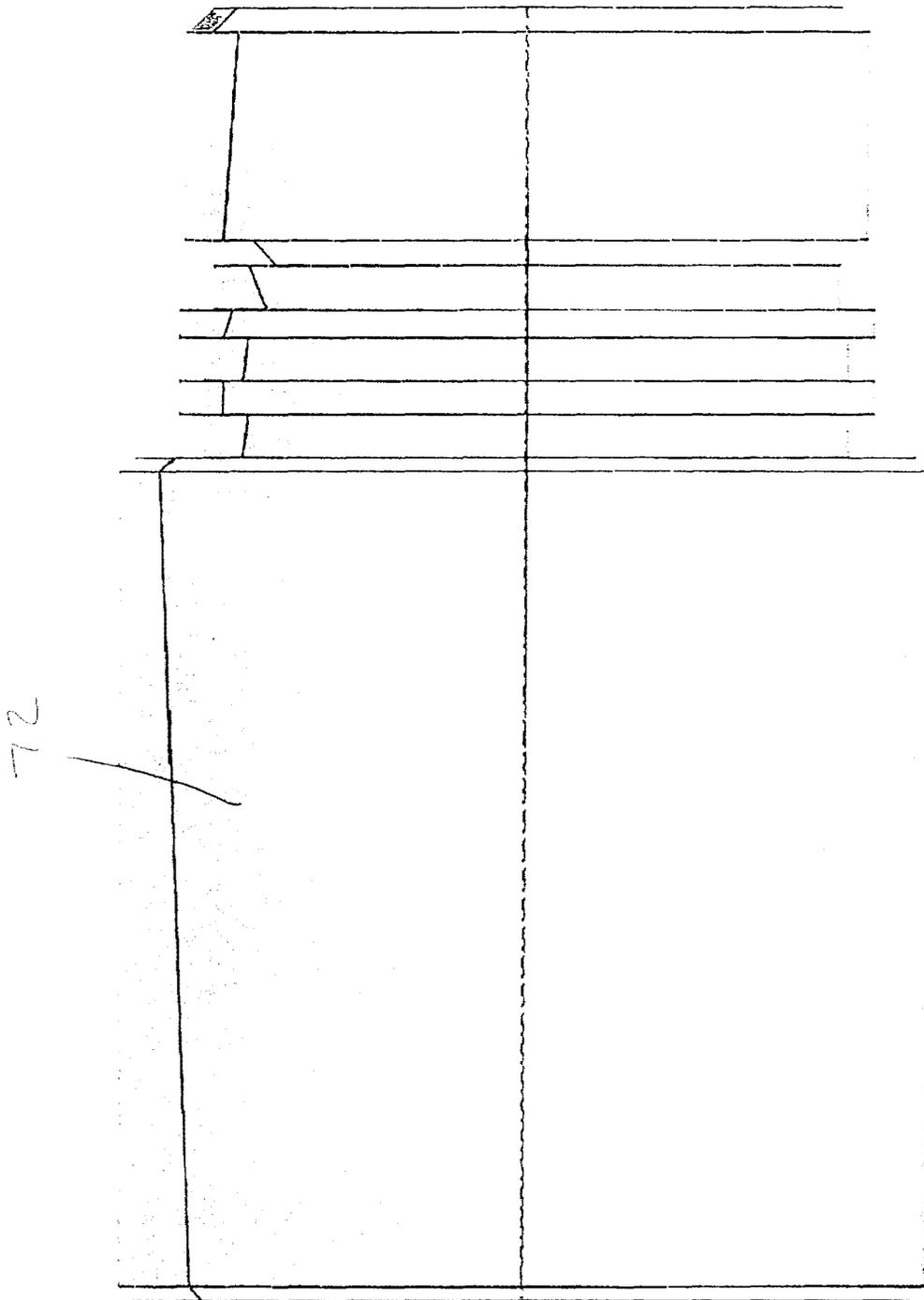


Fig. 23

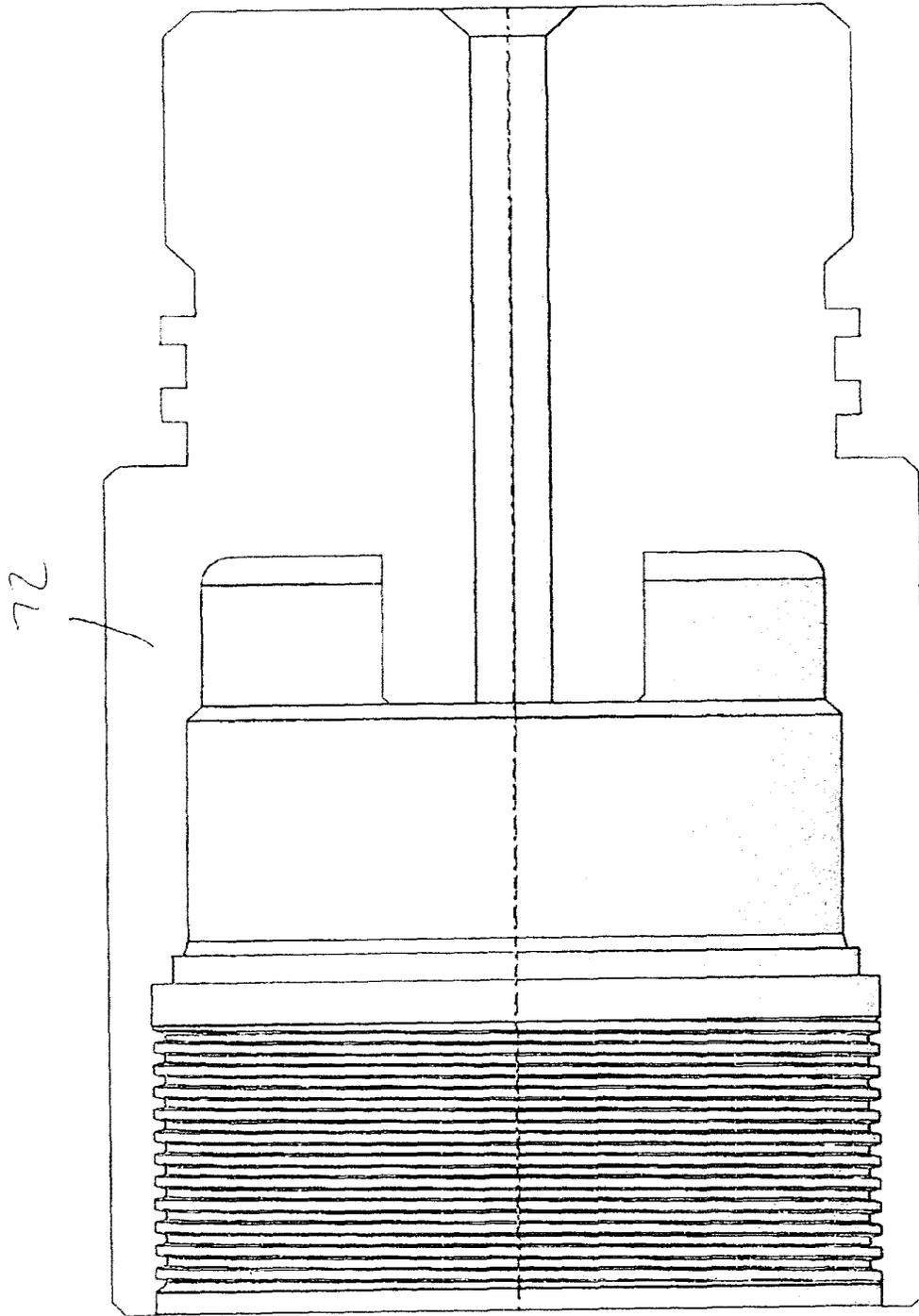


Fig. 24

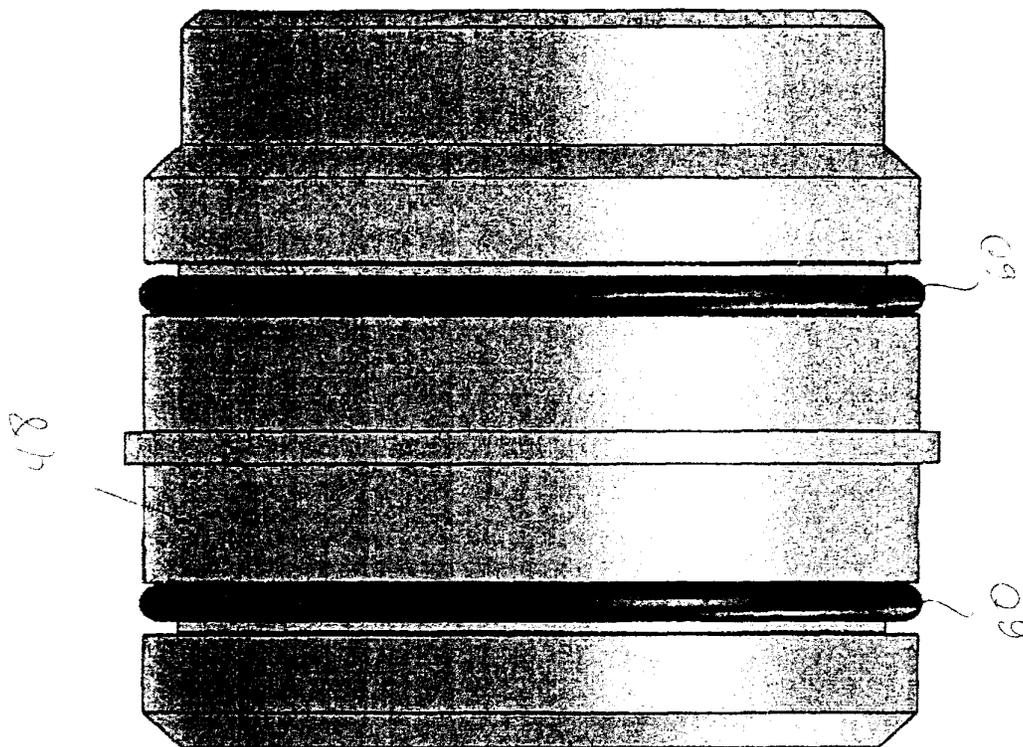


Fig. 25

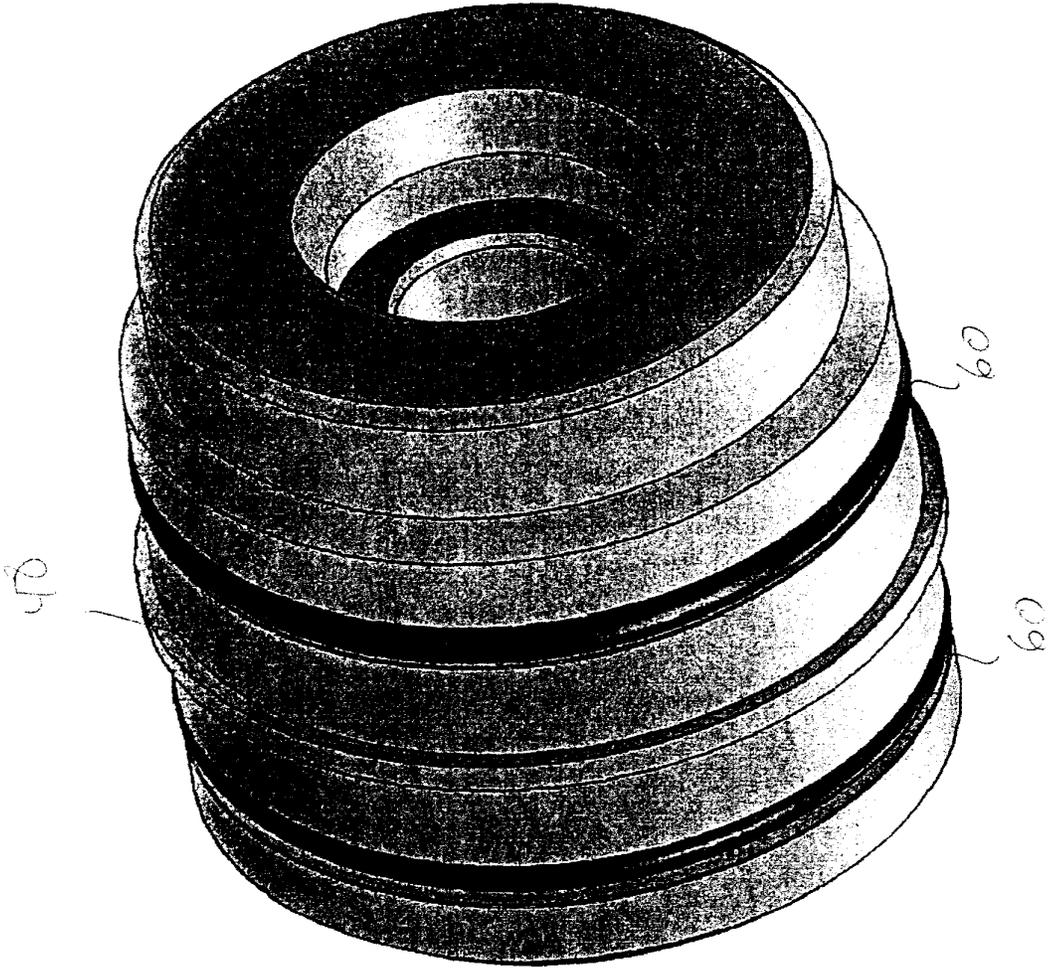


Fig. 26

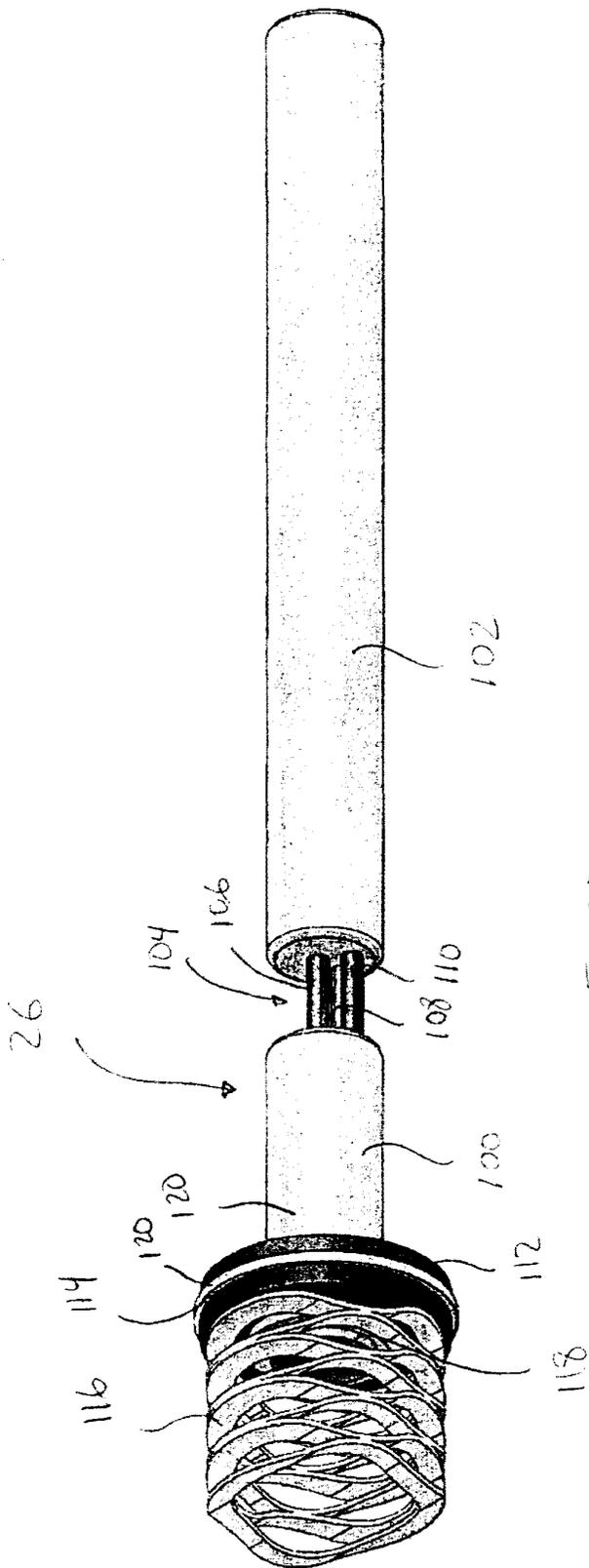
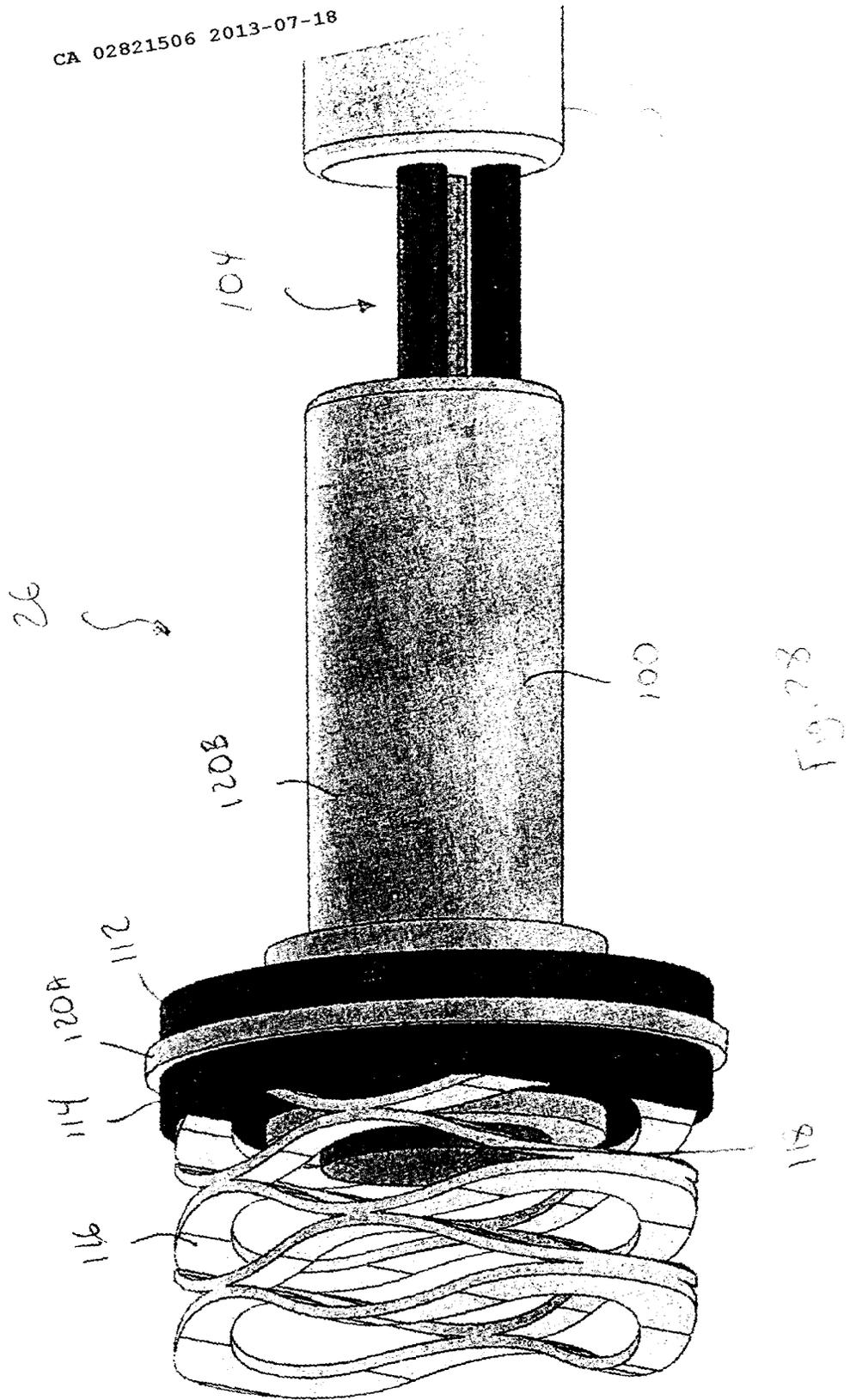


Fig. 27



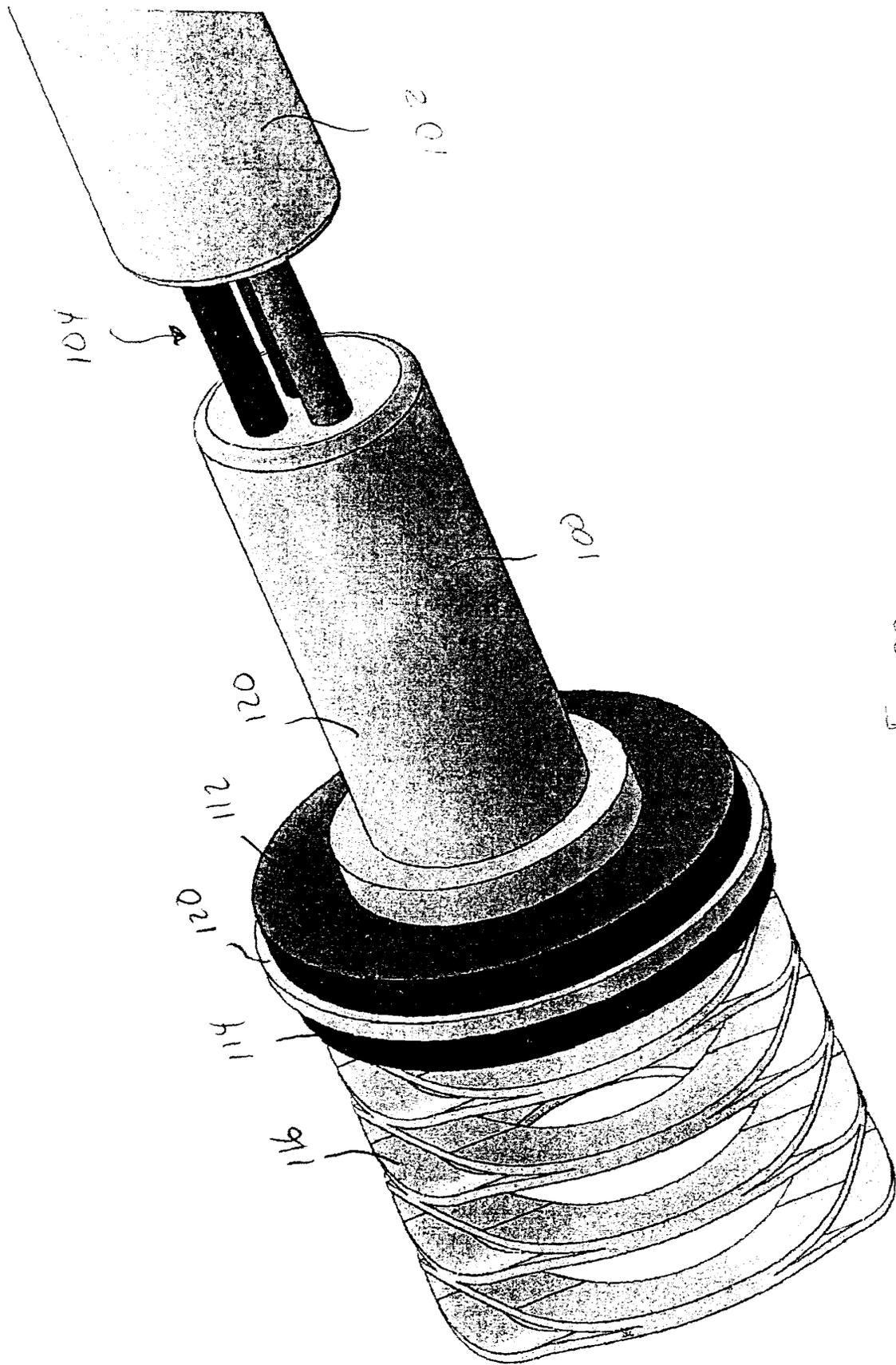


Fig. 29

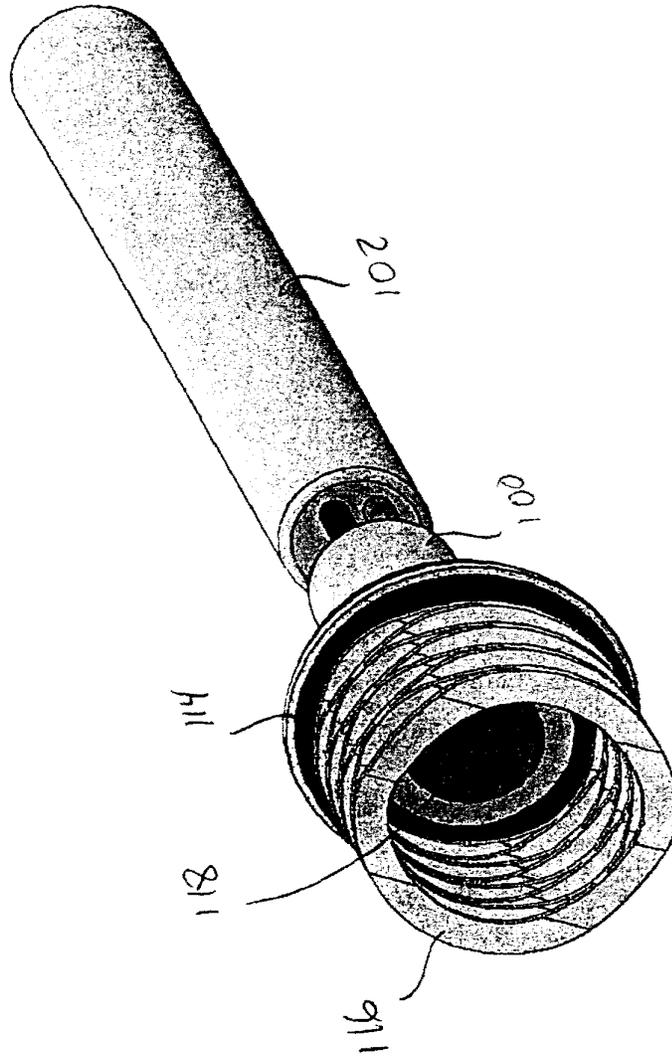


Fig. 30

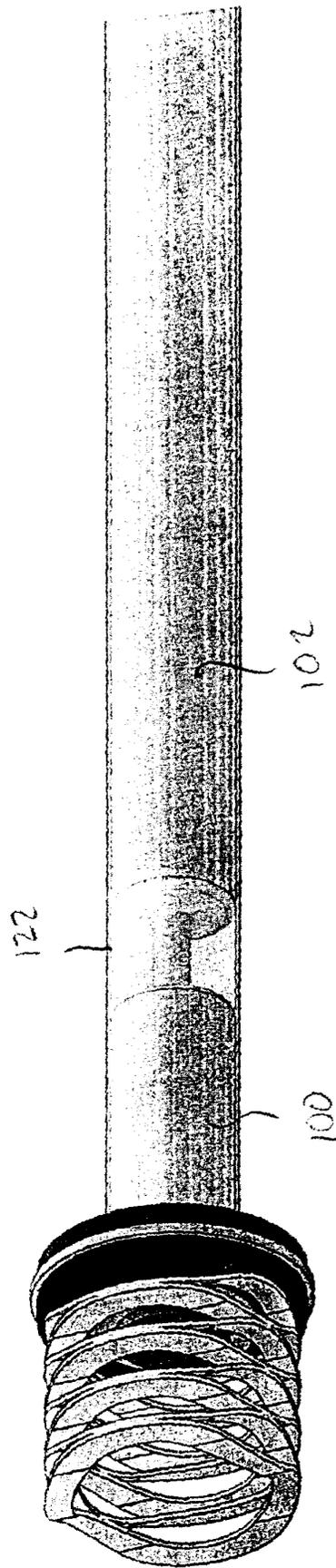


Fig. 31

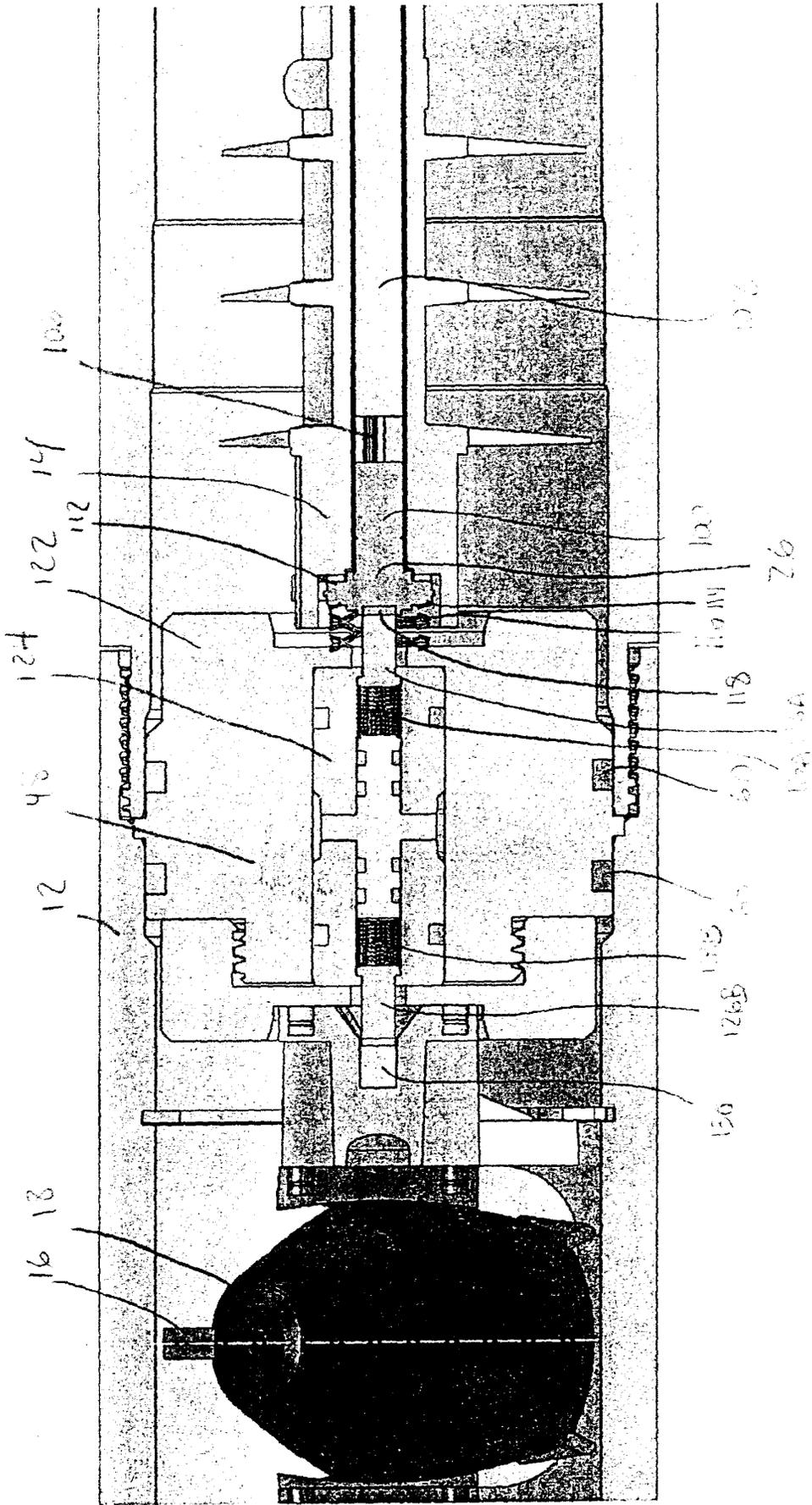


Fig. 32

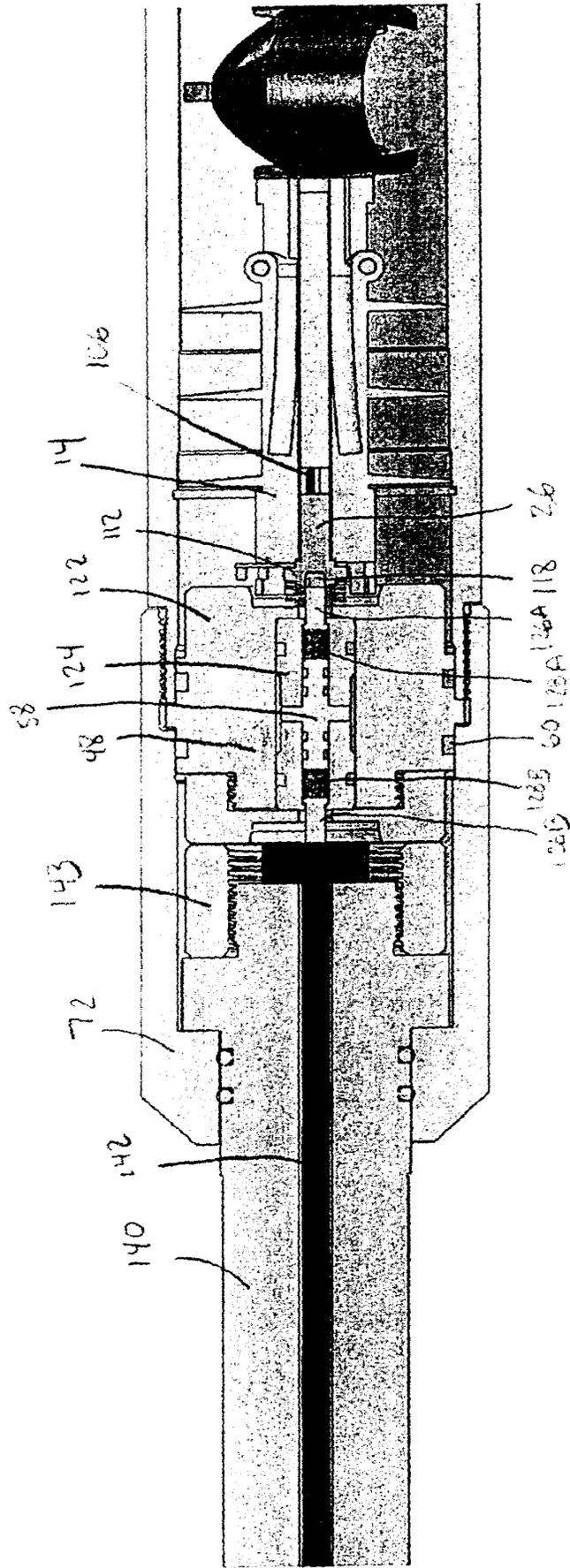


Fig. 33

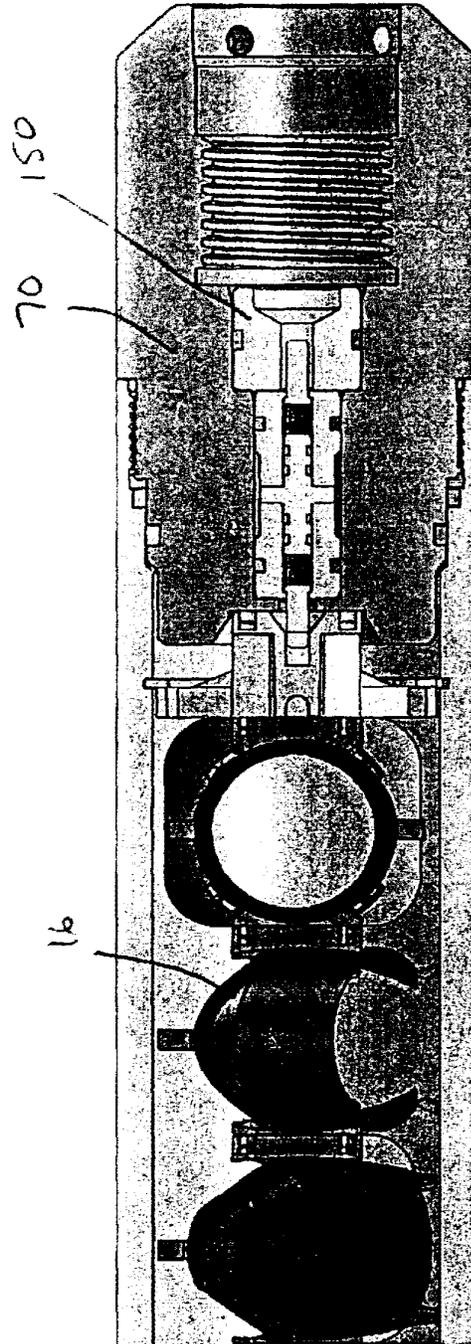


Fig. 34

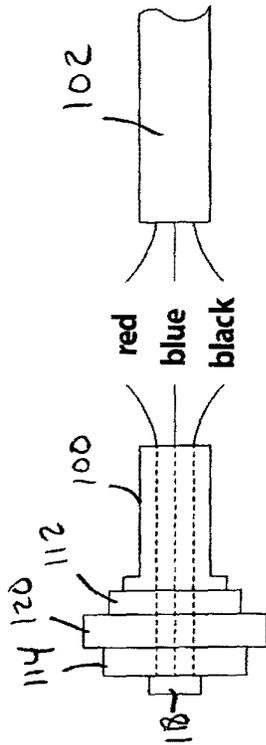


Fig. 35A

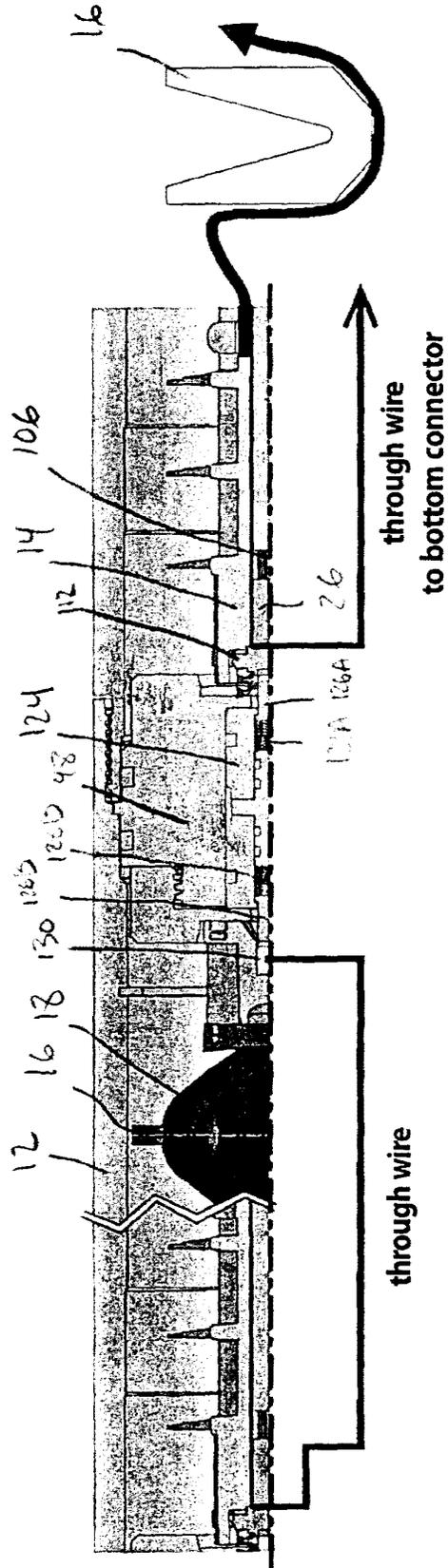
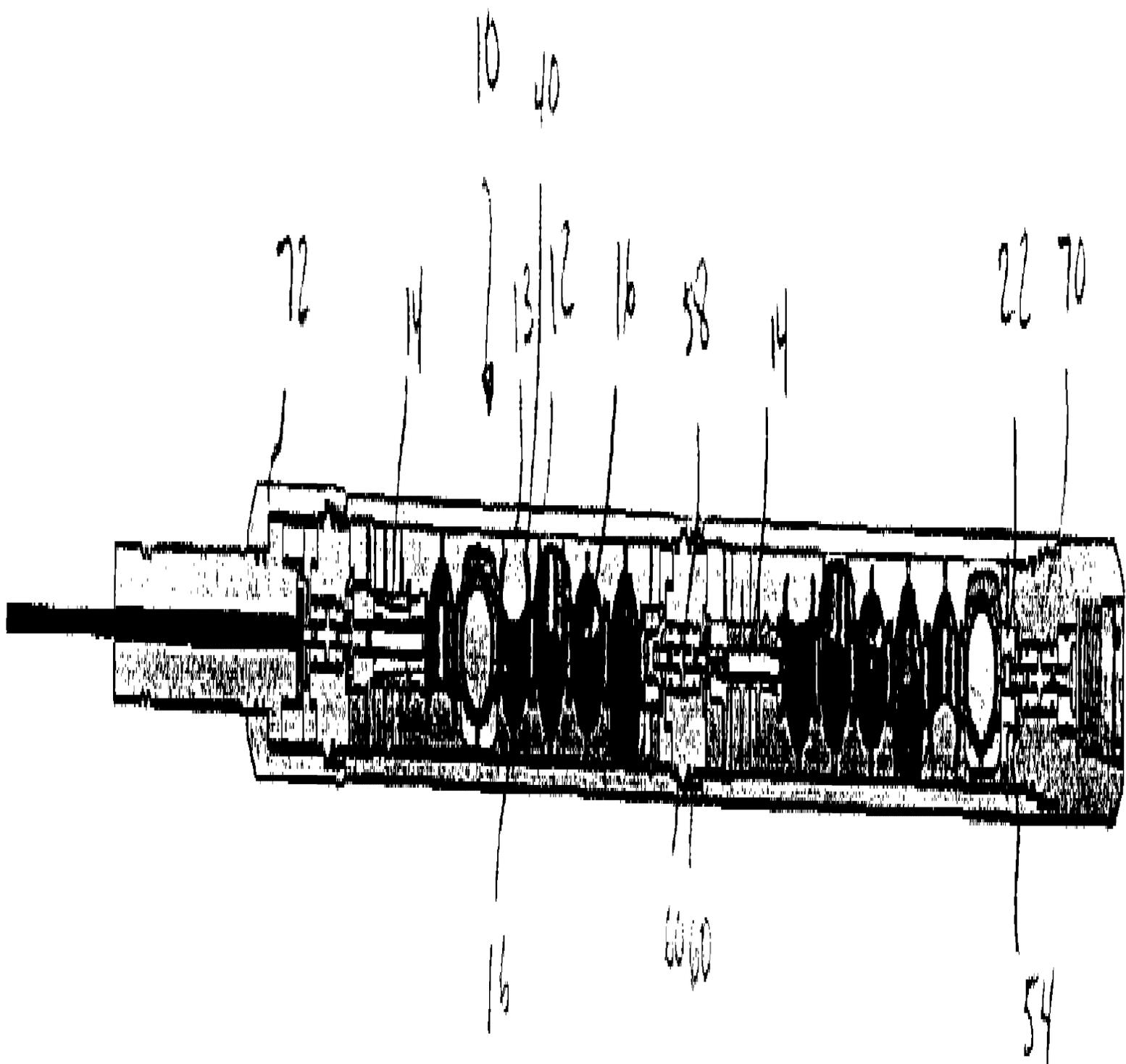
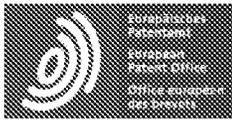


Fig. 35B



**Espacenet****Bibliographic data: CN85107897 (A) — 1986-09-10**

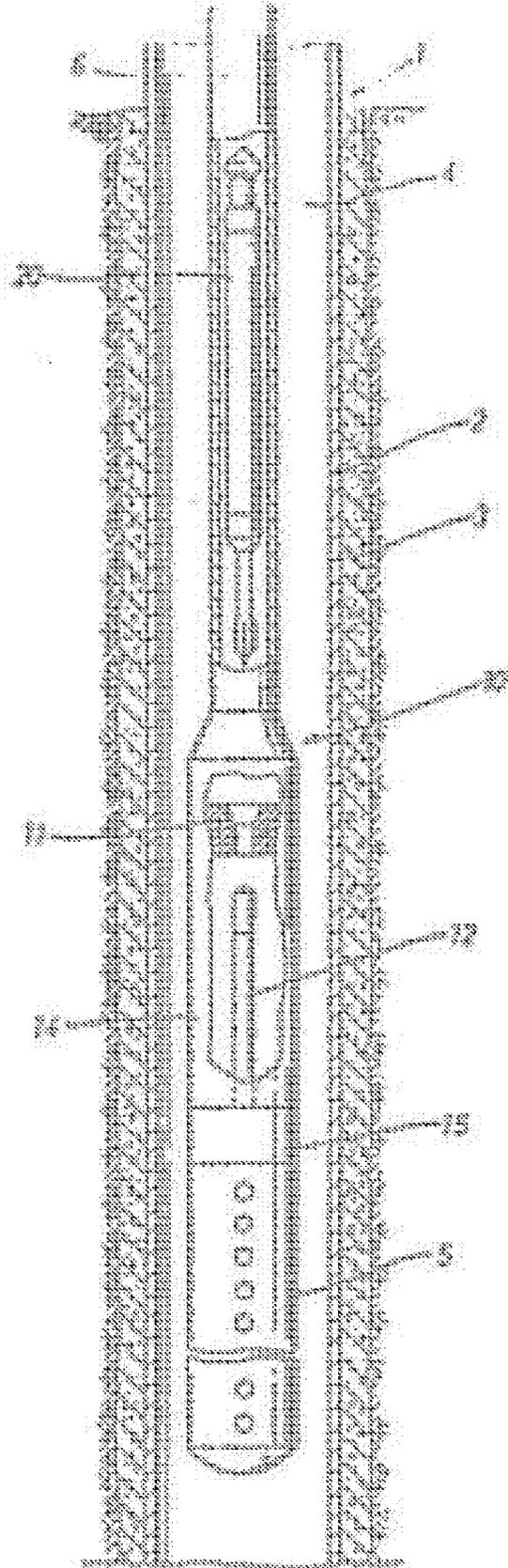
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**FIRING SYSTEM FOR TUBING CONVEYED PERFORATING GUN****Inventor(s):** JAMES T. BAGLEY, ; MAURICE L. SIMON, ; MAURICEL. SIMON**Applicant(s):** SCHLUMBERGER OVERSEAS S.A**Classification:** - international: *E21B43/116; E21B43/1185*; (IPC1-7): E21B43/1185  
- cooperative: E21B43/116; E21B43/11855**Application number:** CN1985107897 19851028**Priority number(s):** US19840665795 19841029**Also published as:** AU4912685 (A) AU578752 (B2) BR8505303 (A) CA1233407 (A)  
CN1006242 (B) more

Abstract not available for CN85107897 (A)

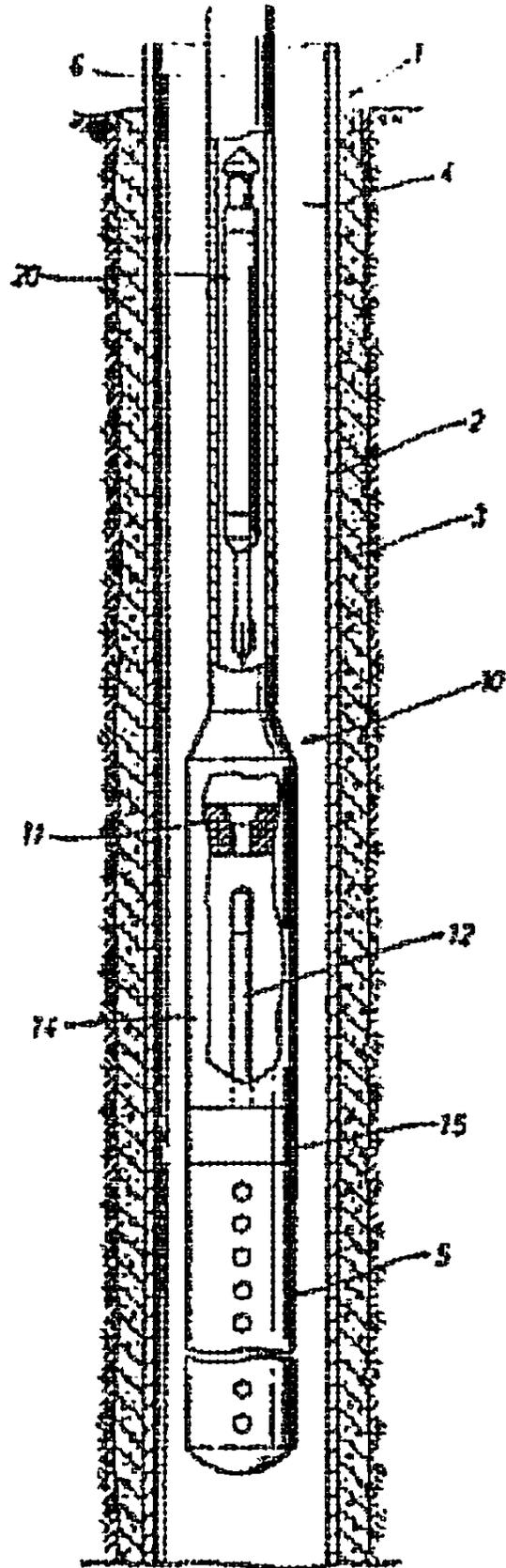
Abstract of corresponding document: US4566544 (A)

A drop bar firing system is provided with a drop bar retracting means that insures that the lower end of the drop bar cannot come into contact with the firing head after a misfire, as the drop bar is fished or the tubing string removed. A safe arm mechanism requires the pressure in the well as the perforating gun is lowered into the well to arm the tubing conveyed perforating firing means. A safe position is automatically developed by the safe arm as the perforating gun is brought out of the well if a live gun must be retrieved. A specially shaped device to fire the tubing conveyed perforating detonator includes a probe of small diameter requiring a heavy impact on center.



**Espacenet****Bibliographic data: CN85107897 (A) — 1986-09-10****FIRING SYSTEM FOR TUBING CONVEYED PERFORATING GUN****Inventor(s):** JAMES T. BAGLEY, ; MAURICE L. SIMON, ; MAURICEL. SIMON**Applicant(s):** SCHLUMBERGER OVERSEAS S.A**Classification:** - international: ***E21B43/116; E21B43/1185***; (IPC1-7): E21B43/1185  
- cooperative: **E21B43/116; E21B43/11855****Application number:** CN1985107897 19851028**Priority number(s):** US19840665795 19841029**Also published as:** AU4912685 (A) AU578752 (B2) BR8505303 (A) CA1233407 (A)  
CN1006242 (B) more**Abstract not available for CN85107897 (A)****Abstract of corresponding document: US4566544 (A)**

A drop bar firing system is provided with a drop bar retracting means that insures that the lower end of the drop bar cannot come into contact with the firing head after a misfire, as the drop bar is fished or the tubing string removed. A safe arm mechanism requires the pressure in the well as the perforating gun is lowered into the well to arm the tubing conveyed perforating firing means. A safe position is automatically developed by the safe arm as the perforating gun is brought out of the well if a live gun must be retrieved. A specially shaped device to fire the tubing conveyed perforating detonator includes a probe of small diameter requiring a heavy impact on center.





Espacenet

## Bibliographic data: CN101397890 (A) — 2009-04-01

Apparatus string for use in a wellbore

**Inventor(s):** LUIS OCHOA [VG] ± (OCHOA LUIS)

**Applicant(s):** SCHLUMBERGER TECHNOLOGY CORP [VG] ±  
(SCHLUMBERGER TECHNOLOGY CORP)

**Classification:** - **international:** E21B17/00; E21B43/11  
- **cooperative:** E21B43/11857; E21B43/119

**Application number:** CN2008192151 20080408

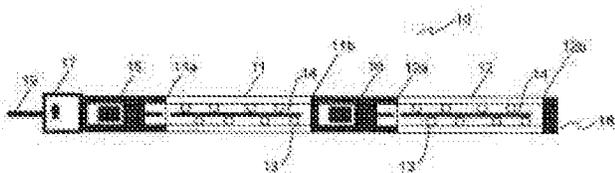
**Priority number(s):** US20070863707 20070928

**Also published as:** CN201306157 (Y) CN201351485 (Y) US2009084535 (A1)  
US8157022 (B2)

### Abstract of CN101397890 (A)

An apparatus string for use in a wellbore is disclosed comprising a plurality of activation modules having first and second ends and containing devices to be

activated/initiated downhole. An apparatus string according to the present invention also comprises a plurality of initiator modules where at least initiator is operatively connected to each activation module and is addressable. Each initiator module may comprise a safety initiator which when the initiator module is addressed initiates the firing of the shaped charges in the gun module to which it is operatively connected. A wireless transmitter is provided which is operatively connected in and integral to the apparatus string for use in transmitting signals to address any initiator module in the apparatus string. An apparatus string according to the present invention may be especially useful in perforating operations.



[19] 中华人民共和国国家知识产权局

[51] Int. Cl.

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[32] 2007.9.28 [33] US [31] 11/863,707

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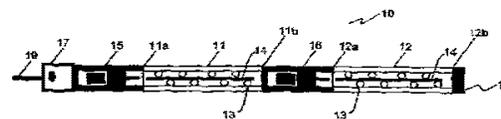
权利要求书3页 说明书6页 附图2页

[54] 发明名称

用于井眼中的设备管柱

[57] 摘要

本发明公开了一种用于井眼中的设备管柱，包括：多个具有第一端和第二端的启动模块，以及将在井下启动的容纳装置。根据本发明的设备管柱也包括多个起爆器模块，至少一个起爆器可操作地连接到各启动模块并可寻址。各起爆器模块可以包括安全起爆器，当起爆器模块被寻址时，所述起爆器启动枪模块中的聚能射孔弹的点火，所述安全起爆器可操作地连接到所述枪模块。提供无线发射器，所述无线发射器可操作地连接到设备管柱中并与设备管柱一体，用于发射信号来对设备管柱终端任何起爆器模块寻址。根据本发明的设备管柱在射孔操作中特别有用。



1. 一种用于井眼中的设备管柱，包括：

无线发射器，所述无线发射器是所述设备管柱的组成部分。

2. 根据权利要求1所述的设备管柱，还包括无线启动系统，所述无线启动系统从所述无线发射器接收命令，并启动所述井眼中的装置。

3. 一种用于井眼中的设备管柱，包括：

多个启动模块，每个所述启动模块具有第一端和第二端，并包括将在井下启动/起爆的装置；

多个电池操作的可寻址起爆器，至少一个起爆器可操作地连接到每个启动模块以当寻址到所述起爆器时、启动/起爆所述启动模块；和

无线发射器，所述无线发射器与设备管柱一体形成，所述无线发射器从地表接收信号，且发射信号来对设备管柱中的起爆器寻址。

4. 根据权利要求3所述的设备管柱，其中所述启动模块中的装置从射孔枪、设定工具、倾倒水泥的设备和推进装置所构成的组中选择。

5. 根据权利要求3所述的设备管柱，其中所述起爆器可操作地连接到每个启动模块的第一端。

6. 根据权利要求3所述的设备管柱，其中起爆器可操作地连接到每个启动模块的第二端。

7. 根据权利要求3所述的设备管柱，其中起爆器可操作地连接到每个启动模块的第一端和第二端。

8. 根据权利要求3所述的设备管柱，其中每个起爆器包括EFI装置。

9. 根据权利要求3所述的设备管柱，其中每个起爆器包括EBW装置。

10. 一种射孔柱，包括：

多个枪模块，每个枪模块具有第一端和第二端，并包括多个聚能射孔弹和互连所述聚能射孔弹的爆炸索；

多个起爆器模块，至少一个起爆器模块可操作地连接到每个枪模块，每个所述起爆器模块可寻址，且包括安全起爆器，当寻址到所述起爆器模

块时，所述安全起爆器启动枪模块中的聚能射孔弹的点火，起爆器模块可操作地连接到所述枪模块；和

无线发射器，所述无线发射器可操作地连接到射孔柱并与所述射孔柱一体形成，用于发射信号来选择射孔柱中的起爆器模块。

11. 根据权利要求10所述的射孔柱，其中所述起爆器模块可操作地连接到各枪模块的第一端。

12. 根据权利要求10所述的射孔柱，其中起爆器模块可操作地连接到各枪模块的第二端。

13. 根据权利要求10所述的射孔柱，其中起爆器模块可操作地连接到各枪模块的第一端和第二端。

14. 根据权利要求10所述的射孔柱，其中所述起爆器模块是用电池操作的。

15. 根据权利要求10所述的射孔柱，其中每个起爆器模块中的安全起爆器是EFI装置。

16. 根据权利要求10所述的射孔柱，其中每个起爆器模块中的安全起爆器是EBW装置。

17. 一种用于射孔柱中的设备，所述设备在射孔位置之外的位置处组装，所述设备包括：

枪模块，具有第一端和第二端，并包括多个聚能射孔弹和互连所述聚能射孔弹的爆炸索；

起爆器模块，所述起爆器模块可操作地连接到枪模块的一端，每个所述起爆器模块包括：(i) 用于对起爆器模块寻址的电路；和(ii) 安全起爆器，当寻址到所述起爆器模块时，将起爆信号提供到枪模块中的所述爆炸索。

18. 根据权利要求17所述的设备，其中所述起爆器模块可操作地连接到每个枪模块的第一端。

19. 根据权利要求17所述的设备，其中所述起爆器模块可操作地连接到所述枪模块的第二端。

20. 根据权利要求17所述的设备，还包括第二起爆器装置，所述第二

起爆器装置可操作地连接到所述枪模块的另一端。

21. 根据权利要求17所述的设备，其中所述起爆器模块是用电池操作的。

22. 根据权利要求17所述的设备，其中所述起爆器模块中的安全起爆器是EFI装置。

23. 根据权利要求17所述的设备，其中所述起爆器模块中的安全起爆器是EBW装置。

## 用于井眼中的设备管柱

### 技术领域

本申请涉及一种用于井眼中的设备管柱 (apparatus string)，所述设备管柱例如可以包括射孔柱。

### 背景技术

为了改进从地下地层采集的目的，射孔枪典型地降低到井眼中，所述井眼延伸通过所述地层。射孔枪典型地包括多个枪部分，每个枪部分包括多个径向取向的聚能射孔弹，所述射孔弹被引爆以在靠近井眼的地层中形成射孔。这些聚能射孔弹可以例如放置在沿着射孔枪的每个枪部分的纵向轴线延伸的螺旋形螺线上的点处。

在钢丝枪中，存在两种金属丝，所述金属丝沿着枪柱的长度前进。这些金属线中的一个连接到正或者负电压的通电电线或者带电电线，另一个线是接地线。这些线将安置在地表处或者附近的电流和电压源连接到射孔枪的主体中的电动雷管。电动雷管是这样的设备：所述设备启动弹药导火线，所述导火线包括爆炸索，所述设备接着启动聚能射孔弹，所述聚能射孔弹将对井射孔并允许在地层中的储层和井眼之间流动。用于射孔枪柱的典型的启动系统通常在一个柱中运行几个枪时、也需要弹药从一个枪行进到另外一个枪。

金属线的存在不仅减小了用于聚能射孔弹的枪中的空间量而且也增加了需要加载枪所需的时间量。如果线被夹紧或者在加载或者输送过程期间短路 (short out)，所述线必须被替换且重新安装在枪中，这也增加了加载所必须的时间。

典型地，除了雷管之外的射孔枪的部件在一个位置组装，然后运到第

二位置，在所述第二位置，将进行射孔操作。在那第二位置处，在加载管中开口一个端口，且安装雷管。例如，所述雷管可以是SECURE™雷管，所述SECURE™雷管由本发明的受让人提供，且该雷管包括可寻址开关、点火组件（fireset）和起爆器。因此，在发生射孔的位置处的雷管组件的安装涉及在非常小的空间中连接多个线。雷管的安装也需要使用安全管，在将雷管连接到加载管中的布线之前、雷管放入所述安全管中。

通常，射孔柱将包括多个射孔枪。在这样的柱中的枪的启动通常将从最下枪部分到最顶部的枪部分。例如，如果射孔柱具有三个枪部分且中间的部分首先启动，中间部分的启动将破坏中间部分中的线，且地表和最下枪部分之间的通信变得不再可能。

包括不需要线或者弹药来运行通过射孔柱中的每个枪的安全系统的设备将对射孔操作的效率、服务质量和安全带来相当的益处。同样，不需要在射孔位置处安装爆炸装置的射孔柱对于效率和安全都是有益的。此外，其中枪部分可以以任何顺序被启动的射孔柱将是有益的。

上述提及的许多问题已经被本发明的实施例所解决。

## 发明内容

本发明的一个实施例涉及一种设备管柱，所述设备管柱包括作为设备管柱的组成部分的无线发射器。根据本发明的设备管柱还包括无线启动系统，所述无线启动系统可以从前述的无线反射器接收命令。

在一个实施例中，提供了用于井眼中的设备管柱，所述设备管柱包括多个启动模块(activation module)。每个启动模块具有第一端和第二端，并包括将在井下启动/起爆(activate/initiate)的装置。根据本发明的设备管柱还包括多个电池操作的可寻址起爆器，至少一个起爆器可操作地连接到每个启动模块以当寻址到所述起爆器时、启动/起爆所述启动模块中的装置。提供与设备管柱一体形成的无线发射器。所述无线发射器从地表接收命令并发射信号来以任何顺序对设备管柱中的起爆器寻址。

在一个实施例中，所述起爆器可操作地连接到每个启动模块的第一

端，而在另一实施例中，起爆器可操作地连接到每个启动模块的第二端。在再一实施例中，起爆器可操作地连接到每个启动模块的第一端和第二端。

在又一实施例中，所述设备管柱的启动模块中的装置从射孔枪、设定工具、倾倒水泥的设备、传感器和推进装置所构成的组中选择。但是，根据本发明的设备管柱不限于这样的装置并可以利用任何在井下需要起爆/启动的装置。

在本发明的一个实施例中，根据本发明的设备管柱包括具有多个枪模块的射孔柱。每个枪模块具有第一端和第二端，并包括多个聚能射孔弹，所述聚能射孔弹分布在枪模块中的分开的位置处，并通过爆炸索互连。根据本发明的设备还包括多个电池操作的、可寻址的起爆器模块，至少一个起爆器模块可操作地连接到每个枪模块。根据本发明的起爆器模块包括需要将起爆器模块组装到枪模块的所有安全特征。当特定的起爆器模块被寻址时，该模块中的安全起爆器被启动，这启动了枪模块中的聚能射孔弹的点火，被寻址的起爆器模块可操作地连接到所述枪模块。

根据本发明的设备还包括无线发射器，所述无线发射器可操作地连接到射孔柱并与所述射孔柱一体形成，用于发射信号来对射孔柱中的任一起爆器模块寻址。

在一个实施例中，起爆器模块可操作地连接到每个枪模块的第一端，同时在第二实施例中，起爆器模块可操作地连接到各枪模块的第二端。在再一实施例中，起爆器模块可操作地连接到射孔柱中的各枪模块的第一端和第二端。

射孔柱中的起爆器模块中的安全起爆器可以例如是EFI或者EBW装置。

根据一个实施例，提供了用于射孔柱中的设备，所述设备在将执行射孔操作的位置之外的位置处组装。所述设备包括具有第一端和第二端的枪模块。所述枪模块包括多个聚能射孔弹和爆炸索，所述聚能射孔弹在分开的间隔上分布，所述爆炸索互连这些聚能射孔弹。电池操作的、可寻址起爆器模块可操作地连接到枪模块的任一端或者两端，且起爆器模块包括电路，所述电路检测、起爆器模块已经被寻址。起爆器模块中的安全起爆器

装置在起爆器模块被寻址到时启动，这启动了枪模块中的聚能射孔弹的点  
火。

所述起爆器模块可以包括安全起爆器，所述安全起爆器是EFI装置或  
者EBW装置。

## 附图说明

在附图中：

图1是根据本发明的设备的一个实施例的横截面的示意图；

图2是根据本发明的设备的第二实施例的横截面示意图；

图3是根据本发明的设备的第三实施例的横截面示意图；

图4是用于射孔柱中的设备的横截面示意图。

## 具体实施方式

应该理解，本发明可以利用许多形式和实施例。在下述说明中，描述  
了本发明的一些实施例，且许多细节得到描述以提供对本发明的理解。但  
是，普通技术人员应该理解，本发明可以在没有这些细节的情况下实施，  
且从所描述的实施例的多种变化和修改是可能的。这样，下述的说明只是  
为了说明而不是为了限制本发明。

如此处所使用，术语“之上”和“之下”、“上”和“下”、“上部”和  
“下部”、“向上”和“向下”以及其他指示在给定点或者元件之上或者之  
下的相对位置的术语用在本说明书中来更清楚地描述本发明的一些实施  
例。但是，当应用到用于偏斜或者水平的井中的设备和方法时，适当地、  
这样的术语可以指的是左至右、右至左或者对角关系。

首先参照图1，提供用于井眼中的设备管柱10，包括多个启动模块11、  
12。所述启动模块中的每个分别具有第一和第二端11a、11b以及12a、12b，  
并包括在井下将被启动的多个装置13。

在图1中，例如，所述设备管柱10可以包括射孔柱，所述射孔柱包括

多个启动模块11、12，每个启动模块11、12包括多个聚能射孔弹13，所述聚能射孔弹13在枪模块中在分开的位置上分布，并通过爆炸索14互连。

仍然参照图1，所述设备管柱10具有多个电池操作的、可寻址起爆器15、16，至少一个起爆器15、16可操作地连接到每个启动模块11、12。起爆器15、16可以可选地接收通过井流体或者除了前述的线结构之外的其他井部件传递的电力。例如，电流可以通过井套管或者向井下延伸的其他导电部件传输。起爆器15、16中的每个可以具有唯一的地址，且当起爆器中的一个（例如15）被寻址时，所述装置的启动在被寻址的起爆器被可操作地连接到其上的启动模块11中发生。例如，当设备管柱10包括射孔柱时，起爆器15的寻址导致启动模块11中的聚能射孔弹13的启动，起爆器15可操作地连接到所述启动模块11。引爆剂（未示出）可以有利地连接在起爆器15、16和启动模块之间，引爆剂与启动模块连接以协助爆炸。每个起爆器15、16可以具有安全起爆器装置，所述安全起爆器装置可以例如是EFI或者EBW装置。

所述设备管柱10可以具有无线发射器17，所述无线发射器17可操作地连接到设备管柱10的组成部分。无线发射器17可以从地表通过通信介质19接收通信信号，并可以用于对将被启动的起爆器模块寻址。这样的命令可以例如通过压力、流动张力、声学或者电磁信号来传递。

例如，当本发明的设备管柱10包括射孔柱时，无线发射器17可以接收识别将被启动的启动模块的命令。假设启动模块11将被启动，无线反射器17可以接收和发射对起爆器15寻址的信号。所述起爆器15的寻址可能导致其中的安全起爆器装置的启动，这反过来启动了启动模块11中的爆炸索14，由此对枪模块11中的聚能射孔弹13点火。相似地，无线发射器17可以对起爆器16寻址。这可能导致反过来启动所述启动模块12中的爆炸索14的起爆器16中的安全起爆器的启动，由此对容纳在其中的聚能射孔弹13点火。

当设备管柱10是射孔柱时，优选地，爆炸线或者炸药没有在相邻的枪模块之间延伸。同样，配置所述设备管柱10和相关的装置从而包含在射孔柱中的枪模块可以以任何顺序启动、这是有利的。同样，起爆器16可以配

置成在枪模块11、12之间提供压力阻挡件。

图1显示了起爆器15被可操作地连接到启动模块11的第一端11a，起爆器16连接到启动模块12的第一端12a。在可选的实施例中，起爆器15、16可以可操作地分别连接到启动模块11、12的第二端11b、12b，如图2中所示。在再一实施例中，起爆器15、16可以分别连接到启动模块11、12的两端，如图3中所示。

除了射孔枪之外，此处所描述的特征也可以应用到设定工具、倾倒水泥的设备和推进装置或一旦所述设备管柱10处于井下时任何需要启动的其他装置。

现在参照图4，多个模块40可以在第一位置组装，所述第一位置不是将执行射孔操作的地方。每个模块40可以是如上所述的枪部分11，起爆器模块15连接到枪部分11，也如上所述。一旦组装，模块40可以安全的传输到将执行射孔操作的地方，由此减轻在那个点安装雷管的需要。

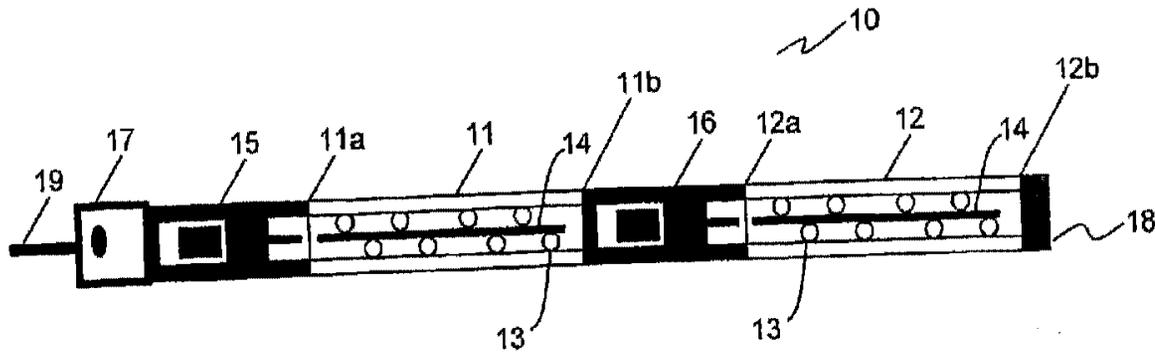


图 1

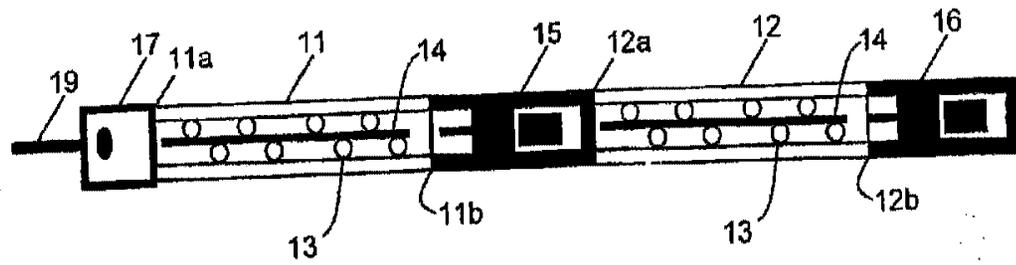


图 2

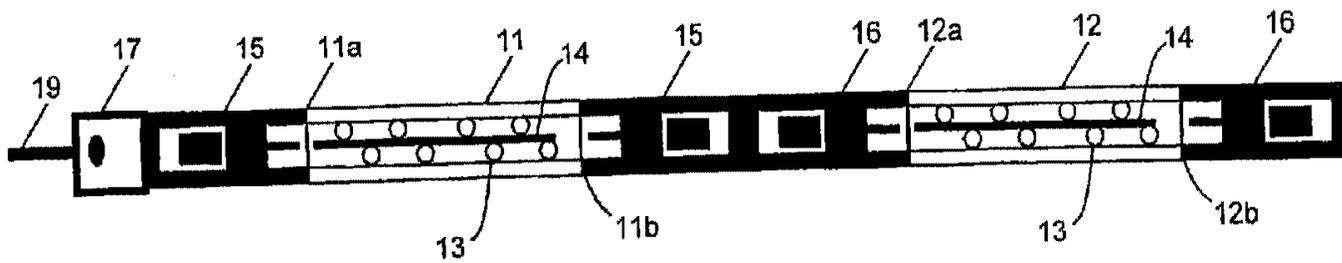


图 3

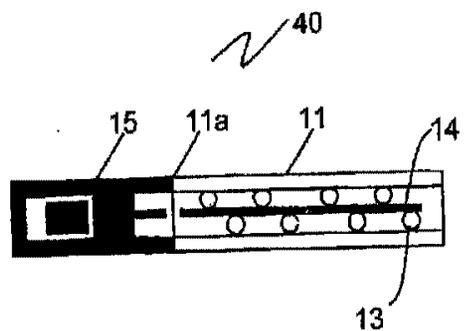


图 4



Espacenet

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### Vertical well orientation multi-pulse increase-benefit perforating device

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**Classification:** - **international:** *E21B43/116; E21B43/119*  
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**Application number:** CN20092245478U 20091127

**Priority number(s):** CN20092245478U 20091127

### Abstract of CN201620848 (U)

The utility model discloses a vertical well orientation multi-pulse increase-benefit perforating device, which is suitable for oil and gas well perforating operation. The device comprises an orientation priming adapter containing an orientation gun head, an orientation key and a priming apparatus, a perforating gun string consisting of a plurality of orientation integral increase-benefit perforating guns connected in series, and a multi-pulse high-energy gas fracturing unit, wherein the orientation key and the priming apparatus are arranged on the orientation gun head, the gun head of the first perforating gun is connected with the lower end of the orientation gun head, the gun tail of the last perforating gun is connected with the multi-pulse high-energy gas fracturing unit, and the axes of perforating bullets in each perforating gun all point to the radial

direction of the orientation key. During operation, the upper end of the orientation gun head is connected with an oil pipe. The utility model provides a novel perforating device integrating orientation perforating, integral increase-benefit perforating and multi-pulse high-energy gas fracturing, can perforate the perforating bullets towards the direction with the best permeability, has good width generation capacity, can prevent the closing of formation fracture, and has obvious oil and gas increase effect.



(12) 实用新型专利

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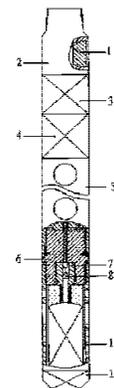
权利要求书 1 页 说明书 4 页 附图 2 页

(54) 实用新型名称

直井定方位多级脉冲增效射孔装置

(57) 摘要

本实用新型公开了一种直井定方位多级脉冲增效射孔装置,适用于油气井射孔作业。该装置包括含有定向枪头、定向键和起爆器的定向起爆接头、由多支定方位一体式增效射孔枪串接成的射孔枪串和多级脉冲高能气体压裂单元,定向键和起爆器装在定向枪头上,第一支射孔枪的枪头与定向枪头下端连接,最后一支射孔枪的枪尾与多级脉冲高能气体压裂单元连接,各射孔枪中的射孔弹轴线均指向定向键所在的径向方向。作业时,定向枪头上端与油管相连。本实用新型是集定方位射孔、一体式增效射孔和多级脉冲高能气体压裂为一身的新型射孔装置,不仅能将射孔弹朝向渗透性最好的方向射孔,而且具有造缝能力好和可防止地层裂缝闭合的优点,增产油气效果十分明显。



CN 201620848 U

1. 一种直井定方位多级脉冲增效射孔装置,包括定向起爆接头、射孔枪串和多级脉冲高能气体压裂单元,其特征在于:所述定向起爆接头含有定向键 [1]、定向接头 [2]、起爆器 [3] 和定向枪头 [4],定向键 [1] 焊接在定向接头 [2] 上,定向接头 [2] 的一端与起爆器 [3] 连接,定向枪头 [4] 上端安装所述起爆器 [3];所述射孔枪串由多支射孔枪 [5] 串接而成,射孔枪 [5] 含有定方位枪体 [18]、弹架 [19]、多发射孔弹 [20] 和一级增效火药 [28],装有射孔弹 [20] 的弹架 [19] 装在定方位枪体 [18] 内,射孔弹 [20] 的轴线与弹架 [19] 轴线垂直且两个相邻射孔弹 [20] 的弹头相差  $180^{\circ}$  相位,一级增效火药 [28] 安装在相邻射孔弹 [20] 之间的缝隙中,各射孔枪 [5] 之间通过装有传爆管和导爆索的双公接头 [24] 连接,导爆索 [30] 一端与传爆管 [15] 连接,另一端与射孔弹 [20] 连接;多级脉冲高能气体压裂单元含有二级增效火药 [10]、三级增效火药 [11]、隔板延时点火器 [8]、点火药柱 [9]、连接杆 [32]、连接件 [7] 和密封堵头 [14],二级增效火药 [10] 和三级增效火药 [11] 通过金属中心管连接在一起,点火药柱 [9] 放置在所述金属中心管内,隔板延时点火器 [8] 安装在所述连接件 [7] 中,连接件 [7] 的一端与二级增效火药 [10] 端口的金属中心管固连,密封堵头 [14] 与三级增效火药 [11] 端口的金属中心管固连;第一支射孔枪 [5] 与所述定向枪头 [4] 的下端连接,最后一支射孔枪 [5] 的枪尾通过连接件 [7] 与多级脉冲高能气体压裂单元固连,且各支射孔枪中的射孔弹 [20] 弹轴均指向所述定向键 [1] 所在的径向方向,射孔作业时,所述定向接头 [2] 的另一端与油管连接。

2. 根据权利要求 1 所述的直井定方位多级脉冲增效射孔装置,其特征在于:在所述定方位枪体 [18] 上的每个盲孔 [31] 两侧的  $90^{\circ}$  方向各设一个泄压孔。

3. 根据权利要求 1 或 2 所述的直井定方位多级脉冲增效射孔装置,其特征在于:还包括公下接头 [6]、筛管 [12] 和筛管堵头 [13],所述连接件安装在公下接头 [6] 中,筛管 [12] 套在二级增效火药 [10] 和三级增效火药 [11] 的外部,筛管 [12] 的一端与公下接头 [6] 的一端连接,另一端与筛管堵头 [13] 连接,公下接头 [6] 的另一端与所述最后一支射孔枪 [5] 连接。

## 直井定方位多级脉冲增效射孔装置

### 技术领域

[0001] 本实用新型属于油、气井完井射孔作业领域,主要涉及一种多级脉冲增效射孔装置,尤其涉及一种集直井定方位射孔、一体式增效射孔与多级脉冲高能气体压裂为一体的射孔装置。

### 背景技术

[0002] 为提高油、气井的产量,采用过多种技术措施,九十年代初开始采用高能气体压裂技术,之后,又采用增效射孔技术(又称复合射孔技术)。由于这两项技术都存在一定的缺陷,近期又出现了一种将增效射孔、高能气体压裂和水力压裂三者有机结合的新技术。中国专利申请 200610104468.0 公开了一种油气井用多级脉冲增效射孔装置,就是集增效射孔、高能气体压裂、水力压裂三种施工工艺为一体的增效射孔装置。该装置在采用防砂撞击起爆器和增效射孔枪的基础上,通过增效枪尾、连接件及对丝连接件将燃速较高的二级增效火药和燃速较低的三级增效火药组装到射孔管串中,采用隔板延时点火器在射孔枪射孔后延迟一段时间再点燃增效火药,形成多个燃气压力脉冲对地层进行压裂,使裂缝得以延伸,并能由增效火药燃气携带岩石裂缝支撑剂进入压开的地层裂缝,阻止地层裂缝的闭合,从而实现增产油气的目的。但是,多种测井资料解释和地层测试结果证明,钻穿油、气层时,井轴周围油、气层的渗透性并非是各向同性的:各种岩层的裂缝、节理发育方向、沉积时的顺流方向其渗透性远远好于其它方向,在这样的方向上地应力最大。如果射孔时能让射孔弹只朝着最大地应力的两个方向射,也即朝渗透性好的地层方向射孔,孔眼深度会比其它方向大,油、气层的产能将会明显增加。

### 实用新型内容

[0003] 本实用新型的目的在于克服现有技术的不足,提供一种集直井定方位射孔、一体式增效射孔与多级脉冲高能气体压裂综合技术为一体的射孔装置,即直井定方位多级脉冲增效射孔装置,该装置可以使射孔作业后达到更好的油、气增产效果。

[0004] 为解决上述技术问题,本实用新型提供的射孔装置包括定向起爆接头、射孔枪串和多级脉冲高能气体压裂单元,所述定向起爆接头含有定向键、定向接头、起爆器和定向枪头,定向键焊接在定向接头上,定向接头的一端与起爆器连接,定向枪头上端安装所述起爆器;所述射孔枪串由多支射孔枪串接而成,射孔枪含有定方位枪体、弹架、多发射孔弹和一级增效火药,装有射孔弹的弹架装在定方位枪体内,射孔弹的轴线与弹架轴线垂直且两个相邻射孔弹的弹头相差  $180^\circ$  相位,一级增效火药安装在相邻射孔弹之间的缝隙中,各射孔枪之间通过装有传爆管和导爆索的双公接头连接,导爆索一端与传爆管连接,另一端与射孔弹连接;多级脉冲高能气体压裂单元含有二级增效火药、三级增效火药、隔板延时点火器、点火药柱、连接杆、连接件和密封堵头,二级增效火药和三级增效火药通过金属中心管连接在一起,点火药柱放置在所述金属中心管内,隔板延时点火器安装在所述连接件中,连接件的一端与二级增效火药端口的金属中心管固连,密封堵头与三级增效火药端口的金属

中心管固连；第一支射孔枪与所述定向枪头的下端连接，最后一支射孔枪的枪尾通过连接件与所述多级脉冲高能气体压裂单元固连，且各支射孔枪中的射孔弹轴均指向所述定向键所在的径向方向，射孔作业时，所述定向接头的另一端与油管连接。

[0005] 根据本实用新型，在所述定方位枪体上的每个盲孔两侧的  $90^\circ$  方向各设一个泄压孔。

[0006] 根据本实用新型，还包括公下接头、筛管和筛管堵头，所述连接件安装在公下接头中，筛管套在二级增效火药和三级增效火药的外部，筛管的一端与公下接头的一端连接，另一端与筛管堵头连接，公下接头的另一端与所述最后一支射孔枪连接。

[0007] 本实用新型的有益效果体现在以下几个方面：

[0008] （一）本实用新型是将油气井用多级脉冲增效射孔装置深穿透增效射孔、高能气体压裂、水力压裂与定向射孔装置四点优点集于一体的新型增效射孔装置。该装置不仅具备了深穿透增效射孔的破裂能力强、造缝深、孔眼大的优点，又吸取水力压裂加支撑剂的技术，利用火药燃气产生的高压，将火药内的岩石裂缝支撑剂挤入地层，防止了地层裂缝的闭合，从而使定向射孔、增效、压裂的增产效能得到更加充分的发挥。

[0009] （二）本实用新型结构简单，连接方便，射孔枪串可以按射孔井段的设计要求由多支定方位一体式增效射孔枪组成，射孔枪和射孔枪之间由双公接头连接，这样既便于定方向又可以大限度地减少射孔盲区；枪内两个相邻射孔弹之间的弹头或弹尾相差  $180^\circ$  相位，通过定向枪头或双公接头上的螺孔与定方位枪体上的过孔位置，可使射孔管串中所有射孔弹的轴线均指向定向键所在的径向方向。施工时，通过测量方向键的位置来调整射孔管串的方位，最终使射孔弹的轴线指向地层的最大地应力方向，即射孔弹将向渗透性最好的地层方向射孔，从而大大提高了射孔作业的产油量。

[0010] （三）本实用新型采用下挂式增效火药，下挂式增效火药的外面有保护筛管，其作用一是避免二级增效火药和三级增效火药在斜井中与套管内壁发生摩擦或碰撞，二是便于火药燃气逸出，三是能收集部分燃烧后的残留物。

[0011] （四）在本实用新型的定向枪体上，其每个盲孔两侧  $90^\circ$  方向各钻一个泄压孔，其作用一是保持两方位枪体仍具有较高的抗外压强度，二是泄压孔底的薄壁能在引爆时开口泄压，三是不用泄压垫且不会在井里留下落物。

#### 附图说明

[0012] 图 1 是直井定方位多级脉冲增效射孔装置的组成示意图。

[0013] 图 2 是图 1 中的多级脉冲高能气体压裂单元结构组成示意图。

[0014] 图 3 是图 1 中的定方位一体式增效射孔枪的结构组成示意图。

#### 具体实施方式

[0015] 下面结合附图及优选实施例对本实用新型作进一步的详述。

[0016] 根据图 1 所示，直井定方位多级脉冲增效射孔装置的优选实施例由定向起爆接头、射孔枪串和多级脉冲高能气体压裂单元构成。定向起爆接头包括定向接头 2、起爆器 3 和定向枪头 4。定向接头 2 上焊有定向键 1，其上端与油管连接，下端与起爆器 3 连接，定向枪头 4 上端带有螺孔且螺孔内安装起爆器 3，下端则与射孔枪串连接。定向接头 2 的作用

是,当陀螺仪等专用仪器沿油管中心孔进入后,使定向键 1 与陀螺仪等专用仪器下的端碰接,同时还能指示出射孔枪串中射孔弹的射孔方向。起爆器 3 是一个制式产品,连接在定向接头 2 与定向枪头 4 之间,其作用是起爆后通过传爆管和导爆索引爆射孔枪串的全部火工件。

[0017] 根据图 2 所示,多级脉冲高能气体压裂单元包括公下接头 6、连接件 7、隔板延时点火器 8、点火药柱 9、二级增效火药 10 和三级增效火药 11、筛管 12、密封堵头 14 和筛管堵头 13。公下接头 6 带有沿轴向的内螺孔和穿线孔,连接件 7 为凸字形且带有外螺纹和台阶内孔。隔板延时点火器 8 的主体是一个圆柱状的金属件,它由上部不锈钢件和下部普通金属装药管通过螺纹旋为一体。隔板延时点火器 8 的主要作用是将爆轰波转换为火焰,它可以在上级射孔枪射孔后延迟一段时间再点燃下级增效火药,避免了火药压力峰值的叠加,其另一个作用是防水,在射孔腔串下井过程中,如果下级增效火药进水,则由于隔板延时点火器 8 中隔板的阻挡而不会让水进入上一级射孔枪中,从而可避免炸枪事故的发生。点火药柱 9 是由含有金属粉烟火药压制而成的具有高热量和高能量且直径为 14mm~16mm、高度为 10mm~30mm 不等的烟火药柱。二级增效火药 10、三级增效火药 11 均为制式火药,即在可燃壳体内放置一个金属中心管,金属中心管两端内壁有第二密封面和连接螺纹,金属中心管与可燃壳体形成的环状空间内装填耐水火药:二级增效火药 10 装填燃速在 8mm/s~10mm/s 或燃速更高的复合固体推进剂或双基药,也可以是燃速相对较高的其它发射药;三级增效火药 11 装填燃速在 4mm/s~6mm/s 的复合固体推进剂或双基药,也可以是燃速相对较低的其它发射药。二级增效火药 10 的快速燃烧特性对于破裂地层,提高射孔层段的裂缝数有很大帮助;而三级增效火药 11 的药量相对较大,产气量也较大,其燃烧产生的大量气体对于延展地层的裂缝长度,达到射孔孔道与地层天然裂缝的有效沟通上有很大的好处。此外,在二级增效火药 10、三级增效火药 11 中均加有适量的支撑剂,本优选实施例中的支撑剂为  $\Phi 0.5\text{mm} \sim \Phi 1\text{mm}$  之间的特制陶瓷小球,这些小球可以随火药燃烧产生的高温气体一起进入地层裂缝中,起到支撑作用,以防地层裂缝的闭合。筛管 12 是一个圆柱形状的金属件,其上带有许多筛眼且两端带有内螺纹,筛眼除含有多排八方位大孔外,还开有四方位长槽。二级增效火药 10 和三级增效火药 11 均安装在筛管 12 的内部,筛管 12 可有效防止二级增效火药 10、三级增效火药 11 与变形的井下套管内壁发生碰撞、摩擦,同时还能让二、三级增效火药 10、11 产生的高能气体顺利散出并将燃烧后的残留物留存在筛管 12 的底部。公下接头 6 与筛管 12 的上端螺纹连接;隔板延时点火器 8 装在连接件 7 的台阶大孔中;连接件 7 的大端与公下接头 6 的螺孔连接,小端与二级增效火药 10 金属中心管的上端螺纹连接;点火药柱 9 放置在二级增效火药 10 和三级增效火药 11 交界处的金属中心管中;密封堵头 14 与三级增效火药 11 金属中心管的下端螺纹连接;筛管堵头 13 与筛管 12 的下端螺纹连接。

[0018] 在本实用新型中,射孔枪串是由多支射孔 5 枪串接而成。在本实用新型中,射孔枪 5 选用定方位一体式增效射孔枪,其数量是根据射孔井段的设计要求来配置的,一般在三支以上。根据图 3 所示,单支射孔枪 5 包括传爆管 15、密封圈 16、止退管 17、定方位枪体 18、弹架 19、射孔弹 20、下定位盘 21、扶正套 22、定向螺钉 23、双公接头 24、扶正塞 25、两个挡圈 26、紧固螺钉 27、一级增效火药 28、上定位盘 29、导爆索 30。传爆管 15 是一个制式产品,可以是任何一种现今在各油田使用的具有传爆功能的传爆管。止退管 17 是一个制式产品,可以是任何一种现今在各油田使用的止退管。导爆索 30 是一个制式产品,可以是任何一种现

今在各油田使用的具有导爆功能的导爆索。枪内的射孔弹 20 与一级增效火药 28 均是制式产品。多个射孔弹 20 沿弹架 19 轴线叠放,射孔弹 20 的轴线与弹架 19 轴线垂直,两个相邻射孔弹 20 之间的弹头或弹尾相差  $180^{\circ}$ 。上定位盘 19 和下定位盘 21 结构相同并带有中心孔,两者通过紧固螺钉 27 分别与弹架 19 的上下端固连,两个挡圈 26 分别与上定位盘 19 和下定位盘 21 固连,其作用是将弹架 19 限制在定方位枪体 18 的中间段。一级增效火药 28 放置在相邻射孔弹 20 之间的缝隙中。在定向起爆接头中,定向枪头 4 的下端带有外螺纹和沿周向布置的定向螺孔,中间带有与两端相通的一级台阶孔,台阶大孔中装传爆管 15,台阶小孔放止退管 17。定方位枪体 18 是整个定方位一体式增效射孔枪 5 的主体,在其每个盲孔 31 两侧的  $90^{\circ}$  方向各钻一个  $\phi 18\text{mm} \sim \phi 30\text{mm}$ ,孔底壁厚为  $2\text{mm} \pm 1\text{mm}$  的泄压孔;其作用一是保持两方位枪体仍具有较高的抗外压强度,二是泄压孔底的薄壁能在引爆时开口泄压,三是在没有泄压垫的情况下不会在井里留下落物;定方位枪体 18 的两个端口处均带有沿轴线的内螺纹和沿周向布置的过孔。双公接头 24 的两端螺纹根部均带周向布置的定向螺孔、密封槽和中心台阶孔。每支定方位一体式增效射孔枪 5 之间通过双公接头 24 与其定方位枪体 18 的两个内螺纹端口相连,其中:连接处通过定向螺钉 23 锁定并通过密封圈 16 密封;双公接头 24 的台阶大孔中装扶正塞 25,扶正塞 25 中装起爆管 15,扶正套 22 一端插入到扶正塞 25 中,另一端插到下定位盘的中心孔中,连接在传爆管 15 两端的导爆索 30 分别与本支射孔枪 15 和下支射孔枪 15 中的射孔弹 20 相连。第一支射孔枪 5 的枪头通过其定方位枪体 18 上端的内螺纹与定向枪头 4 下端的外螺纹连接,最后一支射孔枪 5 的枪尾通过其定方位枪体 18 下端的内螺纹与多级脉冲高能气体压裂单元中的公下接头 6 连接。定向枪头 4 和双公接头 24 的作用是调节射孔弹 20 的安装方向,可通过定向枪头 4 或公接头 24 上的定位螺孔与定方位枪体 18 端口上的过孔进行调节,使射孔弹 20 的轴线指向定向键 1 所在的径向方向。各射孔枪 5 之间采用双公接头 24 连接,既便于定方向又可以大幅度地减少射孔盲区。

[0019] 本实用新型的工作过程如下:

[0020] 施工时,将本发明按照图 1 所示的施工管串下到油气井中的预定深度后,下入陀螺仪等专用仪器测量定向键 1 与射孔方向的偏差,射孔方向是根据测井解释资料提供的射孔井段井斜方位角和其对应地层的最大地应力方位角之差确定的。采用调向工具旋转管串,使定向键指向射孔方向后,从井口往油管内投入一根滚轮投棒,投棒撞击起爆器 3 并使其作用。随即,通过各枪中传爆管 15 和导爆索 30 的作用,由第一支射孔枪 5 开始顺次起爆各支射孔枪内的射孔弹 20 并进行射孔,在各射孔枪 5 射孔后,其产生的高温、高压气体与高温金属热质点将其枪内的一级增效火药 28 点燃并使之燃烧起来;与此同时,由最后一支射孔枪 15 引出的导爆索 30 将多级脉冲高能气体压裂单元中的隔板延时点火器 8 引爆,产生的爆轰能量将点火药柱 9 点燃,点火药柱 9 燃烧后产生的高温高压气体与大量的金属热质点将二级增效火药 10(快速燃烧药)和三级增效火药 11(慢速燃烧)点燃,不同燃速的增效火药产生二次压力脉冲至三次压力脉冲对地层进行压裂,使裂缝不断延伸,达到射孔后的孔道与天然裂缝进一步沟通的效果。同时,火药中的支撑剂随着高温高压的气体一起进入了地层裂缝中,阻止了地层裂缝的闭合,从而达到了更好的出油和出气效果。

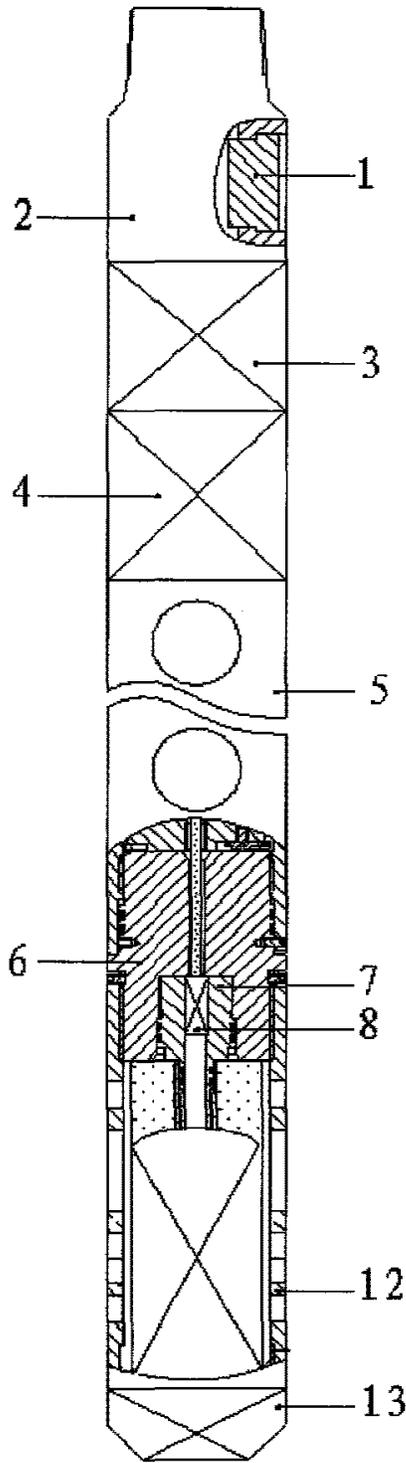


图 1

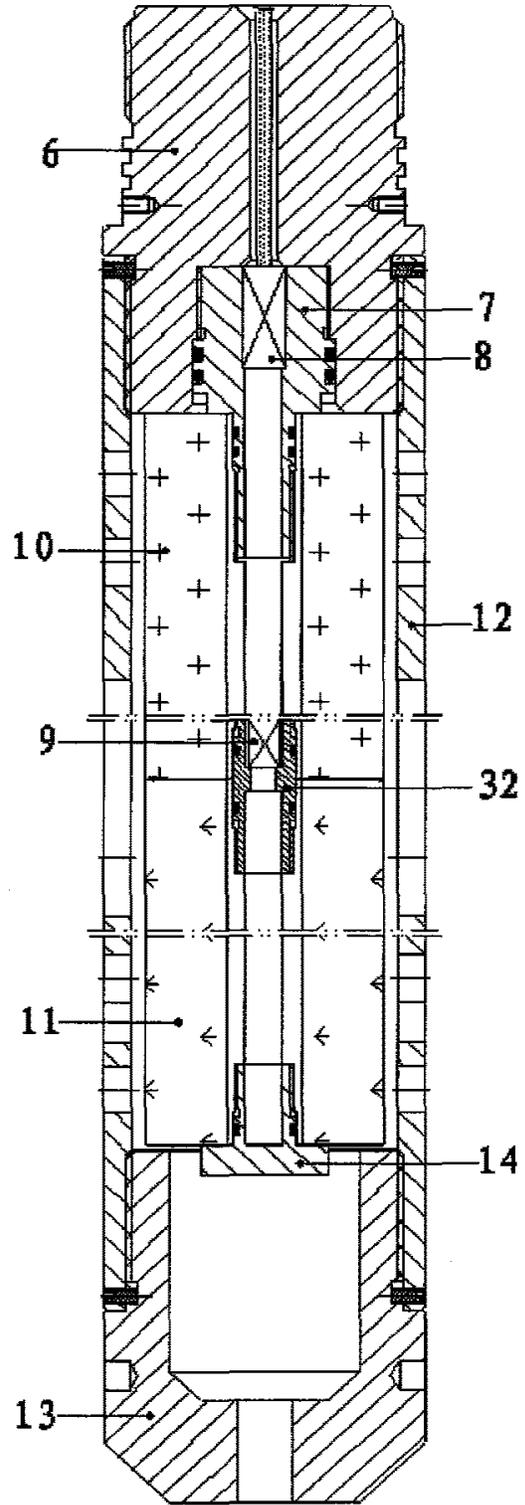


图 2

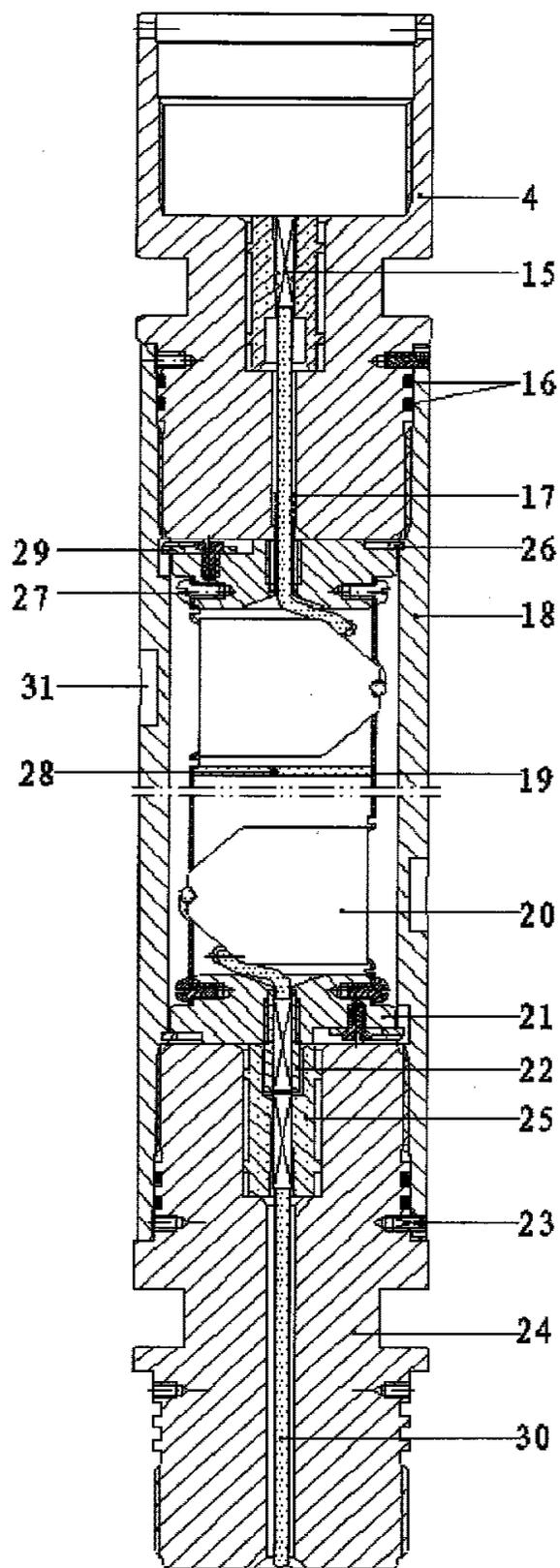


图 3



Espacenet

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### SECTIONAL SAND JET PERFORATOR

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**Classification:** - **international:** *E21B43/114*  
- **cooperative:**

**Application number:** RU20160133700 20160816

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### Abstract of RU2633904 (C1)

FIELD: oil and gas industry. SUBSTANCE: invention relates to devices for directed opening of a production formation in a horizontal well with a casing string and for performing hydraulic fracturing of the formation. A sectional hydro-sandblasted perforator contains a hollow bod and consists of a coupling, separate sections with radial holes and jet nozzles installed therein, centralisers, the separate sections are interconnected by spacers. The radial holes in the sections are formed at a predetermined angle with respect to the axis of the body. The holes in the sections are offset from the axis of the body. The diameter of the holes in the sections is less than the diameter of the holes in the coupling and in the spacers provided with rigid centralisers outside. The coupling, the sections and the spacers are separated by a bearing and pulled together by a shaft with nuts screwed onto it from both sides. The shaft is installed eccentrically relative to the axis of the body and rigidly connected to individual sections, and the nuts are contacted with the coupling and the last section that has been killed by the bearings. The coupling, the individual sections and the spacers are sealed together by the sealing elements, and the individual sections are configured to co-rotate with the shaft with respect to the fixed couplings and spacers.

The jet nozzles are pressed into separate sections made of hard-alloy material in the form of a cone and equipped with external and internal conical surfaces tapering outward from a separate section of the hollow body. The radius of the jet nozzle pressed into a separate section is less than the radial extension of the coupling centralisers and the spacer, and the diameter of the jet nozzle corresponds to six grain diameters of the proppant fraction. EFFECT: invention enables to perform hydro-sandblasting perforation in the well casing string in the direction of minimum formation stress, regardless of the device position in the borehole, increase the efficiency and reliability of operation, and prevent the proppant hole from plugging the jet nozzle opening. 4 dwg, 1 tbl



**ФЕДЕРАЛЬНАЯ СЛУЖБА  
ПО ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ**

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(54) Секционный гидropескоструйный перфоратор

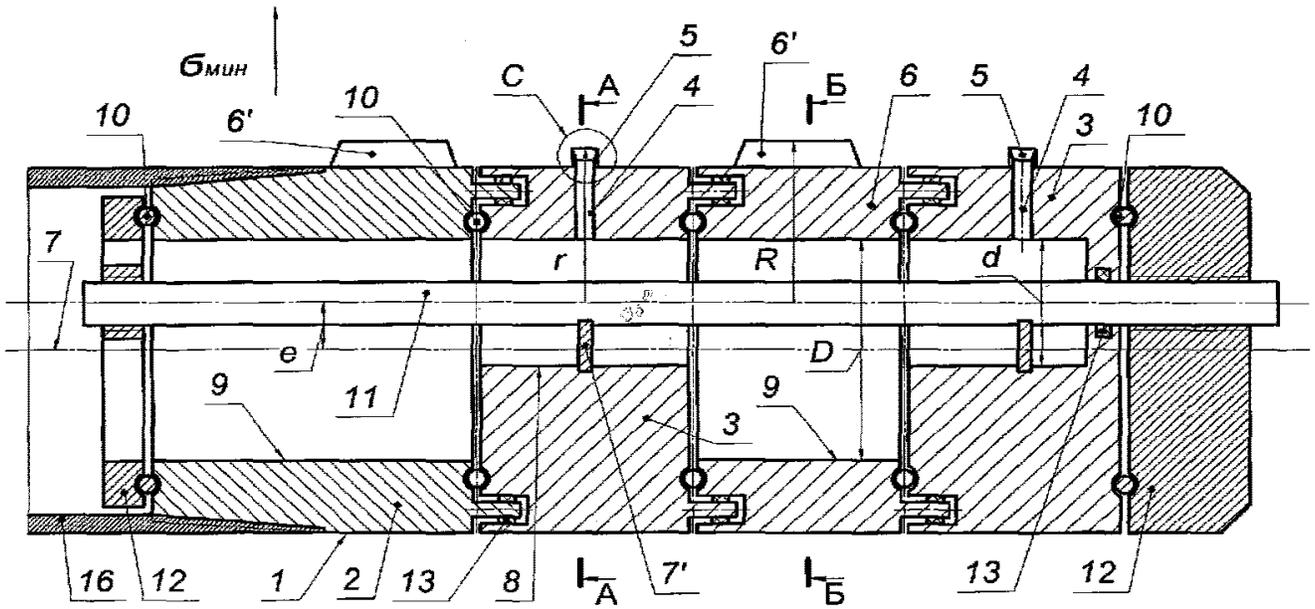
(57) Реферат:

Изобретение относится к нефтегазодобывающей промышленности, в частности к устройствам для направленного вскрытия продуктивного пласта в горизонтальной скважине с обсадной колонной и проведения гидравлического разрыва пласта. Секционный гидropескоструйный перфоратор содержит полый корпус, состоит из муфты, отдельных секций с радиальными отверстиями и установленными в них струйными насадками, центраторов, отдельные секции соединены между собой проставками. В секциях радиальные отверстия выполнены под заданным углом относительно оси корпуса. В секциях отверстия выполнены со смещением вверх от оси корпуса. Диаметр отверстий в секциях меньше, чем диаметр отверстий в муфте и в проставках, снабженных снаружи жесткими центраторами. Муфта, секции и проставки разделены между собой подшипниками и стянуты валом с накрученными на него с двух сторон гайками. Вал установлен эксцентрично относительно оси корпуса и жестко соединен с отдельными секциями, а гайки контактируют с муфтой и

последней заглушенной подшипниками секцией. Муфта, отдельные секции и проставки герметично разделены между собой уплотнительными элементами, а отдельные секции имеют возможность совместного вращения с валом относительно неподвижных муфты и проставок. Струйные насадки запрессованы в отдельные секции, выполнены из твердосплавного материала под конус, оснащены наружной и внутренней коническими поверхностями, сужающимися наружу от отдельной секции полого корпуса. Радиальный вылет запрессованной в отдельную секцию струйной насадки меньше радиального вылета центраторов муфты и проставки, а диаметр струйной насадки соответствует шести диаметрам зерен фракции проппанта. Изобретение позволяет выполнить гидropескоструйную перфорацию в обсадной колонне скважины в направлении минимального напряжения пласта независимо от положения устройства в стволе скважины, повысить эффективность и надежность работы, исключить закупоривание отверстия струйной насадки проппантом. 4 ил., 1 табл.

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Фиг. 1



FEDERAL SERVICE  
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(54) **SECTIONAL SAND JET PERFORATOR**

(57) Abstract:

FIELD: oil and gas industry.

SUBSTANCE: invention relates to devices for directed opening of a production formation in a horizontal well with a casing string and for performing hydraulic fracturing of the formation. A sectional hydro-sandblasted perforator contains a hollow bod and consists of a coupling, separate sections with radial holes and jet nozzles installed therein, centralisers, the separate sections are interconnected by spacers. The radial holes in the sections are formed at a predetermined angle with respect to the axis of the body. The holes in the sections are offset from the axis of the body. The diameter of the holes in the sections is less than the diameter of the holes in the coupling and in the spacers provided with rigid centralisers outside. The coupling, the sections and the spacers are separated by a bearing and pulled together by a shaft with nuts screwed onto it from both sides. The shaft is installed eccentrically relative to the axis of the body and rigidly connected to individual sections, and the nuts are contacted with the coupling and the last section that has

been killed by the bearings. The coupling, the individual sections and the spacers are sealed together by the sealing elements, and the individual sections are configured to co-rotate with the shaft with respect to the fixed couplings and spacers. The jet nozzles are pressed into separate sections made of hard-alloy material in the form of a cone and equipped with external and internal conical surfaces tapering outward from a separate section of the hollow body. The radius of the jet nozzle pressed into a separate section is less than the radial extension of the coupling centralisers and the spacer, and the diameter of the jet nozzle corresponds to six grain diameters of the proppant fraction.

EFFECT: invention enables to perform hydro-sandblasting perforation in the well casing string in the direction of minimum formation stress, regardless of the device position in the borehole, increase the efficiency and reliability of operation, and prevent the proppant hole from plugging the jet nozzle opening.

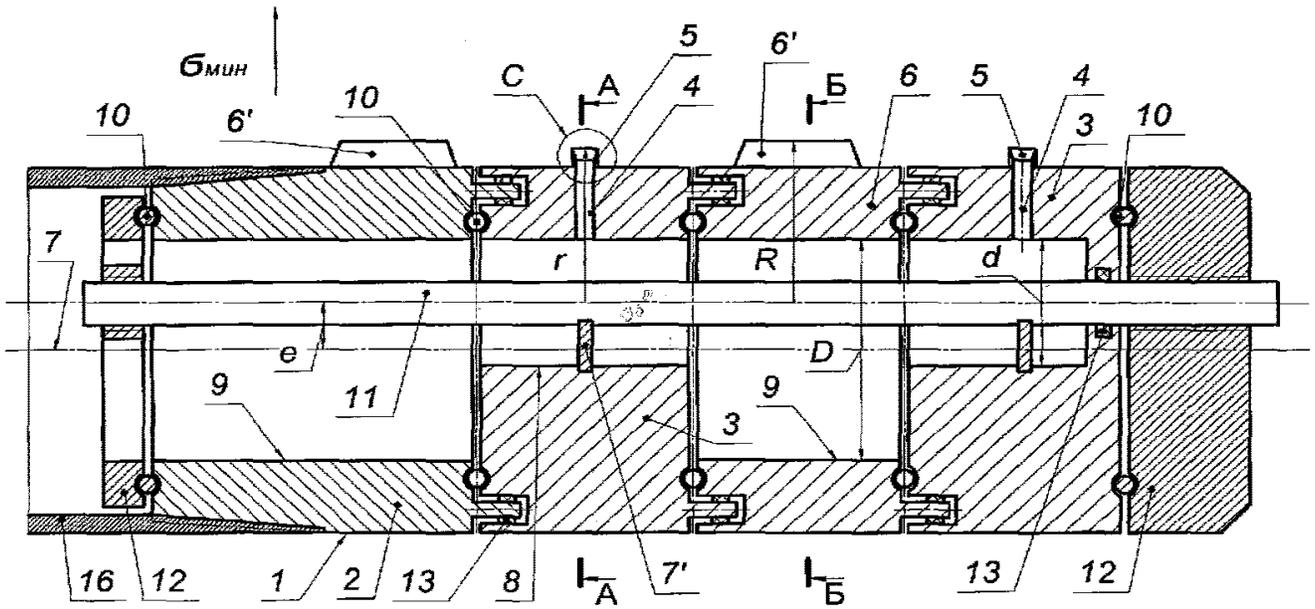
4 dwg, 1 tbl

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Фиг. 1

Изобретение относится к нефтегазодобывающей промышленности, в частности к устройствам для направленного вскрытия продуктивного пласта в горизонтальной скважине с обсадной колонной и проведения гидравлического разрыва пласта.

Известен импульсный гидроперфоратор (патент RU №2061849, МПК E21B 43/114, опубл. 10.06.1996 г., бюл. №16), включающий гидромониторный корпус с продольным каналом, вал, размещенный в корпусе, элемент открытия-закрытия боковых отверстий корпуса и сопла, помещенные в боковых отверстиях. Гидроперфоратор снабжен резиновым амортизатором, размещенным над гидромониторным корпусом, и гидравлическим фиксатором-центратором с выдвигаемыми штоками, размещенными под гидромониторным корпусом, который выполнен с радиальным каналом в плоскости, перпендикулярной плоскости боковых отверстий, перекрыт крышками с подшипниками и тангенциально сообщается в средней части с продольным каналом, имеющим выход в нижней части корпуса по концам радиального канала. Вал размещен в крышках радиального канала и выполнен с односторонним стержневым приливом в средней части длиной, соответствующей радиусу радиального канала, и площадью торцевой части, не меньшей просвета боковых отверстий. Амортизатор состоит из верхнего упора, двухступенчатой втулки и соответствующей ей меньшей ступени патрубка, помещенного внутри двухступенчатой втулки с возможностью осевого перемещения и имеющего уступ в средней части, выше которого до верхнего упора и ниже которого размещены резиновые элементы прямоугольного сечения.

Недостатки данного устройства:

- во-первых, сложность конструкции, обусловленная большим количеством узлов и деталей (двухступенчатой втулки, амортизатора, крышек, упоров и т.д.);
- во-вторых, невозможность выполнения перфорации в заданном направлении относительно оси скважины, например, выполнения перфорации в обсадной колонне или выполнения каверн в открытом стволе в направлении минимального напряжения пород пласта;
- в-третьих, низкая эффективность работы устройства, связанная с тем, что направление выполнения каверн относительно оси скважины из струйных насадок перфоратора в призабойной зоне и направление трещины гидроразрыва пласта (ГРП), которая развивается в направлении минимального напряжения пласта, не совпадают. В результате трещина, образуемая из каверн при последующем ГРП, разворачивается в призабойной зоне пласта в направлении минимального напряжения, что приводит к росту давления в процессе проведения ГРП и может привести к преждевременному прекращению процесса ГРП;
- в-четвертых, высокая длительность перфорации, обусловленная импульсным принципом действия устройства, т.е. время перфорации увеличивается за счет прерывистого действия струи на обсадную колонну и/или открытый ствол.

Наиболее близким по технической сущности и достигаемому результату является секционный гидropескоструйный перфоратор (патент RU №2466270, МПК E21B 43/114, опубл. 10.11.2012 г., бюл. №31), содержащий полый корпус, состоящий из отдельных секций с радиальными отверстиями и установленными в них струйными насадками, центратор. Перфоратор для соединения секций снабжен проставками различной длины и муфтами, причем соединение выполнено встык посредством муфт, расположенных снаружи, а соединительные концы муфт, проставок и каждой секции выполнены с правой и левой резьбами.

Недостатки данного устройства:

- во-первых, невозможность выполнения гидropескоструйной перфорации в обсадной

колонне или открытом стволе скважины в заданном направлении (например, вверх относительно оси горизонтальной скважины) независимо от положения устройства в скважине, например, для выполнения перфорации в обсадной колонне или выполнения каверн в открытом стволе в направлении минимального напряжения пород пласта;

5 - во-вторых, низкая эффективность работы устройства, связанная с тем, что направление выполнения каверн относительно оси скважины из струйных насадок перфоратора в призабойной зоне и направление трещины ГРП, которая развивается в направления минимального напряжения пласта, не совпадают. В результате трещина, образуемая из каверн при последующем ГРП, разворачивается в призабойной зоне  
10 пласта в направлении минимального напряжения, что приводит к росту давления в процессе проведения ГРП и может привести к преждевременному прекращению процесса ГРП;

- в-третьих, низкая надежность работы перфоратора, связанная с тем, что между насадкой и стенкой обсадной колонны имеется значительное расстояние, что приводит  
15 к рассеиванию потока гидроабразивной жидкости (водопропантной смеси) и к ее обратному воздействию рикошетом от обсадной колонны на насадку. В результате места крепления насадок к корпусу перфоратора разрушаются за одну скважино-операцию и требуют подъема перфоратора на поверхность для замены насадок;

- в-четвертых, высокая вероятность закупоривания отверстия струйной насадки  
20 пропантом, так как конструктивно диаметр отверстия струйных насадок не зависит от диаметра зерен пропантанта, что чревато резким ростом давления и прекращением перфорации.

Техническими задачами изобретения являются возможность выполнения перфорации в обсадной колонне или каверн в открытом стволе скважины в заданном направлении,  
25 повышение эффективности и надежности работы секционного гидropескоструйного перфоратора, исключение закупоривания отверстий струйной насадки зернами песка или пропантанта при проведении перфорации.

Поставленные технические задачи решаются секционным гидropескоструйным перфоратором, содержащим полый корпус, состоящий из муфты, отдельных секций с  
30 радиальными отверстиями и установленными в них струйными насадками, центраторов, отдельные секции соединены между собой проставками.

Новым является то, что в секциях радиальные отверстия выполнены под заданным углом относительно оси корпуса, при этом в секциях отверстия выполнены со смещением  
35 вверх от оси корпуса, причем диаметр отверстий в секциях меньше, чем диаметр отверстий в муфте и в проставках, снабженных снаружи жесткими центраторами, при этом муфта, секции и проставки разделены между собой подшипниками и стянуты валом с накрученными на него с двух сторон гайками, причем вал установлен эксцентрично относительно оси корпуса и жестко соединен с отдельными секциями, а гайки контактируют с муфтой и последней заглушенной подшипниками секцией, при  
40 этом муфта, отдельные секции и проставки герметично разделены между собой уплотнительными элементами, а отдельные секции имеют возможность совместного вращения с валом относительно неподвижных муфты и проставок, причем струйные насадки запрессованы в отдельные секции, выполнены из твердосплавного материала под конус, оснащены наружной и внутренней коническими поверхностями,  
45 сужающимися наружу от отдельной секции полого корпуса, при этом радиальный вылет запрессованной в отдельную секцию струйной насадки меньше радиального вылета центраторов муфты и проставки, а диаметр струйной насадки соответствует шести диаметрам зерен фракции пропантанта.

На фиг. 1 схематично изображен предлагаемый секционный гидropескоструйный перфоратор.

На фиг. 2 изображен разрез отдельной секции секционного гидropескоструйного перфоратора.

5 На фиг. 3 изображено сечение проставки секционного гидropескоструйного перфоратора.

На фиг. 4 изображена струйная насадка, ввернутая в радиальное отверстие секции секционного гидropескоструйного перфоратора.

10 Секционный гидropескоструйный перфоратор содержит полый корпус 1 (см. фиг. 1), состоящий из муфты 2, отдельных секций 3 с радиальными отверстиями 4 и установленными в них струйными насадками 5. Отдельные секции 3 соединены между собой проставками 6.

15 Количество отдельных секций 3 и соответственно проставок 6 зависит от количества интервалов перфорации, которые необходимо выполнить в горизонтальном стволе скважины с обсадной колонной или открытым стволом.

Например, рассмотрим секционный гидropескоструйный перфоратор с двумя секциями 3 и одной проставкой 6. При необходимости увеличения интервалов перфорации в горизонтальной скважине количество секций 3 и проставок 6 увеличивают.

20 Для проведения гидropескоструйной перфорации с последующим проведением ГРП заданный угол определяют исходя из направления минимального напряжения  $\sigma_{\text{мин}}$  пласта, в котором необходимо выполнить трещину ГРП. Например, направление минимального напряжения  $\sigma_{\text{мин}}$  пласта относительно оси 7 полого корпуса 1 направлено вверх (см. фиг. 1), поэтому радиальные отверстия 4 в секции 3 направляют вверх, т.е. выполняют под углом  $\alpha=90^\circ$  (см. фиг. 2) к оси 7 полого корпуса 1.

25 Отверстия 8 (см. фиг. 1) в секциях 3 выполнены со смещением вверх от оси 7 полого корпуса 1. Диаметр  $d$  (см. фиг. 1, 2, 3) отверстий 8 в секциях 3 меньше, чем диаметр  $D$  отверстий 9 в муфте 2 и в проставке 6, снабженных снаружи жесткими центраторами 6'. Муфта 2, секции 3 и проставка 6 (см. фиг. 1) разделены между собой подшипниками 10 и стянуты валом 11 с накрученными на него с двух сторон гайками 12.

30 Вал 11 установлен эксцентрично со смещением на величину  $e$  (см. фиг. 1 и 2, 3) относительно оси 7 полого корпуса 1 и жестко соединен с отдельными секциями 3 любым известным соединением, например, с помощью шпонки 7' (на фиг. 1 и 2 показана условно). Гайки 12 (см. фиг. 1) контактируют с одной стороны с муфтой 2, а с другой - с последней заглушенной подшипниками 10 секцией 3.

35 Муфта 2, отдельные секции 3 и проставка 6 герметично разделены между собой уплотнительными элементами 13. Отдельные секции 3 благодаря шпонке 7 имеют возможность совместного вращения с валом 11 относительно неподвижных муфты 2 и проставки 6.

40 Струйные насадки 5 запрессованы в отдельные секции 3, выполнены из твердосплавного материала под конус, оснащены наружной 14 и внутренней 15 коническими поверхностями, сужающимися от отдельной секции 3 полого корпуса 1.

Радиальный вылет  $r$  (см. фиг. 1) запрессованной в отдельную секцию 3 струйной насадки 5 меньше радиального вылета  $R$  центраторов 6' муфты 2 и проставки 6.

45 Для запрессовки струйных насадок 5 в отдельные секции 3 полого корпуса 1 отдельные секции 3 нагревают, после чего запрессовывают в радиальные отверстия 4 струйные насадки 5. Проходной диаметр  $d_H$  струйной насадки 5 (см. фиг. 4) соответствует шести диаметрам зерен песка или пропанта.

Предлагаемый секционный гидropескоструйный перфоратор работает следующим образом.

Перед проведением работ с перфоратором любым известным методом определяют направление минимального напряжения пород пласта, в направлении которого будет развиваться трещина ГРП после проведения гидropескоструйной перфорации.

Радиальные отверстия 4 в отдельных секциях 3 выполняют (сверлят заранее перед сборкой перфоратора) в направлении минимального напряжения по результатам акустического метода.

Например, в процессе бурения горизонтальной скважины акустическим методом определяют, что минимальное напряжение пород пласта направлено вверх (см. фиг. 1), поэтому радиальные отверстия 4 в отдельных секциях 3 выполняют направленными вверх (см. фиг. 2) и собирают перфоратор, как показано на фиг. 1.

Если по результатам акустического метода минимальное напряжение пород пласта направлено вниз (фиг. 1-4 не показано), то радиальные отверстия 4 в отдельных секциях 3 выполняют направленными вниз, после чего собирают перфоратор.

Благодаря тому, что отверстия 8 (см. фиг. 1) в секциях 3 выполнены со смещением вверх от оси 7 полого корпуса 1, а в них размещен вал 11, установленный эксцентрично со смещением на величину  $e$  (см. фиг. 1 и 2, 3) относительно оси 7 полого корпуса 1 и жестко соединен с отдельными секциями 3, то радиальные отверстия 4 в секциях 3 будут размещаться в направлении минимального напряжения независимо от положения инструмента в горизонтальной скважине.

Это позволяет получить перфорацию в направлении минимального напряжения относительно окружности обсадной колонны горизонтальной скважины.

Также в зависимости от диаметра зерен фракций проппанта (см. табл. 1), предназначенного для выполнения гидropескоструйной перфорации, подбирают проходной диаметр  $d_H$  струйной насадки 5 из условия его соответствия шести диаметрам зерен фракции проппанта, что получено опытным путем.

Таблица 1

Диаметр сопла струйной насадки $d_H$ , мм	Фракция проппанта, меш
6	20/40
8	16/20
10	12/18

Например, для фракций проппанта 16/20 меш используют струйные насадки 5 с диаметром  $d_H=8$  мм.

Подбор диаметра насадки в зависимости от используемой фракции проппанта при проведении гидropескоструйной перфорации позволяет исключить закупоривание отверстий струйной насадки проппантом и исключает резкий рост (скачок) давления в процессе перфорации и, как следствие, прекращение перфорации.

На устье горизонтальной скважины на нижний конец колонны насосно-компрессорных труб (НКТ) 16 (см. фиг. 1) наворачивают предлагаемый секционный гидropескоструйный перфоратор. На колонне НКТ 16 гидropескоструйный перфоратор спускают в горизонтальную скважину в заданный интервал перфорации обсадной колонны. В процессе спуска в необходимый интервал перфорации перфоратора центрируется в обсадной колонне центраторами 6' (см. фиг. 1 и 2), которые одновременно защищают струйные насадки 5 от повреждений, так как  $R>r$ , что исключает контакт струйных насадок 5 со стенками обсадной колонны, поскольку конусная поверхность

14 струйных насадок 5 увеличивает их длину, что позволяет приблизить верхний конец 17 (см. фиг. 2) струйных насадок 5 к стенке перфорируемой обсадной колонны.

В заданном интервале перфорации горизонтальной скважины отдельные секции 3 независимо друг от друга вращаются относительно неподвижных муфты 2 и проставки 6 и за счет эксцентриситета  $e$  занимают положение, в котором радиальные отверстия 4 отдельных секций занимают положение, направленное вверх.

Далее прокачивают абразивную жидкость (водопрощантную смесь) по колонне НКТ 16, которая поступает в полый корпус 1 через муфту 2 и проставку 6 в секции 3.

В секциях 3 гидроабразивная жидкость поступает в радиальные отверстия 4, далее на вход струйных насадок 5, где во внутренней конической поверхности 15 происходит постепенный процесс нарастания скорости потока до максимального значения. Жидкость с абразивом, истекая из струйных насадок 5 с высокой скоростью, создает перфорационное отверстие в обсадной колонне и канал (каверну) в продуктивном пласте увеличенных размеров, так как удлинение процесса нарастания скорости на входе позволяет сформировать максимально компактные струи абразивной жидкости и получить их наибольшую пробивную способность, повышающую эффективность перфорации. Приближение верхнего конца 17 струйных насадок 5 к стенке перфорируемой обсадной колонны также повышает эффективность перфорации. В процессе прорезания обсадной колонны струи абразивной жидкости, истекающие из наклонно расположенных струйных насадок 5, отражаются от стенки обсадной колонны и воздействуют на твердосплавные материалы струйных насадок 5 по наружной конической поверхности 14, не повреждая секции 3 полого корпуса 1, при этом сохраняется целостность отдельных секций 3 полого корпуса 1 перфоратора и повышается надежность его работы, так как снижается износ устройства, а это позволяет выполнить за одну спуско-подъемную операцию колонны НКТ гидropескоструйную перфорацию в нескольких интервалах горизонтальной скважины.

После прорезания перфорационных отверстий в обсадной колонне и образования каверн в пласте в направлении минимального напряжения горных пород пласта процесс гидropескоструйной перфорации продолжают с проведением ГРП пласта, т.е. образования и развития трещины разрыва в направлении минимального напряжения горных пород пласта. Развитие трещины ГРП продолжают до закачки в трещину (на фиг. 1-4 не показано) заданной массы проппанта согласно плану работ, например, 2 т.

Повышается эффективность работы устройства, связанная с тем, что направление выполнения каверн относительно оси скважины из струйных насадок перфоратора в призабойной зоне совпадает с направлением развития трещины ГРП в направлении минимального напряжения пласта.

В результате трещина, образуемая из каверн при последующем ГРП, не разворачивается в призабойной зоне пласта в направлении минимального напряжения, как это происходило бы при выполнении работ с использованием прототипа. Это не приводит к росту давления в процессе проведения ГРП и исключает получение преждевременного прекращения процесса ГРП.

Предлагаемый секционный гидropескоструйный перфоратор позволяет:

- выполнить гидropескоструйную перфорацию в обсадной колонне скважины в направлении минимального напряжения  $\sigma_{\text{мин}}$  пласта независимо от положения устройства в стволе скважины;
- повысить эффективность и надежность работы;
- исключить закупоривание отверстия струйной насадки проппантом.

## (57) Формула изобретения

Секционный гидропескоструйный перфоратор содержит полый корпус, состоящий из муфты, отдельных секций с радиальными отверстиями и установленными в них струйными насадками, центраторов, отдельные секции соединены между собой проставками, отличающийся тем, что в секциях радиальные отверстия выполнены под заданным углом относительно оси корпуса, при этом в секциях отверстия выполнены со смещением вверх от оси корпуса, причем диаметр отверстий в секциях меньше, чем диаметр отверстий в муфте и в проставках, снабженных снаружи жесткими центраторами, при этом муфта, секции и проставки разделены между собой подшипниками и стянуты валом с накрученными на него с двух сторон гайками, причем вал установлен эксцентрично относительно оси корпуса и жестко соединен с отдельными секциями, а гайки контактируют с муфтой и последней заглушенной подшипниками секцией, при этом муфта, отдельные секции и проставки герметично разделены между собой уплотнительными элементами, а отдельные секции имеют возможность совместного вращения с валом относительно неподвижных муфты и проставок, причем струйные насадки запрессованы в отдельные секции, выполнены из твердосплавного материала под конус, оснащены наружной и внутренней коническими поверхностями, сужающимися наружу от отдельной секции полого корпуса, при этом радиальный вылет запрессованной в отдельную секцию струйной насадки меньше радиального вылета центраторов муфты и проставки, а диаметр струйной насадки соответствует шести диаметрам зерен фракции проппанта.

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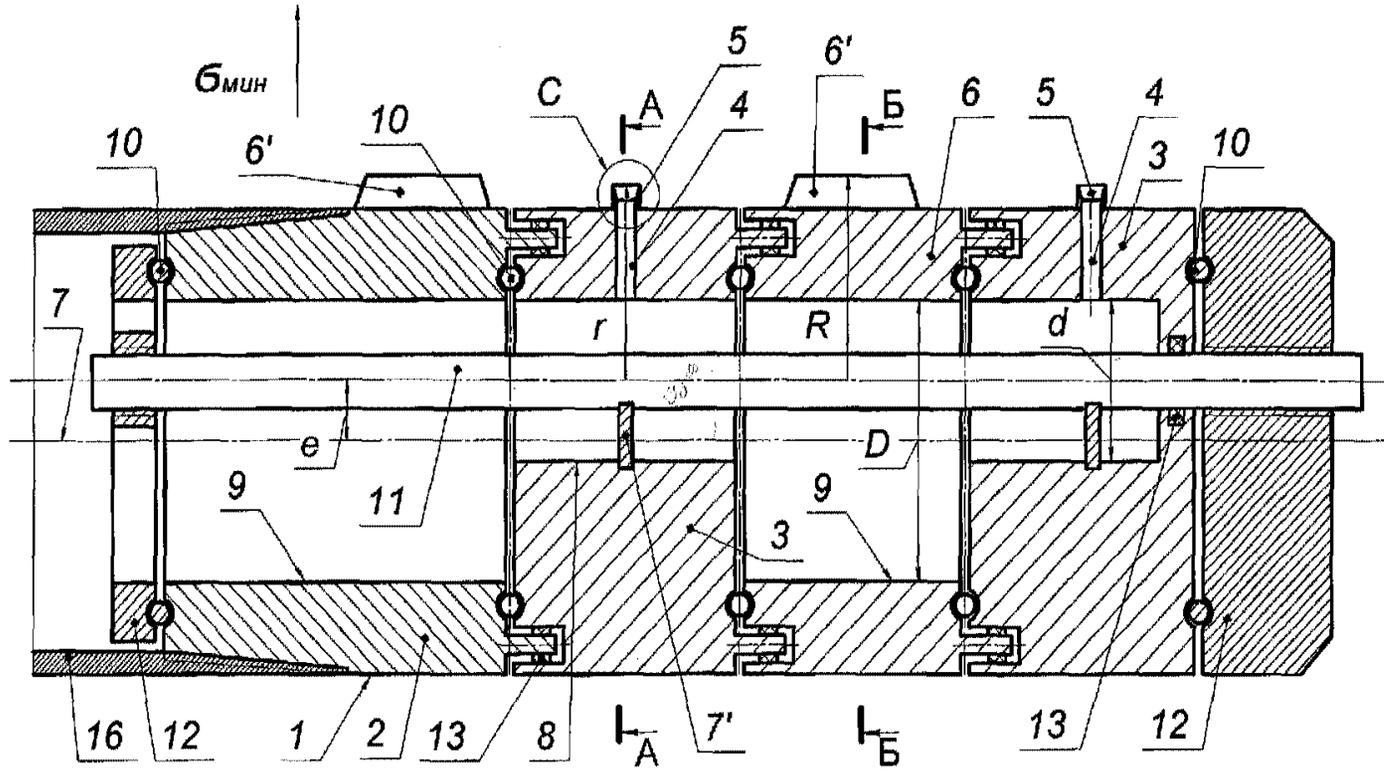
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### Секционный гидropескоструйный перфоратор

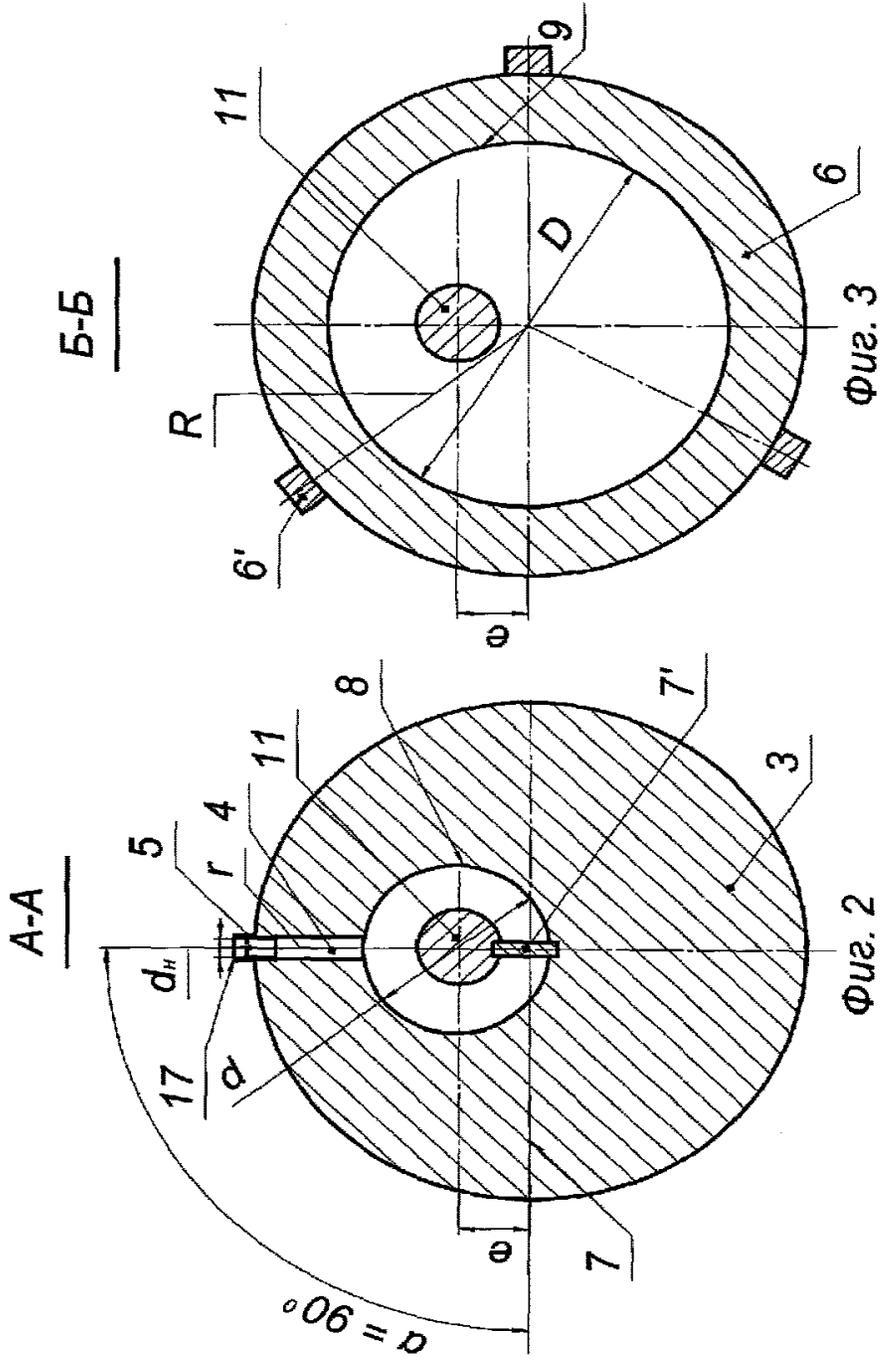


Фиг. 1

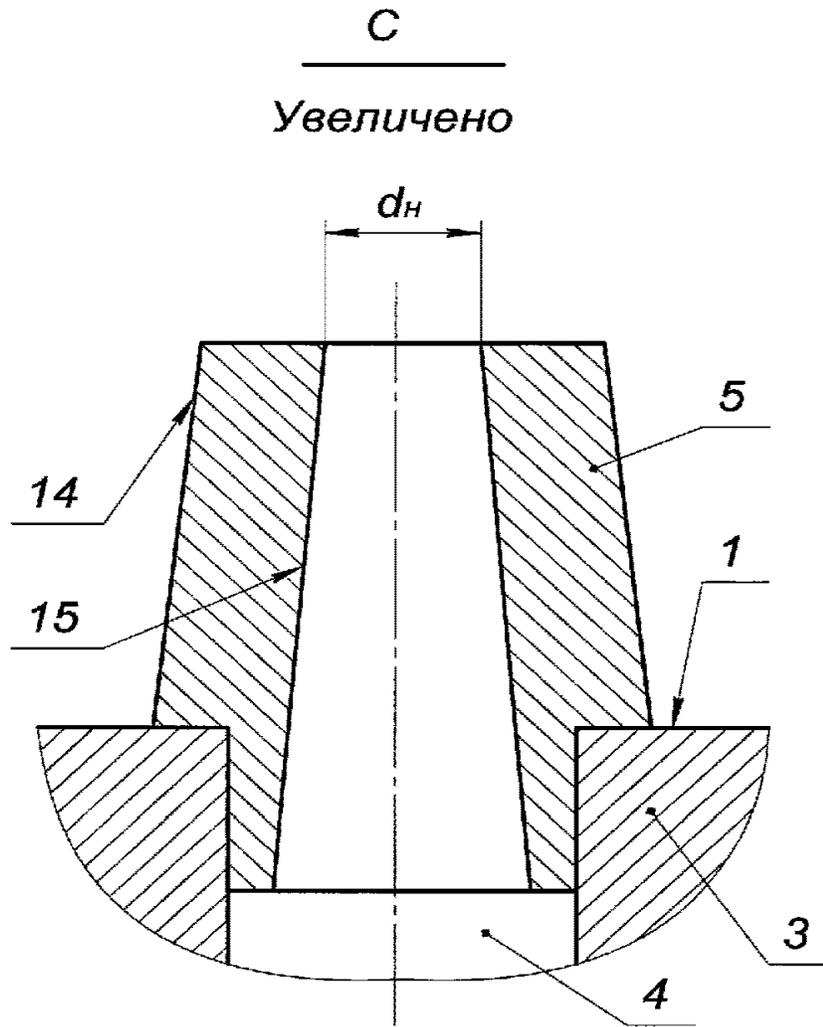
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Секционный гидрокоструйный перфоратор



Секционный  
гидропескоструйный  
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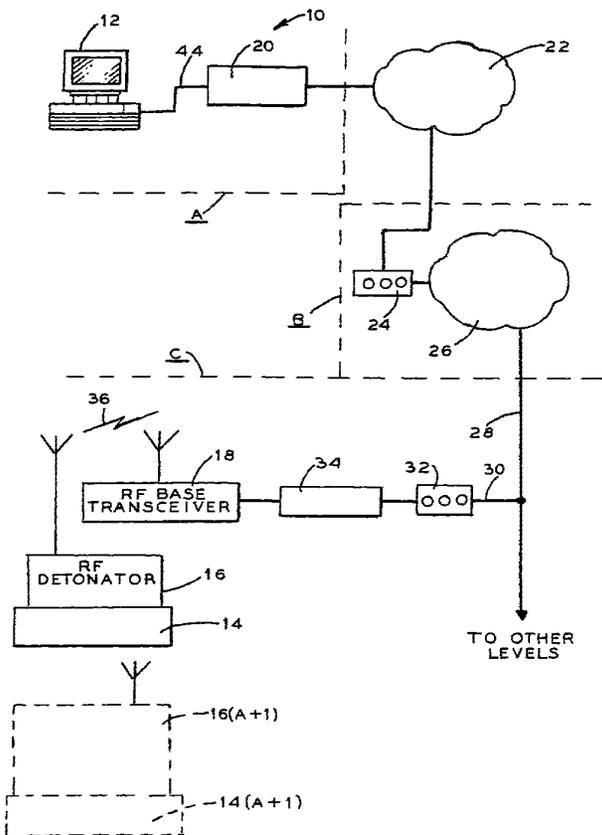
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(54) Title: REMOTE WIRELESS DETONATOR SYSTEM



(57) Abstract: A wireless detonator system wherein a blast initiation signal emanating from a programmable controller (12) is broadcast to individual, remote programmable detonators (16) associated with specific explosive charges (14). The controller (18) communicates with a programmable RF base transceiver. Upon interpreting the blast initiation signal, the RF base transceiver broadcasts instructions to the detonators (14). By assigning a single sacrificial detonator to a single charge, a timed blast sequence may be created without the need for time consuming and expensive hand wiring of the charges.

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REMOTE WIRELESS DETONATOR SYSTEMTECHNICAL FIELD

The instant invention relates to explosive detonator systems in general, and more particularly, to remotely  
5 activated detonators.

BACKGROUND ART

Explosives have been a necessary evil in the mining, demolition, quarrying and construction industries for centuries. Over the years, explosives technology has advanced  
10 arm-in-arm with safety considerations. The current state of the art generally consists of, in simplified fashion, a detonator, fuse, primer, and explosive. The detonator is usually energized via a hardwired electrical signal. By activating the detonator, the fuse is blown which sets off the  
15 primer. As the primer ignites, the charge subsequently explodes. For safety and efficiency reasons, the long daisy chain of firing components are strung together to (1) ensure no inadvertent firing and (2) affirmatively place and sequentially time the explosives for full effect.

20 Hardwired systems suffer from the need to tie numerous detonators together and connect the entire array to a remote initiator site. It is often difficult, labor intensive, expensive and time consuming to run long lengths of electrical wires from the blast site to the remotely situated initiation  
25 site. This is particularly true in underground mining applications using sequential blast patterns.

U.S. patent 5,159,149 to Marsden discloses a remote detonator system employing untethered radio frequency (RF) transmitters and receivers. Each detonator must be physically

coupled and uncoupled with a combined charging energy storage means and a programmable delay time means prior to shot initiation.

Canadian patent 1,309,299 to Beattie et al.,  
5 discloses a wireless system including detonation means capable of receiving RF signals from a remote source hardwired to a fuse via connecting wires.

Canadian patent 1,298,899 to Beattie et al.,  
discloses a dual detonation system employing RF and a steerable  
10 laser beam.

Wired designs include U.S. patent 5,295,438 to Hill et al. and U.S. patent 5,520,114 to Guimard et al. The former patent discloses a transportable programming tool and a control loop. Each detonator is affixed to a split core which is  
15 hooked to the loop. The latter patent discloses a feedback programming unit and an integrated electronic delay detonator.

Current commercially available detonation systems still ultimately require physically connecting wires to each detonator regardless of the mode of initiation.

20 The purpose of the present invention is to provide a remote wireless untethered blast initiation system. The need for such a system comes from a greater requirement to automate the complete mining process. A key part of the underground hard rock mining process is blasting. In order to automate  
25 blasting, a technique is needed to allow for the wireless initiation of a blast. Wiring a blast is a labor intensive manual process requiring a person to physically connect wires to each detonator. As well, many different time delays are required for the blast. Since development blasts can have a  
30 blast pattern containing 80 or more detonators, the possibility

for human error is high. These errors occur in the placement of a detonator with the wrong timing in a hole as designated by the mine engineers' blast design or designed by the development blaster. Incorrect placement and timing of the blast pattern  
5 creates poor break, bootlegs, loose rock, varying muck size and damage to the opening. This in turn creates higher mining costs.

The present invention allows data from a computerized blasting design program to be transferred directly to the  
10 detonators and the machine installing them. This reduces error and allows for a machine to automatically install the detonators. The elimination of wires greatly reduces the complexity of the automated machine required to install the detonators. The elimination of wires or other tethers such as  
15 shock tubes also eliminates the chance of the tethers being cut by the blast before the initiation signal can propagate to the other detonators. This creates a poor blast i.e. oversize chunks, poor perimeter contour and bootlegs. All of the factors create additional worker hazards and therefore cost.  
20 Efficiency and safety of the process is also improved since the blast design data is immediately available to the blast operator and is transferred by computer file instead of being read and acted upon by a person.

Conventional detonators come with preset times,  
25 creating the need to stock many different detonators, each with individual time delays. The present system allows one detonator to be stocked and allows for much finer control of the blast by allowing a higher resolution and greater number of delay times. The detonators may be timed in 1 millisecond (ms)  
30 increments up to 10,000 ms, giving total timing control. These times are determined by measuring rock properties. Matching

the timing to the rock properties gives consistent fragmentation, which is required in automated mining.

#### SUMMARY OF THE INVENTION

Accordingly, there is provided a wireless detonator system that is adapted to initiate a timed sequential blast pattern by direct wireless connection to each individual detonator.

A remote central processing unit (CPU) programmed with detonator programming software communicates to an RF base transceiver. The transceiver communicates to at least one dedicated RF detonator affixed to an individual charge via a RF signal. The detonator interprets the signal and fires off an internal fuse directly setting off the associated charge.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an overall schematic diagram of an embodiment of the invention.

Figure 2 is a schematic diagram of an embodiment of the invention.

Figure 3 is a schematic diagram of an embodiment of the invention.

Figure 4 is a schematic diagram of an embodiment of the invention.

#### PREFERRED EMBODIMENT OF THE INVENTION

Figure 1 depicts a schematic representation of the remote detonating system 10. A programmable controller 12, preferably a personal computer, ultimately communicates via a

wireless RF signal link with one or more discrete explosive charges 14 (A+1) (A equaling -1, 0, 1, 2, 3, etc.).

Each explosive charge 14 (A+1) includes its own affixed and dedicated micro RF detonator 16(A+1). (For non-  
5 limiting simplicity, any reference to an individual component will include multiple iterations unless indicated to the contrary, i.e. 14 and 16)

By virtue of the controller's 12 software, once a firing program has been initiated, an RF trigger will target  
10 each individual detonator 16 according to a preselected sequentially timed firing pattern. By reducing or eliminating wired connections between the CPU 12 and the blast site, the difficulties posed by the prior art direct hardwired or wireless systems are reduced.

15 In the embodiment depicted, the inventors utilized Inco Limited's preexisting broadband CATV communications system connecting surface structures to underground mine locations. However, as will become apparent, any communication system bridging the controller 12 and the blast site may be used.

20 The system 10 includes the controller/computer 12 (preferably equipped with Microsoft® Windows® 95 or NT® (or later), and Inco Limited's proprietary Teleblast™ blast control software [copyrighted copies are available from Inco Limited]), a local RF base transceiver 18 and one or more remote RF remote  
25 detonators 16.

As briefly stated previously, Figure 1 demonstrates Inco Limited's underground communications system in an abbreviated fashion. The controller 12, which may be disposed above ground or in any remote secure location, is connected to  
30 a conventional serial to ethernet converter 20. The signal is

passed through a conventional network 22 to a first standard  
modem 24. The modem 24 in turn is connected to a broadband  
CATV interface 26 which is disposed (in Inco's case) at the  
surface in a mine head frame. The communications link is  
5 passed underground through a main broadband underground  
communications trunk system 28.

A branch line 30 off the trunk 28 is diverted to a  
second standard modem 32 which in turn communicates with a  
conventional ethernet to serial converter 34. The converter 34  
10 in turn communicates with the RF base transceiver 18.

As one skilled in the art may appreciate, the means  
for transmitting a signal from the controller 12 to the RF base  
transceiver 18 can be as varied as desired depending on site  
considerations, available equipment, finances, state of the art  
15 communication technology, etc. It is within the realm of this  
invention that in above ground situations such as demolition,  
construction, quarrying, etc, the distance and communication  
system may be relatively short, line of sight, wireless and  
simple. In other situations, the communication system  
20 traversing the controller 12 and RF base transmittal 18 may be  
quite involved, sophisticated and greatly spaced. Whatever the  
situation, however, one skilled in the art is capable of  
causing the controller 12 to communicate with the RF base  
transceiver 18 using available technology.

25 In the embodiment shown, the controller 12 ultimately  
communicates with the RF base transceiver 18 using its serial  
communications port (COM1) via a RS-232 serial bus 44. The RF  
base transceiver 18 modulates the data stream coming from the  
controller 12 onto a radio signal 36. The signal 36 is  
30 received by each individual RF detonator 16 and demodulated to

provide intelligence to a detonator internal central processing unit (CPU) 38. (See Figure 3).

The instant system 10 allows for easy integration onto a conventional PC two-way network such as one typically  
5 installed in underground mines. The system 10 takes advantage of existing cable and network infrastructure already installed thereby reducing cost. The cost of installing dedicated wiring is eliminated. Security of communications is ensured by using a mathematical coding scheme, cyclic redundancy check ("CRC"),  
10 addressable detonators 16 and a dedicated blasting radio channel.

The system 10 unabashedly takes advantage of the ever increasing and amazing reductions in electronic component size and cost. The components making up the RF detonator 16 can be  
15 made so small and cheaply that they are literally expendable. By physically mating the RF detonator 16 to each specific charge 14, the safety and efficiency of explosive blasting is considerably ramped up.

In the present discussion, a particular  
20 manufacturer's components are referenced for convenience. However, it should be understood that comparable alternatives may be substituted for the particular identified components. What must be borne in mind that a remote safety-triggering signal is transmitted from a remote initiation site to a  
25 transceiver 18. The transceiver 18 in turn broadcasts a wireless signal to a distinct explosive charge 14. Each charge 14 includes its own stand-alone dedicated transceiver detonator 16. The detonator 16 interprets the signal from the transceiver 18 and, if conditions are appropriate, initiates  
30 the explosive sequence.

Turning to Figures 2 and 3, the controller 12 is shown connected to the RF base transceiver 18 (minus intermediate connections).

The controller 12 is programmed with the appropriate software and commands the system 10. The Teleblast blast control software:

- a) computes the CRC for communication verification and integrity. This is a method for checking the accuracy of a digital transmission over a communications link. The computer 12 performs a calculation on the data and attaches the resulting CRC value to the communication data stream; the receiving CPU 38 performs the same calculation and compares its result to the original value in anticipation of a hand shake confirmation. If they do not match, a transmission error has occurred and the receiving computer requests retransmission of the data;
- b) allows the operator to program a blast batch identification number, a detonator identification number and detonator (cap) delay time in milliseconds (0 to 10000) into each detonator 16; and
- c) allows the operator to initiate a common fire command to start a countdown from each individual detonator delay setting for all detonators 16 within a blast batch.

In the non-limiting embodiment shown, the RF base transceiver 18 includes an Adcom® Telemetry  $\mu$ -T™ micromodule (Adcom Telemetry Inc., Boca Raton, Florida, USA), and a source of low voltage power, i.e. a battery 42.

According to the manufacturer, the module 40 incorporates a small programmable microprocessor or CPU 46 and transmitter/receiver 48 into a small package that eliminates a hand wired system. The system 10 incorporates the advantages of digital/analog telemetry and programmable logic functions provided by the module 40 so as to recognize and respond to the CRC, the blast batch identifier, the blasting cap identifier, communications verification, the blasting cap detonator, fire command, detonation delay times, cycle times and any safety/override commands generated by the controller (collectively "the recognition protocols").

The recognition protocols are programmed into and recognized by the module 40 and the resultant instructions are transmitted via an antenna 50. According to the manufacturer, depending on the configuration selected, the signal may be broadcast up to about a mile (1.6 km) - line of sight. In an underground environment, conventional accommodations may have to be made to access signals blocked by rock, ore, coal, debris, etc.

The RF base transmitter 18 transmits its signal 36 to one or more RF detonators 16. The self-contained detonator 16 includes a slave Adcom Telemetry  $\mu$ -T micromodule 50 comprising a programmable microprocessor 38 and a transmitter/receiver 54 that are identical to their counterparts in the module 40. Signals broadcast from the RF base transceiver 10 are received by an antenna 56.

The detonator CPU 38 receives intelligence containing radio signals consisting of the relevant recognition protocols.

The detonator 16 is powered by an energy source 58 such as a battery or a charged capacitor. The energy stored in these devices begins to discharge once the energy source 58 is affirmatively engaged. Dissipation occurs through the module 5 50 or through a relay switch 60 on the detonator 16. The capacity of the energy source allows for a 24 hour discharge time. This way, if for some reason the blast cannot be fired, the blast does not remain alive. It must be reprimed in order to fire.

10 The energy source 58 also powers the transmitter/receiver 54, the detonator CPU 38, the relay 60 and a fuse 64.

Upon recognition and acceptance of the fire command signal by the detonator microcontroller 38, the detonator 16 15 outputs a fire command to the relay 60. The relay 62 switches the stored energy from the energy source 58 to the fuse 64. As the fuse 64 blows, the primer is activated causing discharge 82 and the explosion of the dedicated charge 14.

By utilizing an array of appropriately timed 20 independent RF detonators 16, a sequential blast pattern can be initiated without the need for a rat's nest of wires.

Once the detonators 16 are loaded in the desired blasting pattern, there is no further need to physically come into contact with the detonators 16 and their associated 25 charges 14. Preferably, the detonators 16 are remotely programmed after installation by the broadcast of the relevant installation recognition protocols from the controller. Because each detonator 16 is essentially a stand alone, self-contained unit with its own learning capable CPU 38 and related

discharge components 60, 64, 58, any post installation contact is minimized thereby increasing safety and efficiency.

Figures 4 depicts a successful prototype detonator 84.

5 The Adcom module 50 includes an 8-pin input/output (I/O) connector 66.

A Triridge™ 2988 5 volt SPST relay 68 was, for the test, connected to pins 2 and 6 of the connector 66 with a jumper 80 between pins 6 and 8 to complete the power circuit.  
10 A 300 ohm ¼ watt resistor 70 and light emitting diode (LED) 72 were bridged across the pins and the relay 68.

A 9 volt battery 74 supplies energy to the prototype. (A capacitor 76 is shown as an optional alternative to the battery 74). The jumper 80 supplies the power to the RF  
15 detonator 16. A fuse 78 (a flashbulb may be substituted for effect) is blown by the relay 68. Upon receipt of a "fire" signal from an RF base transceiver 18, the detonator 16 compares the transmitted recognition protocols and, when satisfied, opens the relay 68, illuminates the LED 72 and blows  
20 the fuse 78 (flash bulb).

As mentioned previously, the present system 10 easily lends itself to disparate operations. For example, in the non-limiting mining application depicted in Figure 1, the controller may be located on the surface in an office A,  
25 Communication lines 44 (which may also be wireless and close or distant from the blast site) link the controller 12 through an existing network 12 to a mine head end location B on the surface. The communications stream continues underground C through the mine's existing main broadband trunk 28 where  
30 eventually it is routed to the RF base transceiver 18 on the

level where blasting is contemplated. The RF transceiver 18 is positioned to expeditiously communicate with the various arranged RF self-contained detonators 16. The existing communications infrastructure provides efficient two-way  
5 communications between the RF detonator 16 and the controller 12.

Other examples would place the controller 12 as a laptop in a shed or mobile vehicle. If controller-blast site distances allow, the wired link between the controller 12 and  
10 the RF base transceiver 18 may be replaced with a RF communications package.

While in accordance with the provisions of the statute, there are illustrated and described herein specific embodiments of the invention, those skilled in the art will  
15 understand that changes may be made in the form of the invention covered by the claims and that certain features of the invention may sometimes be used to advantage without a corresponding use of the other features.

CLAIMS:

1. A remote detonator system, the system comprising a controller, the controller communicating with a base transceiver, the controller adapted to generate an initiation  
5 signal, the base transceiver remotely communicating with at least one self-contained detonator, the detonator associated with a dedicated explosive charge, the base transmitter adapted to recognize and respond to the initiation signal and initiate and transmit a resultant signal to the detonator, and the  
10 detonator adapted to receive and interpret the resultant signal to energize its dedicated explosive charge.
2. The system according to claim 1 wherein the base transceiver includes a microcontroller, the microcontroller communicating with a transceiver, and a power supply for the  
15 base transceiver.
3. The system according to claim 2 wherein the base transceiver includes an antenna.
4. The system according to claim 1 wherein the detonator is a stand alone unit, the detonator including a second remote  
20 accessible microcontroller, the second microcontroller communicating with a second transceiver, the microcontroller communicating with a second power source, the second microcontroller communicating with a relay, and a fuse.
5. The system according to claim 4 wherein the detonator  
25 includes a second antenna.
6. The system according to claim 4 wherein the fuse is connected to the explosive charge.

7. The system according to claim 1 wherein the controller includes blast initiation programming having recognition protocols, the base transceiver and the detonator adapted to learn, recognize and respond to the recognition  
5 protocols.

8. The system according to claim 7 wherein the recognition protocols include a communications link, a blast batch identifier, a blasting cap identifier, a communications integrity verifier, a blasting cap delay instruction, and a  
10 fire command.

9. The system according to claim 1 including a broadband connection between the controller and the base transceiver.

10. The system according to claim 1 wherein the base transceiver includes means for accepting the initiation signal  
15 from the controller, and CPU means for interpreting the initiation signal and transmitting a resultant signal away from the base transceiver.

11. The system according to claim 1 wherein the detonator includes means for accepting the resultant signal, CPU means  
20 for learning and interpreting the resilient signal, blast initiation means responsive to the resultant signal, and the detonator affixed to the dedicated explosive charge.

12. The system according to claim 1 including a plurality of detonators.

25 13. The system according to claim 1 including a plurality of dedicated explosive charges, each dedicated explosive charge affixed to a matching dedicated detonator.

14. The system according to claim 1 including an RF base transceiver.

15. The system according to claim 1 including at least one RF detonator.

5 16. A method of remotely initiating explosive charges by remotely activating detonators, the method comprising:

a) sending a initiation signal to a base transceiver, the initiation signal including preselected safety and firing parameters,

10 b) causing the base transceiver to receive and interpret the initiation signal and, if appropriate, generate a resultant fire signal,

c) causing the resultant fire signal to be broadcast over a known area,

15 d) receiving the resultant firing signal with a self-contained, stand-alone detonator, the alone detonator adapted to interpret the resultant firing signal, and

20 e) causing the resultant firing signal, if appropriate, to initiate an explosive charge particularly dedicated and connected to the stand-alone detonator.

17. The method according to claim 14 including utilizing a plurality of detonators with associated explosive charges, and each detonator connected to a dedicated explosive charge.

18. The method according to claim 16 including sending  
25 the initiation signal to the base transceiver via a broad band transmission.

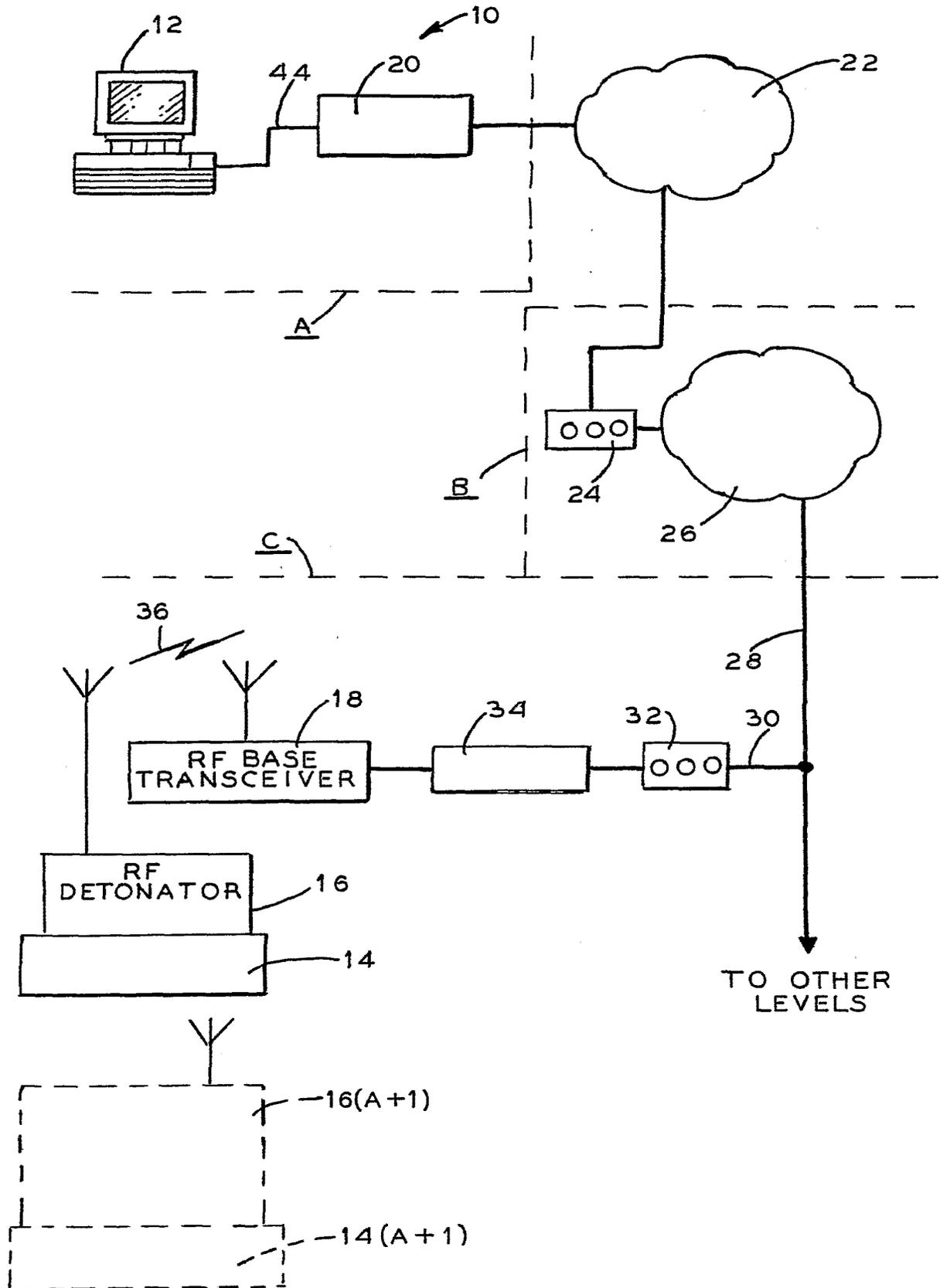
19. The method according to claim 16 wherein the initiation signal includes recognition protocols, the base transceiver determining that the recognition protocols are appropriate, and transmitting the resultant fire signal to a  
5 detonator.

20. The method according to claim 16 wherein the firing signal is encoded in an RF signal transmitted from the base transceiver to a detonator.

21. The method according to claim 16 including  
10 programming the detonator from a remote location.

1/3

FIG. 1



2/3

FIG. 2

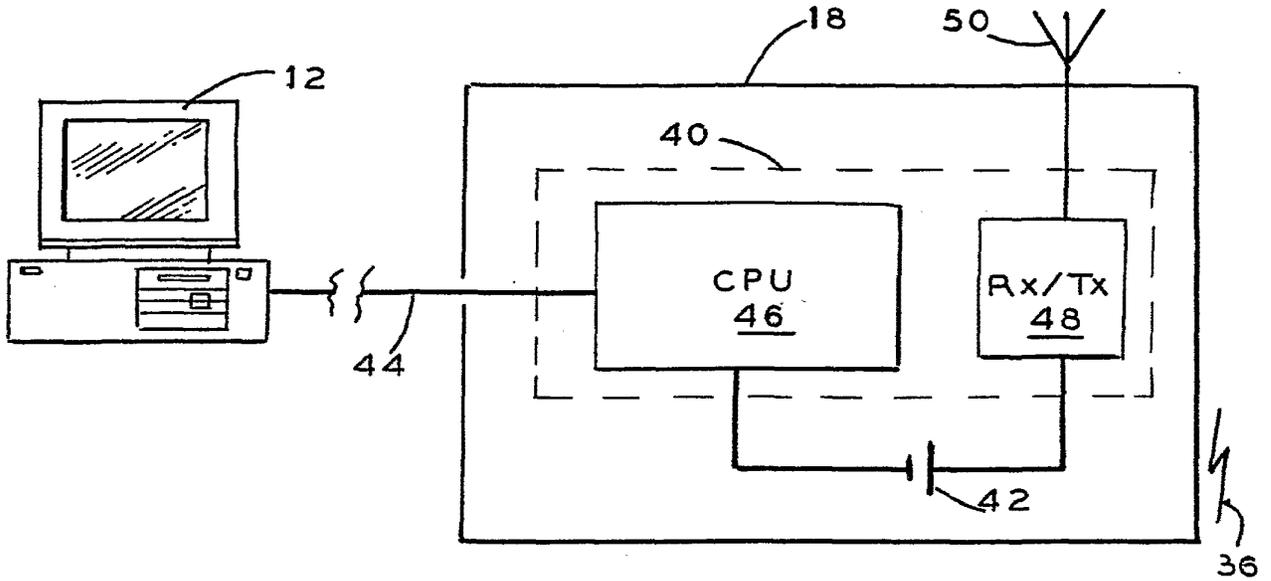


FIG. 3

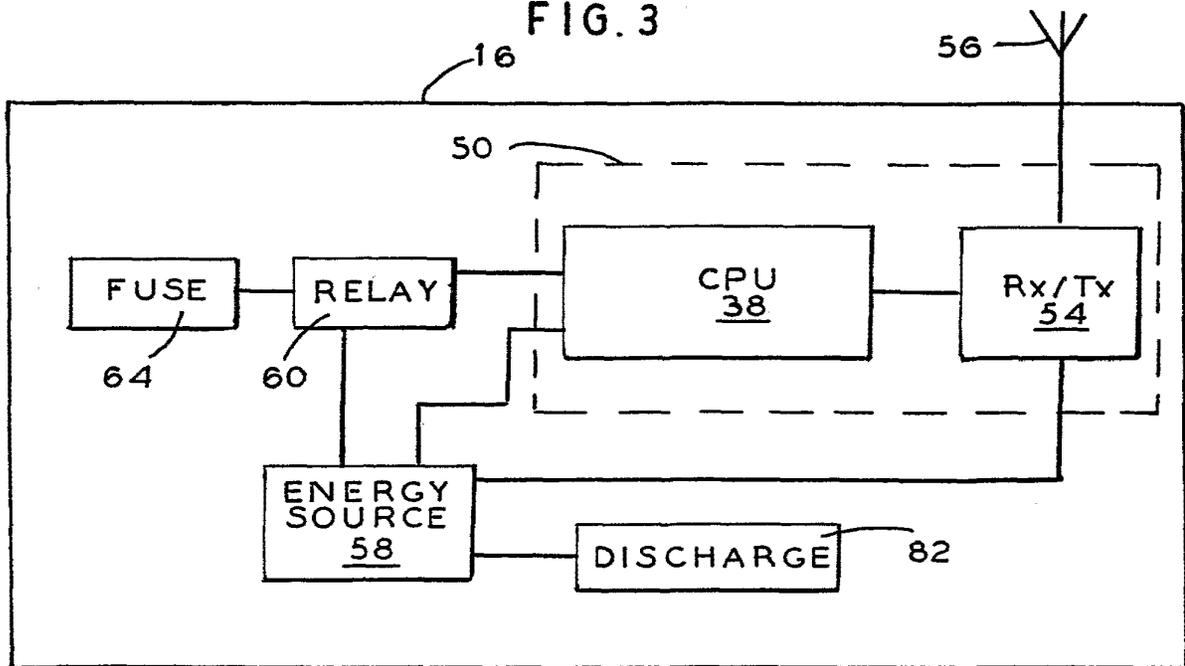
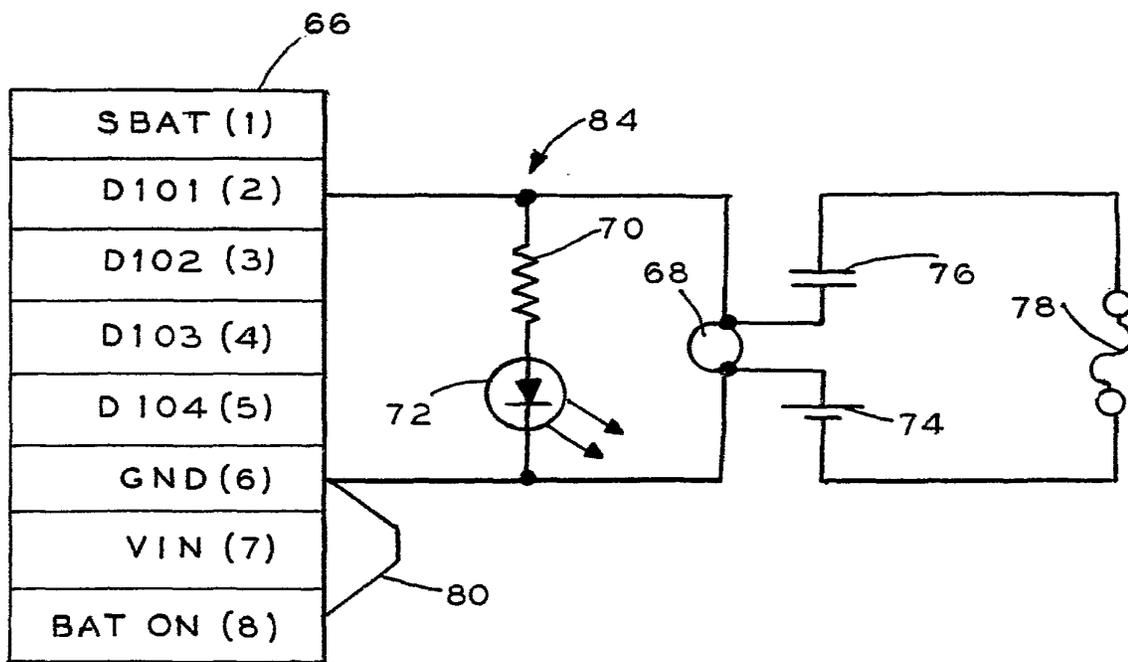


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No  
PCT/CA 00/01369

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 F42D1/05

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

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 F42D F42C

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

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

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 99 24776 A (ROCKTEK LTD ;WRIGHT KEITH (AU); GAVRILOVIC MIKE (US)) 20 May 1999 (1999-05-20) page 8, line 1 -page 9, line 14; figures 1-11 page 10, line 20 -page 11, line 27 page 15, line 2-17 page 22, line 17 -page 23, line 23 page 24, line 1-17 ---	1-3,7, 9-21
P,X	WO 00 26607 A (ZEMLA ANDREAS ;SCHAEFER HEINZ (DE); STEINER ULRICH (DE); DYNAMIT N) 11 May 2000 (2000-05-11) the whole document ---	1-3,7-21

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
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- \*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
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- \*Z\* document member of the same patent family

Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

International Application No  
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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International Application No

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- (74) Agent: **CARSON, Matt, W.**; Baker Hughes Incorporated, P.O. Box 4740, Houston, TX 77027-4740 (US).

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**Declarations under Rule 4.17:**  
 — as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

[Continued on next page]

(54) Title: WIRELESS PERFORATING GUN INITIATION

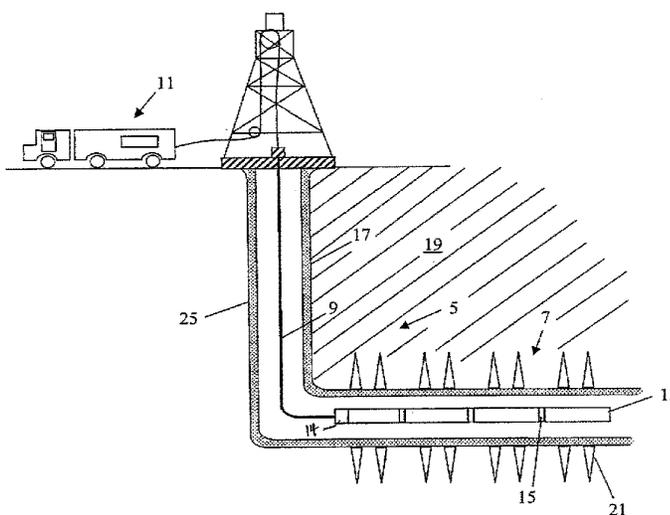


FIG. 1

(57) Abstract: A perforating system and method for wellbore perforating. The system comprises a perforating string having a perforating gun with shaped charges, a communication module for receiving detonation signals, and a controller associated with each perforating gun. The module receives surface signals for gun detonation and wirelessly transmits the signals to selected guns via the associated controllers.

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- 
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

**Published:**

- *without international search report and to be republished upon receipt of that report*
- *with information concerning request for restoration of the right of priority in respect of one or more priority claims*

**WIRELESS PERFORATING GUN INITIATION****BACKGROUND OF THE INVENTION**

## 1. Field of the Invention

The disclosure herein relates generally to the field of oil and gas production. More specifically, the present disclosure relates to a method and apparatus for initiating detonation of a perforating using wireless transmission.

## 2. Description of Related Art

Perforating systems are used for the purpose, among others, of making hydraulic communication passages, called perforations, in wellbores drilled through earth formations so that predetermined zones of the earth formations can be hydraulically connected to the wellbore. Perforations are needed because wellbores are typically completed by coaxially inserting a pipe or casing into the wellbore, and the casing is retained in the wellbore by pumping cement into the annular space between the wellbore and the casing. The cemented casing is provided in the wellbore for the specific purpose of hydraulically isolating from each other the various earth formations penetrated by the wellbore. As is known, hydrocarbon-bearing strata, such as reservoirs, exist within these formations. The wellbores typically intersect these reservoirs.

Perforating systems are used for perforating through the cement and casing into the surrounding subterranean formation. These systems typically comprise one or more perforating guns strung together, these strings of guns can sometimes surpass a thousand feet of perforating length. Included with the perforating guns are shaped charges that typically include a charge case, a liner, and a quantity of high explosive inserted between the liner and

the charge case. When the high explosive is detonated, the force of the detonation collapses the liner and ejects it from one end of the charge at very high velocity in a pattern called a "jet". The jet penetrates the casing, the cement and a quantity of the formation thereby forming a perforation in the formation that enables fluid communication between the wellbore and its surrounding formation.

FIG. 1 is a side partial cutaway view of a perforating system 5 comprising a perforating string 7 suspended within a wellbore 25. The perforating string 7 comprises a series of perforating guns 13 axially connected to one another by connecting subs 15. Tubing 9 is shown attached to the perforating string 7 and is a raising/lowering means for the perforating guns 13. The tubing 9 can also provide communication between the perforating string 7 and a surface truck 11. In some instances wireline is used in place of the tubing 9. The surface truck 11 typically includes a winch type device for disposal and retrieval of a perforating string 7 or instrument string in and out of the well. Also included within the surface truck 11 is an interface enabling surface personnel to transmit commands and receive data to and from the perforating string 7. The communicated data between the surface and the string 7 is generally provided along or by means of the tubing 9. The perforating string 7 of FIG. 1 is shown disposed in a deviated portion of the wellbore 25. For the purposes of illustration, perforations 21 are shown that extend from the wellbore 25, through the casing 17 that lines the wellbore 25, and into the surrounding formation 19.

The shaped charges are initiated by sending a signal from the surface to the perforating string 7 through the tubing 9. The signal is then received by a firing head 14 disposed on the upper portion of the perforating string 7. The firing head 14 transfers the firing signal to an initiator which then detonates an associated detonating cord. Typically the initiator is a type electrical blasting cap, an electrically-activated exploding bridge wire ("EBW") initiator, an electrically activated exploding-foil initiator ("EFI") or a percussively-

activated explosive initiator. The explosive-filled tube is generally referred to as "detonating cord". A type of detonating cord known in the art is sold by the Ensign-Bickford Company under the trade name PRIMACORD®. A resulting detonation wave passes along the length of the detonating cord that in turn initiates detonation of the connected shaped charges.

Figure 2 shows an example of a section of a perforating gun 13 being detonated within a wellbore 25. As shown, the perforating gun 13 includes shaped charges 16 having a connected detonation cord 18. Some of the shaped charges 16 have been detonated thereby producing perforations 21 extending into the corresponding formation 19. A portion of the detonating cord 18 is missing proximate to the shaped charges having already been detonated demonstrating how the cord has been consumed by the detonating pressure wave. Thus, it is illustrated how the sequential detonation of adjacent shaped charges takes place in a particular perforating gun producing perforations extending through a casing 17 and to the corresponding formation 19.

#### BRIEF SUMMARY OF THE INVENTION

A method of perforating a wellbore comprising disposing a perforating system in a wellbore on a conveyance member, wherein the perforating system comprises a perforating gun, a receiver and/or transmitter, and a communication module. The method also includes transmitting a detonation signal to the communication module, wherein the communication module is configured to transmit a corresponding wireless detonation signal to the controller and wherein the controller is configured to initiate detonation of the perforating gun in response to receiving a detonation signal from the communication module. The detonation signal may be transmitted from the surface through the conveyance member. The perforating gun detonation may be initiated by a pressure source, optionally the pressure source may be from wellbore pressure. Perforating gun detonation may occur by introducing wellbore pressure communication to an initiating system associated with the perforating gun. A

selectable open and closed control valve may be used for communicating the wellbore fluid to the perforating gun initiator. The perforating system may further comprise many perforating gun with associated controllers. Thus the method may include selectively sending signals from the communication module to selected controllers thereby selectively detonating a particular perforating gun, or a particular collection of perforating guns. The wireless signal may be a mud pulse, a radio signal, a high frequency signal along the perforating system, a low frequency signal along the perforating system or combinations thereof.

The present disclosure also includes a perforating system disposable in a wellbore comprising, a perforating gun, a communication module configured to receive commands from the surface while disposed within a wellbore, and a perforating gun controller in selective communication with the communication module. The perforating gun controller is configured to initiate perforating gun detonation in response to communication from the communication module. Optionally, the perforating gun controller comprises a controller module and a receiver and perhaps a transmitter for two way communication of data and logic. The perforating system can further comprise a perforating gun initiator, optionally the initiator is responsive to commands from the perforating gun controller and may be pressure actuated. A control valve may be employed for producing initiating that is actuatable by the controller and in pressure communication with the wellbore and the initiator. The control valve may also selectively communicate wellbore pressure to the initiator. The communication module may optionally be configured to emit signals, where the signals may be one or a combination of a mud pulse signal, a radio signal, a high frequency signal and a low frequency signal. The perforating system may further comprise a conveyance member, the conveyance member may be wireline, tubing, coiled tubing, slickline, tractor, or combinations there of.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING.

FIG. 1 depicts a perforating operation in a side partial cut-away view.

FIG. 2 illustrates a side cutaway view of shaped charge detonation.

FIG. 3 and 3a are schematic views of a perforating system of the present disclosure.

FIG. 4 is a side schematic view of a controller and initiator of a perforating gun.

## DETAILED DESCRIPTION OF THE INVENTION

The device and system disclosed herein comprises a perforating system configured to initiate perforating gun detonation by transmitting wireless signals from a portion of the perforating string selectively to individual perforating guns or sets of perforating guns. The perforating string is configured to receive command data from the wellbore surface while the string is disposed within a wellbore. A module within the system may receive the surface commands, process the signal received, and send a corresponding signal to initiate perforating gun detonation. Each gun, or set of guns, will have an associated receiver or receiver/transmitter and controller for receiving the signal from the module and activating perforating gun initiation. Optionally, a transmitter can be included in association with the receiver. Perforating gun initiation may be through pressure from the wellbore communicated to an initiator or an electrical initiator. In one embodiment of pressure actuation, the receiver/controller for each perforating gun selectively opens a valve or port allowing pressure communication between a wellbore and the initiator. Introducing pressure to the initiator in turn activates the initiator for detonating shaped charges with the associated perforating gun (or sets of perforating guns).

Figure 3 provides a schematical view of an embodiment of a perforating system 30. The perforating system comprises a perforating string 32 disposable within a wellbore on a conveyance member 28. The conveyance member may be a wireline, a slickline, tubing,

coiled tubing, and any other know or later developed means for deploying perforating systems within a wellbore.

A head 34 is located at the uppermost portion of the perforating string 32 and coupled to the conveyance member 28. The head may be used to electrically connect the perforating system to the conveyance member 28. It provides both mechanical and electrical attachment for conveying signals from the conveyance member 28 to the perforating string 32. In addition to providing electrical and/or mechanical connectivity between the conveyance member 28 and the perforating string 32, the head 34 may also be configured as a frangible link that may be broken with excessive tension applied to the conveyance member 28.

Disposed on the perforating string 32 adjacent the head 34 is a communication module 36. As will be described in more detail below, the communication module 36 is configured to receive a signal, represented by arrow 58, from surface and transmit that signal to the remaining portions of the perforating string. Arrows (60, 62, 64) represent communication from the communication module 36 to different components within the perforating string 32. The communication between the communication module and the other portions of the perforating string may be coded so that specific operations may be selectively undertaken by the perforating system 30.

A controller 38 is included with the embodiment of the perforating string 32 of Figure 3. The controller 38 is shown in data communication with the communication module 36 by the arrow 60. The arrow 60 illustrates a command path emanating from the communication module 36 being received by the controller 38. The controller 38 includes means for receiving the signal 60 and processing means for processing data embedded within the signal. The processor can be programmed to undertake a particular action accordingly based upon the content of the data signal 60. For example if it receives a data signal

representative of a command to initiate an operation of a perforating gun, a corresponding data detonation signal may be generated by the processor and then forwarded to an associated firing head. The corresponding data signal is represented by arrows 68, 70, and 72.

Firing head 40 is coupled and associated with a perforating gun 42, wherein the perforating gun has shaped charges 43. The perforating string 32 includes additional sets of controllers (44, 50), firing heads (46, 52), and perforating guns (48, 54). In the embodiment shown, the controller 44 is associated with firing head 46 and perforating gun 48; the controller 50 is associated with firing head 52 and perforating gun 54. It should be pointed out however that the perforating string 32 may be comprised of a single perforating gun, or a perforating string with a multiplicity of perforating guns that may exceed thousands feet in length.

In one mode of operation, perforating gun detonation may be commenced by sending a signal from a surface controller 56 to the communication module 36. Although the arrow 58 is shown external to the perforating string 32, the arrow 58 is representative of data, signal, or command communication between the surface controller 56 and the communication module 36. Optionally, communication could be transmitted in any number of ways, such as along the conveyance member 28, as well as other known and later developed methods of transferring the signal from the surface controller 56 to the communication module 36.

Based upon the data signal represented by arrow 58, the communication module 36 may then send a corresponding detonation initiation signal to one of the firing heads, selected firing heads, or all firing heads simultaneously. The signal, which is preferably wireless, may consist of many different forms. The signal may comprise a mud pulse, a radio frequency signal, a high frequency signal as well as a low frequency signal. The low frequency signal may be transmitted through the body of the tool, the wellbore mud, as well as the casing. As noted above, each of the firing heads, will include a receiver and processing device capable of

receiving the signal and then decoding the signal to determine whether or not action should be taken by the firing head.

Along with the processor, a program memory will be accessible to compare the signal received with pre-encoded instructions so the processor includes the capability of taking a particular action based upon the data received from the controller 38. Although shown as separate modules, the controller (38, 44, 50) may be combined with the respective firing heads (40, 46, 52). Accordingly, a single module would have the capability of receiving a data signal, decoding a data signal, and firing the associated perforating gun. Arrows 68, 70, and 72 represent a data command emanating from the controller to its associated firing head.

The perforating system 30 discussed herein includes many advantages over prior art perforating systems. For example, known systems are typically configured to detonate the entire string in a sequence from the top portion of the string to the lower portion. The individual modular configuration of the perforating string 32 of Figure 3 provides the capability of selectively initiating a single perforating gun, or a collection of one or more perforating guns within the string. In some situations, it might be desired to initiate one or more of the perforating guns, reposition the perforating system 32 within an associated wellbore, and then send another command from the surface controller 56 to the communication module 36 for the detonation of one or more other selected perforating guns.

FIG 3a illustrates schematic view of an optional embodiment of a perforating system 30a where the communication module 36a is not mechanically attached to the perforating string 32a. In the embodiment of FIG. 3a the communication module 36a communicates with controllers (38, 4, 50) via wireless communications (represented by dashed lines with arrows) through means of the wellbore.

With reference now to Figure 4, another alternative example of a portion of a perforating string 32b is shown. In this embodiment, the portion of the perforating string 32b comprises a controller 38a, a firing head 40a, and an associated perforating gun 42a. Controller module 38a includes a receiver 74 and a controller module 78. In some instances the receiver 74 may also operate as a transmitter. The receiver 74 and controller module 78 may each receive power by an associated battery 76. A communication link 75 illustrates communication between the receiver and a controller module. Wire 77 provides electrical communication for electrical connectivity between the battery 76 and receiver 74 and controller 78.

Firing head section 40a includes a valve 82 selectively opened or closed by a control module. Also included is an inlet line 84 providing pressure communication to the inlet of the valve 82 and the outside of the firing head 40a. Thus, the inlet to the valve 82 will be subject to wellbore pressure when the perforating system 32b is disposed in wellbore fluid. An exit line 86 downstream of the control valve 82 terminates in an initiator 88 therefore providing pressure communication downstream of the valve 82 and the initiator 88. The initiator 88 comprises a cylinder 89 having disposed therein a piston 90 and hammer 92; the hammer 92 extends downward from the piston 90. The cylinder 89, having a largely cylindrical opening, with the piston 90 correspondingly formed to axially move within the cylinder 89. The interface between the outer radius of the piston 90 and the inner circumference of the cylinder 89 should form a seal.

A shear pin 91 is shown extending through the wall of the cylinder 89 and into a recess formed in the piston 90. The shear pin 91 is included to prevent unwanted movement of the piston 90 within the cylinder 89. However, the shear pin 91 may be made of a soft polymeric material easily sheared upon being subject to relatively low pressure differential across the respective sides of the piston 90. Also disposed in the cylinder 89 is a pressure

detonator 93 having a detonation cord connected on its lower end. The detonation cord 94 extends from the firing head 40a and into the associated perforating gun 42a. As is known, initiation of the detonation cord 94 in turn will produce a detonation wave traveling along the detonation cord 94 for initiating detonation of the shaped charges 43a connected to the detonating cord 94.

An optional detonator 96 is also shown within the firing head 40a. The optional detonator is connected to the controller module 78 by wire, with a pressure activated safety switch 98, and on its opposite end has a detonation cord 97 that connects to the primary detonation cord 94.

In one mode of operation of the perforating string segment 32a of Figure 4, a detonation signal is delivered to the controller 38a via signal arrow 60. A receiver 74, which is configured to receive and decode the content of the signal 60, receives the signal, decodes it, and forwards its content to the controller module 78. Although shown as separate devices, the receiver 74 and controller module 78 may be integrated within a single module such as a processor, printed circuit board, or an information handling system. As with the other controllers discussed above, the controller module 78 is programmed to take action depending upon the content of the signal 60. In situations where the signal content includes a detonation command, a corresponding detonation signal, represented by arrow 80, is forwarded to the control valve 82. The control valve, which includes an actuator, may be opened thereby providing pressure communication through the inlet line 84 and exit line 86 into the cylinder 89. The pressure communication, typically in the form of wellbore fluid flowing into a cylinder, exceeds the ambient pressure within the cylinder 89. This in turn forces the piston 90 out of its seat by shearing the shear pin 91 and propels the piston 90 and hammer 92 downward into striking contact with the detonator 93. The sharpened point of the hammer 92 will have sufficient percussion to cause ignition of the detonator 93 in order to produce a

corresponding detonation in the detonation cord 94 for detonating the shaped charges 43a. Accordingly, one of the advantages of using the combination of controller module 38a and firing head 40a for pressure based initiation is that the perforating string 32 is not subject to a premature detonation based on an errant electrical signal. That is because the perforating string would be detonatable only by the presence of wellbore pressure. As such, detonation of these perforating guns would not occur accidentally prior to being inserted within the wellbore.

The present invention described herein, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the invention has been given for purposes of disclosure, numerous changes exist in the details of procedures for accomplishing the desired results. For example, the invention described herein is applicable to any shaped charge phasing as well as any density of shaped charge. Moreover, the invention can be utilized with any size of perforating gun and any type of perforating element and as such is not limited to shaped charges as a perforating element. These and other similar modifications will readily suggest themselves to those skilled in the art, and are intended to be encompassed within the spirit of the present invention disclosed herein and the scope of the appended claims.

## CLAIMS

What is claimed is.

1. A method of perforating a wellbore comprising:  
  
disposing a perforating system in a wellbore on a conveyance member, wherein the perforating system comprises a perforating gun, and a communication module;  
  
and  
  
sending a detonation signal to the communication module, wherein the communication module is configured to transmit a corresponding wireless detonation signal to the controller and wherein the controller is configured to initiate detonation of the perforating gun in response to receiving a detonation signal from the communication module.
2. The method of perforating a wellbore of claim 1, wherein the perforating system further comprises a controller and a firing head.
3. The method of perforating a wellbore of claim 2, wherein the controller comprises a receiver, a transmitter, battery, and a control module.
4. The method of perforating a wellbore of claim 1 wherein the detonation signal is transmitted from the surface through the conveyance member
5. The method of perforating a wellbore of claim 1, wherein the detonator signal originates from a downhole communication module detached from the perforating system.
6. The method of perforating a well of claim 1 where in the communication module is attached to the conveyance member.

7. The method of perforating a well of claim 1 where in the communication module is detached to the conveyance member.
8. The method of perforating a wellbore of claim 1, wherein the perforating gun detonation is initiated by a pressure source.
9. The method of claim 8, wherein the pressure source comprises wellbore fluid.
10. The method of claim 1, wherein the receiver initiates perforating gun detonation by introducing wellbore pressure communication to an initiating system associated with the perforating gun.
11. The method of claim 10, wherein allowing wellbore pressure communication comprises opening a valve separating wellbore fluid pressure and the initiating system.
12. The method of claim 10, wherein the initiating system comprises a hammer configured to strike an initiator when exposed to pressure.
13. The method of claim 12, wherein the pressure comprises wellbore fluid pressure.
14. The method of claim 1, wherein the perforating system comprises another perforating gun and another controller.
15. The method of claim 14, further comprising selectively transmitting a corresponding detonation signal to a selected controller.
16. The method of claim 1 wherein the wireless signal is selected from the list consisting of a mud pulse, a radio signal, a high frequency signal, a low frequency signal, and combinations thereof.
17. A perforating system disposable in a wellbore comprising:  
a perforating gun;

a communication module configured to receive commands from the surface while disposed within a wellbore; and

a perforating gun controller in selective communication with the communication module.

18. The perforating system of claim 17, wherein the perforating gun controller is configured to initiate perforating gun detonation in response to communication from the communication module.
19. The perforating system of claim 17, wherein the perforating gun controller comprises a controller module and a receiver.
20. The perforating system of claim 17, further comprising a perforating gun initiator.
21. The perforating system of claim 20, wherein the initiator is responsive to commands from the perforating gun controller.
22. The perforating system of claim 20, wherein the initiator is pressure actuated.
23. The perforating system of claim 22, further comprising a control valve actuatable by the controller and in pressure communication with the wellbore and the initiator.
24. The perforating system of claim 23, wherein the control valve selectively communicates wellbore pressure to the initiator.
25. The perforating system of claim 17, wherein the communication module is configured to emit signals selected from the list consisting of a mud pulse signal, a radio signal, a high frequency signal, a low frequency signal, and combinations thereof.
26. The perforating system of claim 17 further comprising a conveyance member.

27. The perforating system of claim 26, wherein the conveyance member is selected from the list consisting of a wireline, tubing, coiled tubing, and a slickline.
28. A method of wellbore perforating with a perforating string conveyed in a wellbore, wherein the perforating string comprises a communication module, a shaped charge, and a controller in detonating communication with the shaped charge, said method comprising:
  - transmitting a first signal to the communication module;
  - transmitting a second signal from the communication module to the controller based on the first signal content; and
  - initiating shaped charge detonation based on the second signal.
29. The method of wellbore perforating of claim 28 wherein the second signal is wireless.
30. The method of wellbore perforating of claim 29, wherein the wireless signal is selected from the list consisting of a mud pulse, a radio signal, a high frequency signal, a low frequency signal, and combinations thereof.
31. The method of wellbore perforating of claim 28 further comprising communicating wellbore pressure to a pressure activated shaped charge initiator.
32. The method of wellbore perforating of claim 28 wherein the perforating string comprises perforating guns having shaped charges and a perforating gun controller associated with each perforating gun.

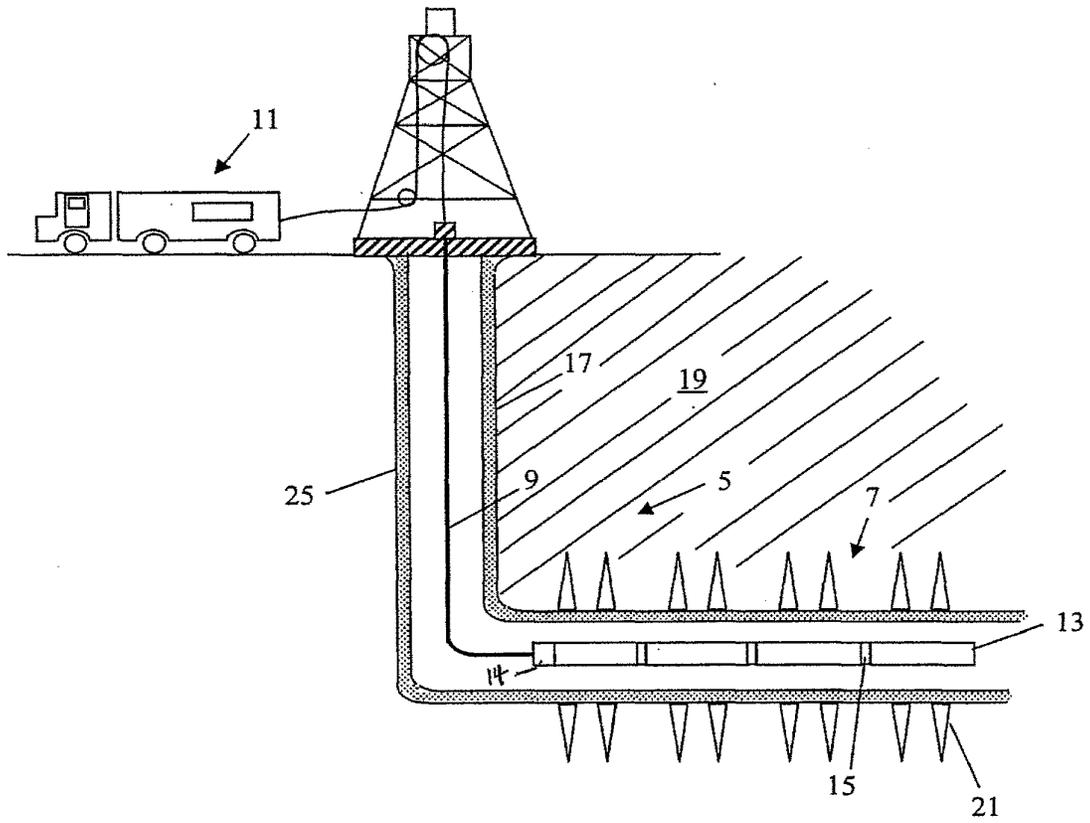


FIG. 1

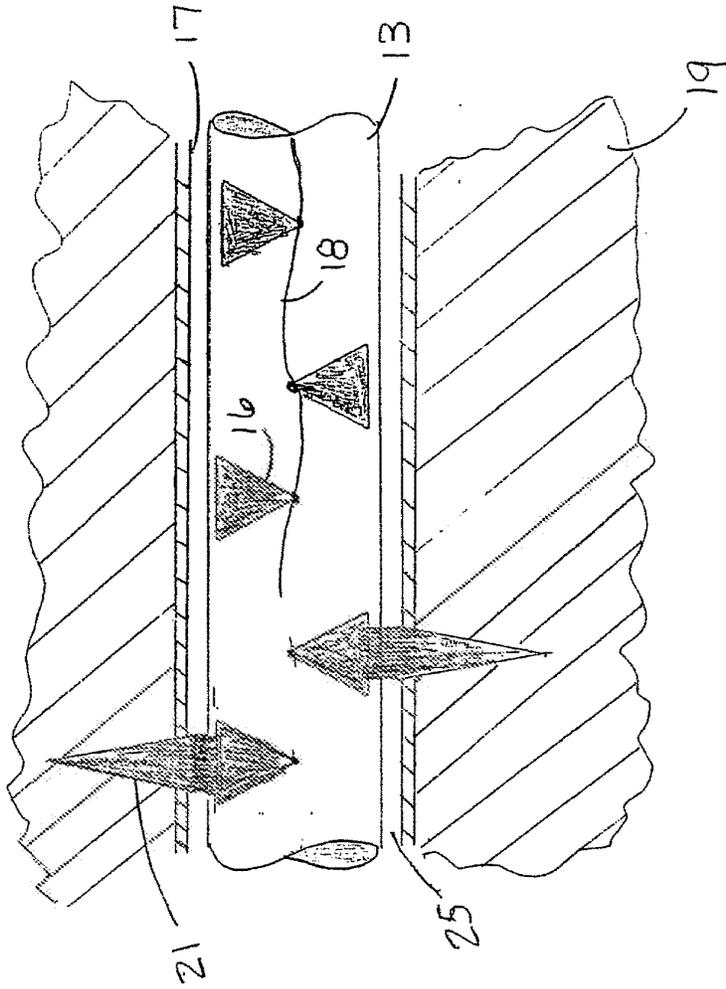


FIG. 2

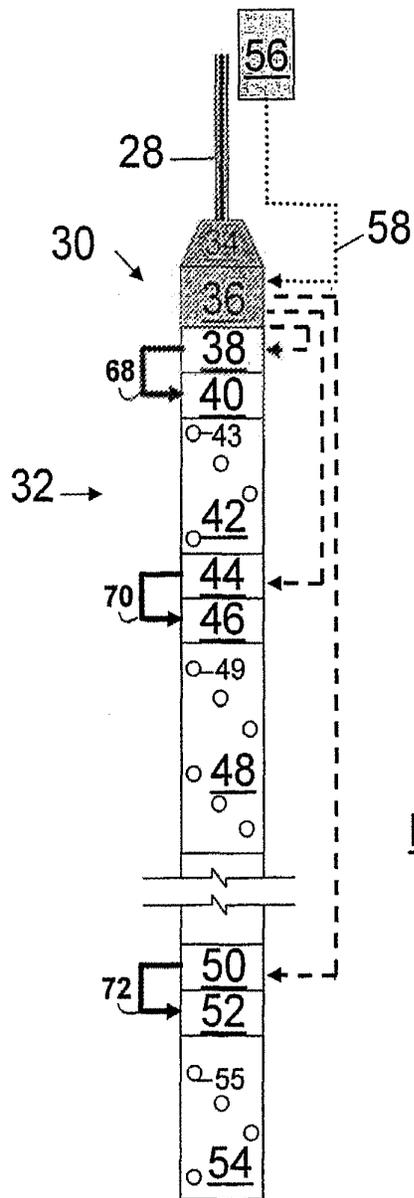


FIG. 3

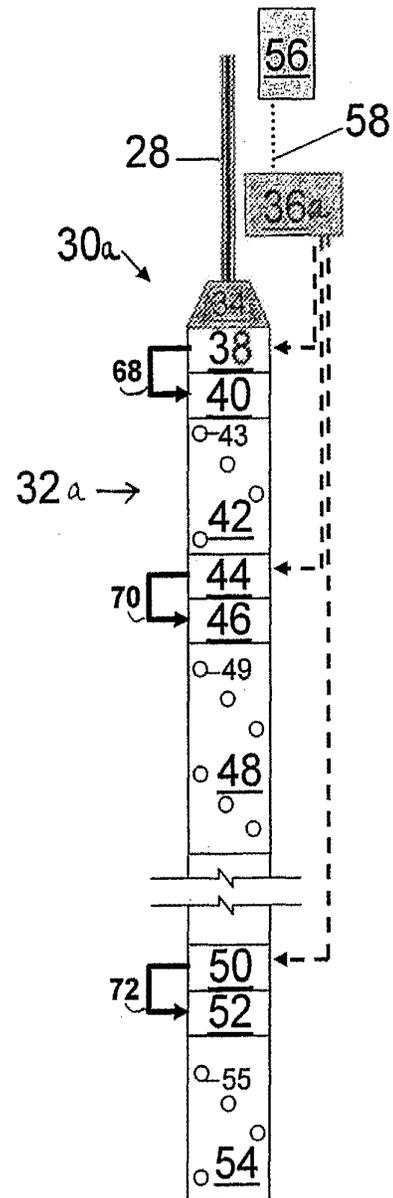
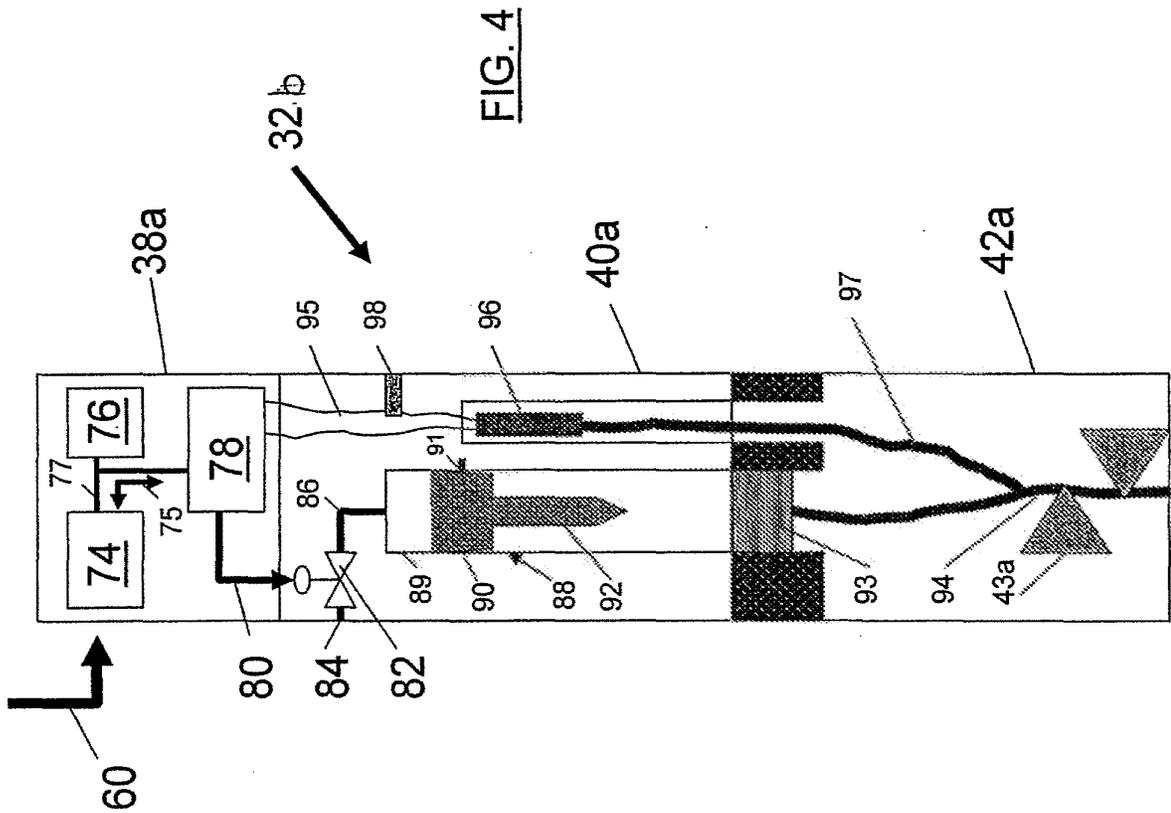


FIG. 3a





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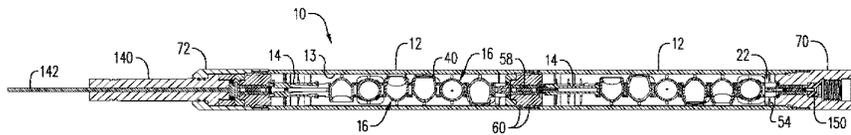
**Declarations under Rule 4.17:**

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
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(54) Title: PERFORATION GUN COMPONENTS AND SYSTEM



**FIG. 1**

(57) Abstract: A perforation gun system based on combinations of basic components including a top connector, a self-centralizing charge holder system and a bottom connector that can double as a spacer. Any number of spacers can be used with any number of holders for any desired specific metric or imperial shot density, phase and length gun system. A perforation gun system kit as well as a method of assembling a perforation gun system is also disclosed.



WO 2015/006869 A1

## PERFORATION GUN COMPONENTS AND SYSTEM

### Field of the Invention

The invention generally relates to perforation gun systems. More particularly, the invention relates to various perforation gun components that can be modularly assembled into a perforation gun system, the assembled perforated gun system itself, a perforation gun system kit, and a method for assembling a perforation gun system.

### Background of the Invention

Perforation gun systems are used in well bore perforating in the oil and natural gas industries to tie a bore hole with a storage horizon within which a storage reservoir of oil or natural gas is located.

A typical perforation gun system consists of an outer gun carrier, arranged in the interior of which there are perforators-usually hollow or projectile charges-that shoot radially outwards through the gun carrier after detonation. Penetration holes remain in the gun carrier after the shot.

In order to ignite the perforators, there is a detonating cord leading through the gun carrier that is coupled to a detonator.

Different perforating scenarios often require different phasing and density of charges or gun lengths. Moreover, it is sometimes desirable that the perforators shooting radially outwards from the gun carrier be oriented in different directions along the length of the barrel. Therefore, phasing may be required between different guns along the length.

Onsite assembly of perforation gun systems may also be problematic under certain conditions as there are certain safety hazards inherent to the assembly of perforation guns due to the explosive nature of certain of its sub-components, including the detonator and the detonating cord.

There is thus a need for a perforation gun system, which by virtue of its design and components would be able to address at least one of the above-mentioned needs, or overcome or at least minimize at least one of the above-mentioned drawbacks.

### Summary of the Invention

The object of the invention is to provide a perforation gun system that addresses at least one of the above-mentioned needs.

According to the invention, there is provided a perforation gun system having an outer gun carrier and comprising:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connected to the top connector and to each stackable charge holder;
- at least one bottom connector for terminating the detonation cord in the gun system; and
- a detonator energetically coupled to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a rotation coupling for providing a selectable clocking rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

In some embodiments, the bottom connector may double as a spacer for spacing a plurality of stackable charge holders, and may either act as a metric dimensioned spacer or as an imperial dimensioned spacer for any specific metric or imperial shot density, phase and length gun system.

According to another aspect of the invention, there is also provided a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:

- a top connector;

- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

According to another aspect of the invention, there is also provided a method for assembling a perforation gun system, comprising the steps of:

- (a) providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:
  - a top connector;
  - at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
  - a detonation cord connectable to the top connector and to each stackable charge holder;
  - at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and
  - a detonator energetically couplable to the detonation cord,wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;
- (b) assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;
- (c) running the detonation cord into a bottommost bottom connector;

- (d) assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;
- (e) running connecting wire between the bottommost bottom connector and the top connector;
- (f) clicking the detonation cord into capturing projections provided in each of the charge holders;
- (g) running the detonation cord into the top connector;
- (h) cutting the detonator cord; and
- (i) installing charges into each of the charge holders.

A number of optional steps that are detailed below may be added to the above-described steps of the method.

According to another aspect of the invention, there is also provided a top connector for a perforation gun system comprising:

- a coupler for providing energetic coupling between a detonator and a detonating cord;
- at least one directional locking fin for locking the top connector within a gun carrier;
- a rotation coupling for providing a selectable clocking rotation between the top connector, and a charge holder

wherein the top connector is configured to receive electrical connections therethrough.

According to another aspect of the invention, there is also provided a stackable charge holder for a perforation gun system having an outer gun carrier, the charge holder comprising:

- a charge receiving structure for receiving a single shaped charge;
- a plurality of projections for centralizing the shaped charge within the gun carrier;
- and
- at least one rotation coupling for providing a selectable clocking rotation between the charge holder and an adjacent component in the perforation gun system;

wherein a pair of the plurality of projections is configured for capturing a detonation cord traversing the charge holder.

According to another aspect of the invention, there is also provided a bottom connector for a perforation gun system comprising:

- a terminating structure arranged for terminating a detonation cord in the gun system;
- a plurality of wings for axially locking the bottom connector to a snap ring fixed in the carrier.
- a rotation coupling for providing a selectable clocking rotation between the bottom connector and a charge holder;

wherein the rotation coupling is arranged such that bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.

### **Brief Description of the Drawings**

These and other objects and advantages of the invention will become apparent upon reading the detailed description and upon referring to specific embodiments thereof that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, exemplary embodiments of the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a side cut view of a perforation gun system according to an embodiment of the invention.

Figure 2 is a side view of a top connector, bottom connector and stackable charge holders of a perforation gun system in accordance with another embodiment of the invention.

Figure 3 is a side view of a top connector, bottom connector and stackable charge holders of a perforation gun system in accordance with another embodiment of the invention.

Figure 4 is a front perspective view of a bottom connector in accordance with an embodiment of the invention.

Figure 5 is a rear perspective view of the bottom connector shown in Figure 4.

Figure 6 is a front view of a stackable charge holder in accordance with an embodiment of the invention.

Figure 7 is a front perspective view of the stackable charge holder shown in Figure 6.

Figure 8 is a rear perspective view of the stackable charge holder shown in Figure 6.

Figure 9 is a bottom view of the stackable charge holder shown in Figure 6.

Figure 10 is a top view of the stackable charge holder shown in Figure 6.

Figure 11 is a bottom view of a half-portion of a top connector in accordance with an embodiment of the invention.

Figure 12 is a side view of the half-portion of the top connector shown in Figure 11.

Figure 13 is a top perspective view of the half-portion of the top connector shown in Figure 11.

Figure 14 is a bottom perspective view of the half-portion of the top connector shown in Figure 11.

Figure 15 is a perspective view of a top connector in accordance with an embodiment of the invention.

Figure 16 is a front end view of the top connector shown in Figure 15.

Figure 17 is a rear end view of the top connector shown in Figure 15.

Figure 18 is a rear perspective view of the top connector shown in Figure 15.

Figure 19 is an enlarged detailed side cut view of a portion of the perforation gun system including a bulkhead and stackable charge holders shown in Figure 1.

Figure 20 is a perspective view of a bottom sub of a gun system in accordance with an embodiment of the invention.

Figure 21 is a side view of a gun carrier of a gun system in accordance with an embodiment of the invention.

Figure 22 is a side cut view of the gun carrier shown in Figure 21.

Figure 23 is a side view of a top sub of a gun system in accordance with an embodiment of the invention.

Figure 24 is a side cut view of the top sub shown in Figure 23.

Figure 25 is a side view of a tandem seal adapter of a gun system in accordance with an embodiment of the invention.

Figure 26 is a perspective view of the tandem seal adapter shown in Figure 25.

Figure 27 is a perspective view of a detonator in accordance with an embodiment of the invention.

Figure 28 is a detailed perspective view of the detonator shown in Figure 27.

Figure 29 is another detailed perspective view of the detonator shown in Figure 27.

Figure 30 is another detailed perspective view of the detonator shown in Figure 27.

Figure 31 is another detailed perspective view of the detonator shown in Figure 27, with a crimp sleeve.

Figure 32 is a detailed side view of a tandem seal adapter and detonator in accordance with another embodiment of the invention.

Figure 33 is a side cut view of a portion of a perforation gun system illustrating the configuration of the top sub in accordance with another embodiment of the invention.

Figure 34 is a side cut view of a portion of a perforation gun system illustrating the configuration of the bottom sub in accordance with another embodiment of the invention.

Figures 35A and 35B are electrical schematic views of a detonator and of wiring within a perforated gun system in accordance with another embodiment of the invention.

### **Detailed Description of the Invention**

In the following description and accompanying figures, the same numerical references refer to similar elements throughout the figures and text. Furthermore, for the sake of simplicity and clarity, namely so as not to unduly burden the figures with several reference numbers, only certain figures have been provided with reference numbers, and components and features of the invention illustrated in other figures can be easily inferred therefrom. The embodiments, geometrical configurations, and/or dimensions shown in the figures are preferred for exemplification purposes only. Various features, aspects and advantages of the embodiments will become more apparent from the following detailed description.

Moreover, although the invention was primarily designed for well bore perforating, for example, it may also be used in other perforating scenarios or in other fields, as apparent to a person skilled in the art. For this reason, expressions such as “gun system”, etc., as used herein should not be taken as to limit the scope of the invention and includes all other kinds of materials, objects and/or purposes with which the invention could be used and may be useful. Each example or embodiment are provided by way of explanation of the invention, and is not meant as a limitation of the invention and does not constitute a definition of all possible embodiments.

In addition, although the embodiment of the invention as illustrated in the accompanying drawings comprises various components and although the embodiment of the adjustment system as shown consists of certain geometrical configurations as explained and illustrated herein, not all of these components and geometries are essential to the invention and thus should not be taken in their restrictive sense, i.e. should not be taken as to limit the scope of the invention. It is to be understood, as also apparent to a person skilled in the art, that other suitable components and cooperations thereinbetween, as well as other suitable geometrical configurations may be used for the adjustment systems, and corresponding parts, according to the invention, as briefly explained and as can easily be inferred herefrom by a person skilled in the art, without departing from the scope of the invention.

Referring to Figures 1 to 3, an object of the invention is to provide a perforation gun system 10 having an outer gun carrier 12. The gun system 10 includes a top connector 14. At least one stackable charge holder 16 is provided for centralizing a single shaped charge 18 within the gun carrier 12. A detonation cord 20 is connected to the top connector 14 and to each stackable charge holder 16.

The gun system 10 includes at least one bottom connector 22 for terminating the detonation cord 20 in the gun system. As better shown in Figure 2, it is also possible that the bottom connector 22 double as or serve the function of a spacer 24 for spacing a plurality of stackable charge holders 16.

The gun system also includes a detonator 26 energetically coupled to the detonation cord 20.

As better shown in Figures 4 to 18, each of the top connector 14, stackable charge holder 16 and bottom connector 22 includes a rotation coupling 30 for providing a selectable clocking rotation between each of the above-mentioned components.

Hence a user can build multiple configurations of gun systems using various combinations of basic components. A first of these basic components includes a top connector. Another basic component is a single charge holder that centralizes a single shaped charge. The holder is adapted to be stacked and configured into 0, 30, 60, up to

360 degrees or any other combination of these phases for any specified length. Another basic component is a bottom connector that terminates the detonation cord in the gun. The bottom connector may carry as well an electrical connection therethrough. The bottom connector may also double as an imperial measurement stackable spacer to provide any gun shot density up to, for example, 6 shots per foot. Alternately, another bottom connector may be provided or configured to double as a metric measurement stackable spacer to provide any gun shot density up to, for example, 20 shots per meter. Another basic component includes a push-in detonator that does not use wires to make necessary connections. The push-in detonator may use spring-loaded connectors, thus replacing any required wires and crimping.

Therefore, within the self-centralizing charge holder system, any number of spacers can be used with any number of holders for any specific metric or imperial shot density, phase and length gun system.

In an embodiment, only two pipe wrenches are required for assembly on site of the gun system, as no other tools are required.

In an embodiment, the top connector 14 provides energetic coupling between the detonator and detonating cord.

In an embodiment, each of the top connector 14, stackable charge holder 16 and bottom connector 22 are configured to receive electrical connections therethrough.

In an embodiment, all connections are made by connectors, such as spring-loaded connectors, instead of wires, with the exception of the through wire that goes from the top connector 14 to the bottom connector 22, whose ends are connectors.

In an embodiment, components of the assembly may include molded parts, which may also be manufactured to house the wiring integrally, through, for instance, overmolding, to encase the wiring and all connectors within an injection molded part. For example, the charge holder 16 could be overmolded to include the through wire.

In an embodiment, as shown in Figures 4 and 5, each bottom connector 22 includes a plurality of fins 32 for axially locking each bottom connector against a snap ring 54, or an equivalent retainment mechanism to keep the charge holder 16 from sliding out of the bottom of carrier 12 as it is handled. (shown on Figure 1). The bottom connector 22 from a first gun assembly can accommodate or house an electrical connection through a bulkhead assembly 58 to the top connector 14 of a second or subsequent gun assembly, as seen for instance in Figure 19. The top and bottom connector, as well as the spacer, in an embodiment, are made of 15% glass fiber reinforced, injection molding PA6 grade material, commercially available from BASF under its ULTRAMID® brand, and can provide a positive snap connection for any configuration or reconfiguration. As better shown in Figure 5, a terminating means structure 34 is provided to facilitate terminating of the detonation cord. The snap ring 54 is preinstalled on the bottom of the carrier 12. The assembly can thus shoulder up to the snap ring 54 via the bottom connector fins 32.

In an embodiment and as shown in Figures 6 to 10, each stackable charge holder 16 has a plurality of projections 40 resting against an inner surface 13 or diameter of the gun carrier 12 (as shown in Figure 1) and thereby centralizing the shaped charge therewithin. A pair of the plurality of projections 42 may also be configured for capturing the detonation cord (not shown) traversing each stackable charge holder 16. The projections 42 are also used for centralizing the shaped charge within an inner surface of the gun carrier.

In an embodiment, as shown in Figures 11 to 18, the top connector 14 includes at least one directional locking fin 46. Although the use of directional locking fins is described, other methods of directional locking may be used, in order to eliminate a top snap ring that would otherwise be used to lock the assembly. As better shown in Figure 19, the locking fins 46 are engageable with corresponding complementarily-shaped structures 47 housed within the carrier 12, upon a rotation of the top connector 14, to lock the position of the top connector along the length of the carrier 12.

In an embodiment, as better shown in Figure 19, the bottom connector 22 on one end and the top connector 14 on the other end abuts/connects to the bulkhead assembly 58 for grounding the detonator 26 within the gun carrier 12, through grounding means, depicted herein as a tandem seal adapter 48 (see also Figures 25 and 26). The tandem

seal adapter 48 is configured to seal the inner components within the carrier 12 from the outside environment, using sealing means 60 (shown herein as o-rings). Thus, the tandem seal adapter 48 seals the gun assemblies from each other along with the bulkhead 58, and transmits a ground wire to the carrier 12. Hence, the top connector 14 and bulkhead 58 accommodate electrical and ballistic transfer to the charges of the next gun assembly for as many gun assembly units as required, each gun assembly unit having all the components of a gun assembly.

In an embodiment, the tandem seal adapter 48 is a two-part tandem seal adapter (not shown) that fully contains the bulkhead assembly 58 (comprised of multiple small parts as shown, for instance, in Fig. 19) and that is reversible such that it has no direction of installation.

In an embodiment and as better shown in Figures 27-31 and 35A, the detonator assembly 26 includes a detonator head 100, a detonator body 102 and a plurality of detonator wires 104, including a through wire 106, a signal-in wire 108 and a ground wire 110. The through wire 106 traverses from the top to the bottom of the perforating gun system 10, making a connection at each charge holder 16. The detonator head 100 further includes a through wire connector element 112 connected to the through wire 106 (not shown), a ground contact element 114 for connecting the ground wire 110 to the tandem seal adapter (also not shown), through ground springs 116, and a bulkhead connector element 118 for connecting the signal-in wire 108 to the bulkhead assembly 58 (also not shown). Different insulating elements 120A, 120B are also provided in the detonator head 100 for the purpose of insulating the detonator head 100 and detonator wires 104 from surrounding components. As better shown in Figure 31, a crimp sleeve 122 can be provided to cover the detonator head 100 and body 102, thus resulting in a more robust assembly. The above configuration allows the detonator to be installed with minimal tooling and wire connections.

In an embodiment as shown in Figures 32, 33 and 35B illustrate a connection and grounding of the above-described detonator assembly 26 through the tandem seal adapter 48 and a pressure bulkhead 124. The bulkhead 124 includes spring connector end interfaces comprising contact pins 126A, 126B, linked to coil springs 128A, 128B. This dual spring pin connector assembly including the bulkhead 124 and coil springs

128A, 128B is positioned within the tandem seal adapter 48 extending from a conductor slug 130 to the bulkhead connector element 118. The dual spring pin connector assembly is connected to the through wire 106 of the detonator assembly 26.

In an embodiment and as better shown in Figures 11 to 18, the top connector 14 may have a split design to simplify manufacturing and aid in assembly. By "split design" what is meant is that the top connector 14 can be formed of two halves - a top half 15A and a bottom half 15B. As better shown in Figures 15 or 18, the top connector 14 may also include a blind hole 47 to contain or house the detonation cord, thus eliminating the need for crimping the detonation cord during assembly.

In an embodiment and as shown for example in Figures 4 to 18, the rotation coupling 30 may either include a plurality of pins 50 (Figure 5) symmetrically arranged about a central axis of the rotation coupling 30, or a plurality of sockets 52 (Figure 4) symmetrically arranged about the central axis of the rotation coupling 30 and configured to engage the plurality of pins 50 of an adjacent rotation coupling 30.

In another embodiment, the rotation coupling 30 may either include a polygon-shaped protrusion, or a polygon-shaped recess configured to engage the polygon-shaped protrusion of an adjacent rotation coupling. The polygon can be 12-sided for example for 30 degree increments.

In another embodiment of the invention, the top and bottom subs work with off the shelf running/setting tools as would be understood by one of ordinary skill in the art.

In one embodiment and as shown in Figure 33, the top sub 72 facilitates use of an off the shelf quick change assembly 140 to enable electrical signals from the surface, as well as to adapt perforating gun system to mechanically run with conventional downhole equipment. The quick change assembly 140 may include a threaded adapter 143 to set an offset distance between an electrical connector 142 and the contact pin 126B extending from the bulkhead assembly 58.

In one embodiment and as shown in Figure 34, the bottom sub 70 may be configured as a sealing plug shoot adapter (SPSA) to be used specifically with this embodiment of the

invention. The SPSA may receive an off the shelf quick change assembly 140 (not shown) and insulator 150 that communicates with a firing head threaded below it (not shown). A setting tool (not shown) may run on the bottom side of the perforating gun.

In an embodiment, final assembly of the tool string requires only two pipe wrenches. No tools are required to install the detonator or any electrical connections.

An object of the invention is to also provide a perforation gun system kit having the basic component parts described above and capable of being assembled within an outer gun carrier.

The invention also provides a method for assembling a perforation gun system, to which a certain number of optional steps may be provided. The steps for assembling the gun system for transport include the steps of:

(a) providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier (element 12 in Figures 1, 21 and 22), the kit comprising a combination of:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and
- a detonator energetically couplable to the detonation cord, wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;

(b) assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;

(c) running the detonation cord into a bottommost bottom connector;

- (d) assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;
- (e) running connecting wire between the bottommost bottom connector and the top connector;
- (f) clicking the detonation cord into capturing projections provided in each of the charge holders;
- (g) running the detonation cord into the top connector;
- (h) cutting the detonator cord, if the detonator cord is not pre-cut a predetermined length; and
- (i) installing charges into each of the charge holders.

In an embodiment, the method further includes, prior to transport, the steps of:

- (j) pushing assembled components together to engage all pin connections therebetween; and
- (k) carrying out a continuity test to ensure complete connectivity of the detonating chord.

In an embodiment, on location, to complete the assembly, the method further comprises the steps of

- (l) threading on the previously assembled components a bottom sub (element 70 on Figures 1 and 20);
- (m) installing and connecting the detonator;
- (n) pushing in a tandem seal adapter with o-rings onto the first gun assembly;
- (o) pushing in a bulkhead (element 58 in Figure 19) onto the tandem seal adapter, if the bulkhead and the tandem seal adapter are not pre-assembled;
- (p) threading a subsequent gun assembly onto the first gun assembly or threading a top sub (element 72 in Figures 1, 23 and 24) onto a topmost assembled gun assembly, for connection to a quick change assembly.

Of course, the scope of the invention should not be limited by the various embodiments set forth herein, but should be given the broadest interpretation consistent with the description as a whole. The components and methods described and illustrated are not limited to the specific embodiments described herein, but rather, features illustrated or described as part of one embodiment can be used on or in conjunction with other

embodiments to yield yet a further embodiment. Further, steps described in the method may be utilized independently and separately from other steps described herein. Numerous modifications and variations could be made to the above-described embodiments without departing from the scope of the invention and claims, as apparent to a person skilled in the art.

In this specification and the claims that follow, reference will be made to a number of terms that have the following meanings. The singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Further, reference to "top," "bottom," "front," "rear," and the like are made merely to differentiate parts and are not necessarily determinative of direction. Similarly, terms such as "first," "second," etc. are used to identify one element from another, and unless otherwise specified are not meant to refer to a particular order or number of elements.

As used herein, the terms "may" and "may be" indicate a possibility of an occurrence within a set of circumstances; a possession of a specified property, characteristic or function; and/or qualify another verb by expressing one or more of an ability, capability, or possibility associated with the qualified verb. Accordingly, usage of "may" and "may be" indicates that a modified term is apparently appropriate, capable, or suitable for an indicated capacity, function, or usage, while taking into account that in some circumstances the modified term may sometimes not be appropriate, capable, or suitable. For example, in some circumstances an event or capacity can be expected, while in other circumstances the event or capacity cannot occur--this distinction is captured by the terms "may" and "may be."

As used in the claims, the word "comprises" and its grammatical variants logically also subtend and include phrases of varying and differing extent such as for example, but not limited thereto, "consisting essentially of" and "consisting of."

Advances in science and technology may make equivalents and substitutions possible that are not now contemplated by reason of the imprecision of language; these variations should be covered by the appended claims. This written description uses examples to disclose the invention, including the best mode, and also to enable any person of ordinary skill in the art to practice the invention, including making and using

any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those of ordinary skill in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

## CLAIMS

1. A perforation gun system having an outer gun carrier and comprising:
  - a top connector;
  - at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
  - a detonation cord connected to the top connector and to each stackable charge holder;
  - at least one bottom connector for terminating the detonation cord in the gun system; and
  - a detonator energetically coupled to the detonation cord,wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a rotation coupling for providing a selectable clocking rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.
2. The perforation gun system according to claim 1, wherein the at least one bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.
3. The perforation gun system according to claim 2, wherein the at least one bottom connector doubles as a metric-dimensioned spacer.
4. The perforation gun system according to claim 2, wherein the at least one bottom connector doubles as an imperial-dimensioned spacer.
5. The perforation gun system according to any one of claims 1 to 4, wherein the top connector provides energetic coupling between the detonator and the detonating cord.
6. The perforation gun system according to any one of claims 1 to 5, wherein the detonator is a wireless push-in detonator with spring loaded connectors.

7. The perforation gun system according to any one of claims 1 to 6, wherein each of the top connector, the at least one stackable charge holder and the at least one bottom connector are configured to receive electrical connections therethrough.
8. The perforation gun system according to claim 7, wherein the electrical connections between the top connector, the at least one charge holder, the at least one bottom connector and the detonator are spring-loaded quick connections.
9. The perforation gun system according to any one of claims 1 to 8, wherein each bottom connector comprises a plurality of fins for axially locking each bottom connector to a snap ring.
10. The perforation gun system according to any one of claims 1 to 9, wherein each stackable charge holder comprises a plurality of projections resting against an inner surface of the gun carrier and thereby centralizing the shaped charge therewithin.
11. The perforation gun system according to claim 10, wherein a pair of the plurality of projections is configured for capturing the detonation cord traversing each stackable charge holder.
12. The perforation gun system according to any one of claims 1 to 11, wherein the top connector comprises at least one directional axial locking fin.
13. The perforation gun system according to any one of claims 1 to 12, wherein the top connector comprises a tandem seal adapter for grounding the detonator to the gun carrier.
14. The perforation gun system according to any one of claims 1 to 13, wherein the top connector comprises a blind hole for containing the detonation cord.
15. The perforation gun system according to any one of claims 1 to 14, wherein the top connector is formed by assembling first and second halves of an unassembled top connector.

16. The perforation gun system according to any one of claims 1 to 15, wherein the rotation coupling is selected from the group comprising a plurality of pins symmetrically arranged about a central axis of the rotation coupling, and a plurality of sockets symmetrically arranged about the central axis of the rotation coupling and configured to engage the plurality of pins of an adjacent rotation coupling.

17. The perforation gun system according to any one of claims 1 to 15, wherein the rotation coupling is selected from the group comprising a polygon-shaped protrusion, and a polygon-shaped recess configured to engage the polygon-shaped protrusion of an adjacent rotation coupling.

18. The perforation gun system according to any one of claims 1 to 17, further comprising a material overmolded over wiring and connectors of the top connector, the at least one charge holder, and the at least one bottom connector.

19. A perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

20. A method for assembling a perforation gun system, comprising the steps of:  
(a) providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:  
-a top connector;

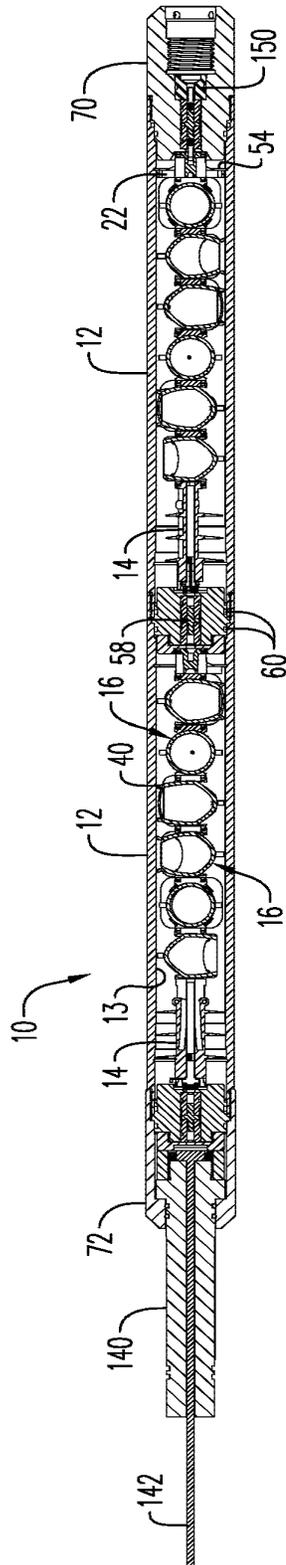
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
  - a detonation cord connectable to the top connector and to each stackable charge holder;
  - at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and
  - a detonator energetically couplable to the detonation cord, wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;
- (b) assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;
- (c) running the detonation cord into a bottommost bottom connector;
- (d) assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;
- (e) running connecting wire between the bottommost bottom connector and the top connector;
- (f) clicking the detonation cord into capturing projections provided in each of the charge holders;
- (g) running the detonation cord into the top connector;
- (h) cutting the detonator cord, if the detonator cord is not precut a predetermined length; and
- (i) installing charges into each of the charge holders.
21. The method according to claim 20, further comprising the steps of:
- (j) pushing assembled components together to engage all pin connections therebetween; and
  - (k) carrying out a continuity test.

22. The method according to claim 21, further comprising the steps of:
- (l) threading on the previously assembled components a bottom sub;
  - (m) installing and connecting the detonator;
  - (n) pushing in a tandem sub with o-rings onto the first gun assembly;
  - (o) pushing in a bulkhead onto the tandem sub, if the bulkhead and the tandem seal adapter are not pre-assembled;
  - (p) threading a subsequent gun assembly onto the first gun assembly or threading a top sub onto a topmost assembled gun assembly.
23. A top connector for a perforation gun system comprising:
- a coupler for providing energetic coupling between a detonator and a detonating cord;
  - at least one directional locking fin for locking the top connector within a gun carrier;
  - a rotation coupling for providing a selectable clocking rotation between the top connector, and a charge holder
- wherein the top connector is configured to receive electrical connections therethrough.
24. A stackable charge holder for a perforation gun system having an outer gun carrier, the charge holder comprising:
- a charge receiving structure for receiving a single shaped charge;
  - a plurality of projections for centralizing the shaped charge within the gun carrier;
  - and
  - at least one rotation coupling for providing a selectable clocking rotation between the charge holder and an adjacent component in the perforation gun system;
- wherein a pair of the plurality of projections is configured for capturing a detonation cord traversing the charge holder.
25. The stackable charge holder according to claim 24, wherein the at least one rotation coupling is selected from the group comprising a plurality of pins symmetrically arranged about a central axis of the rotation coupling, and a plurality of sockets symmetrically arranged about the central axis of the rotation coupling and configured to engage the plurality of pins.

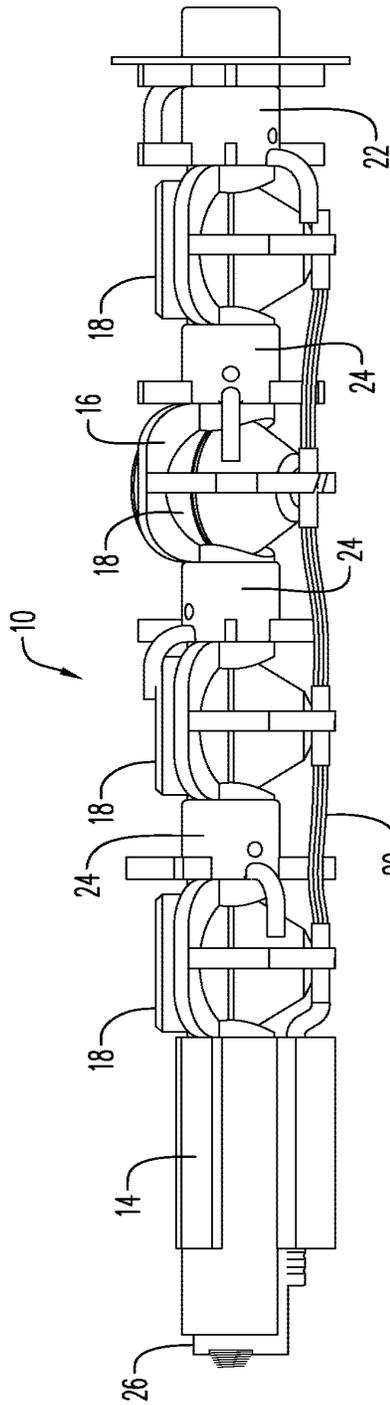
26. A bottom connector for a perforation gun system comprising:
- a terminating structure arranged for terminating a detonation cord in the gun system;
  - a plurality of wings for axially locking the bottom connector to a snap ring.
  - a rotation coupling for providing a selectable clocking rotation between the bottom connector and a charge holder;

wherein the rotation coupling is arranged such that bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.

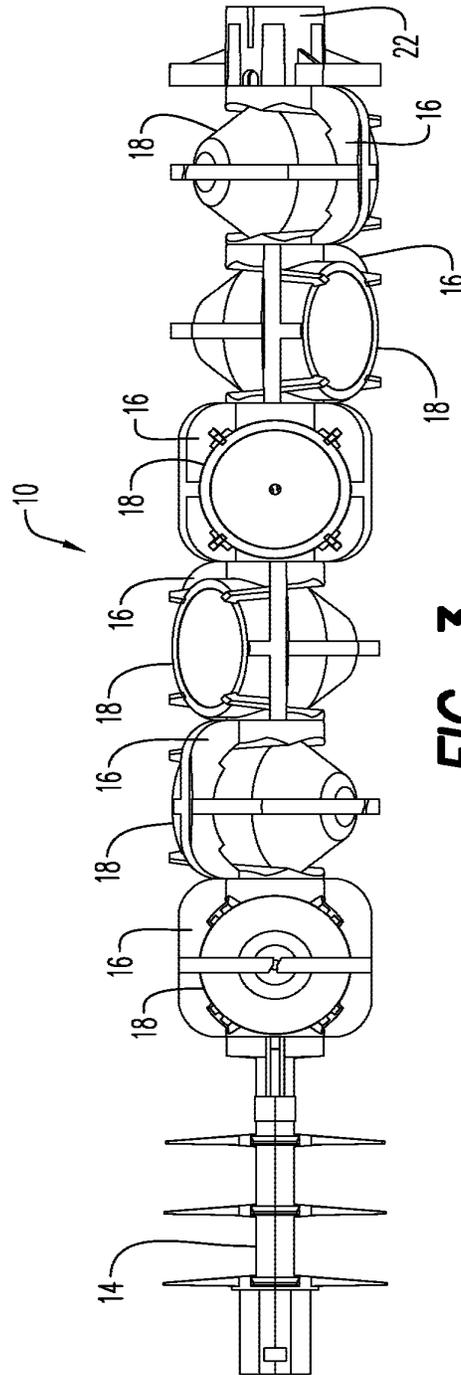
1/18



**FIG. 1**



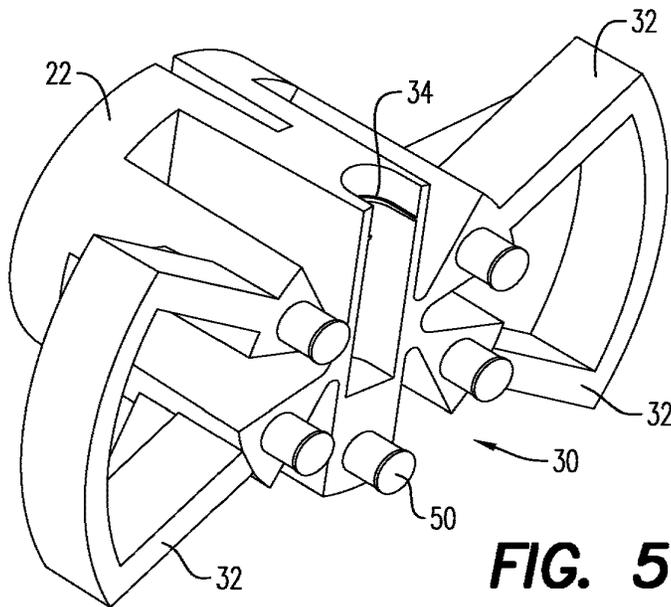
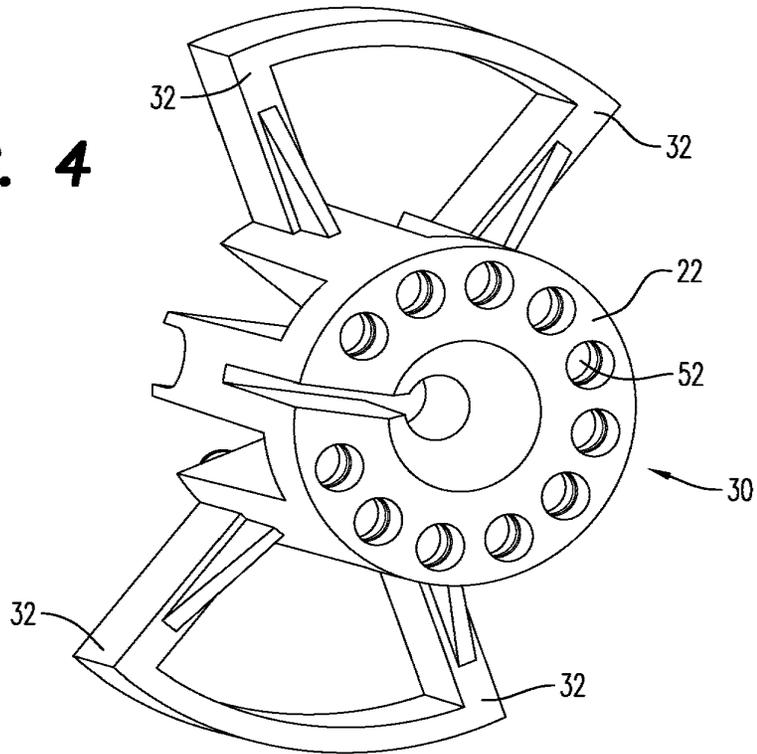
**FIG. 2**



**FIG. 3**

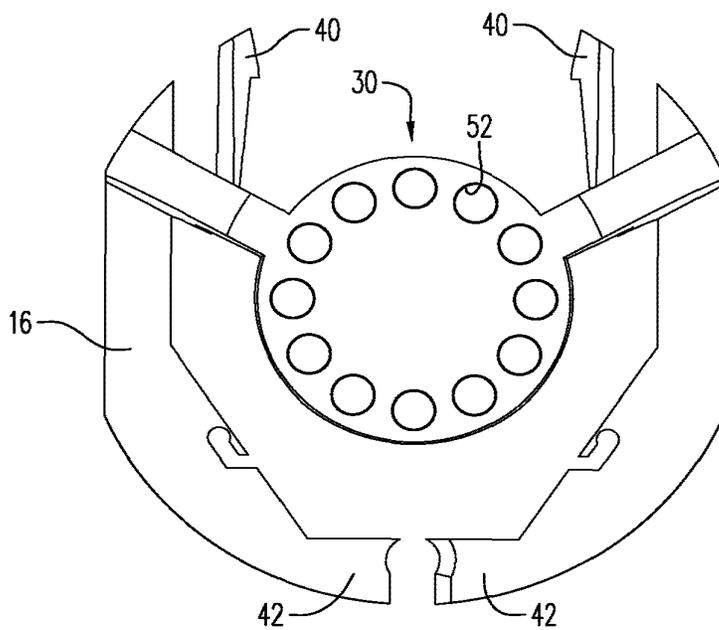
3/18

**FIG. 4**

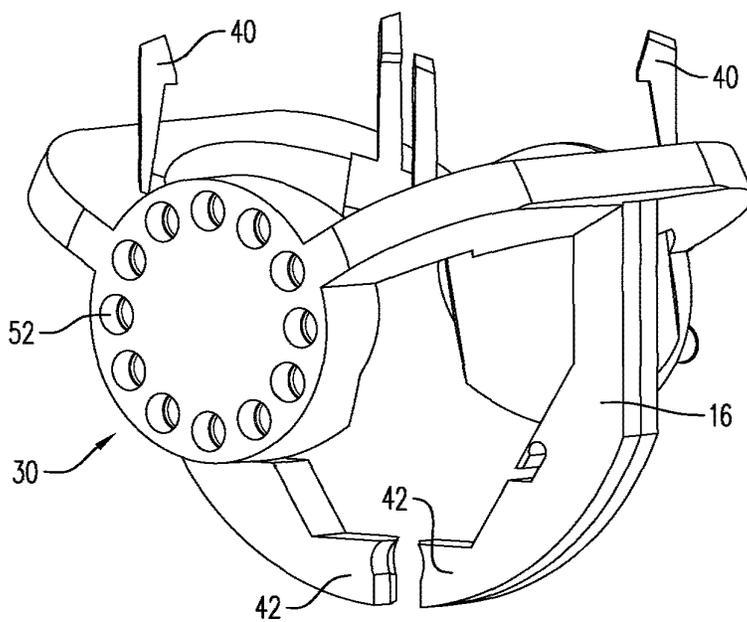


**FIG. 5**

4/18

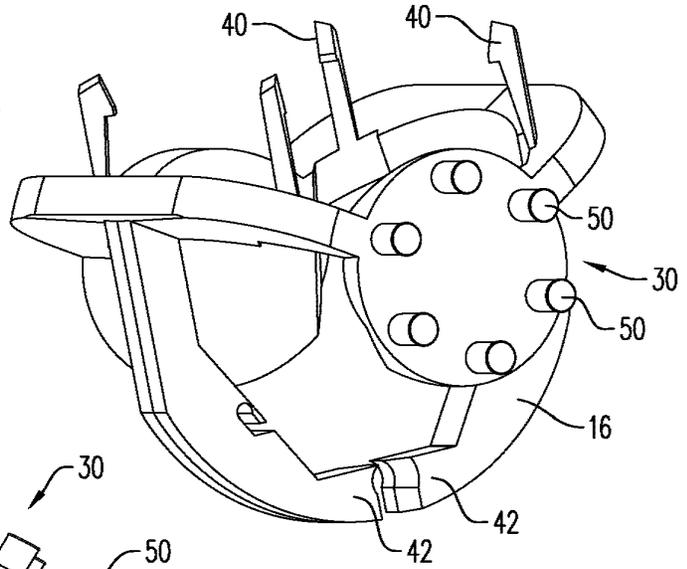


**FIG. 6**

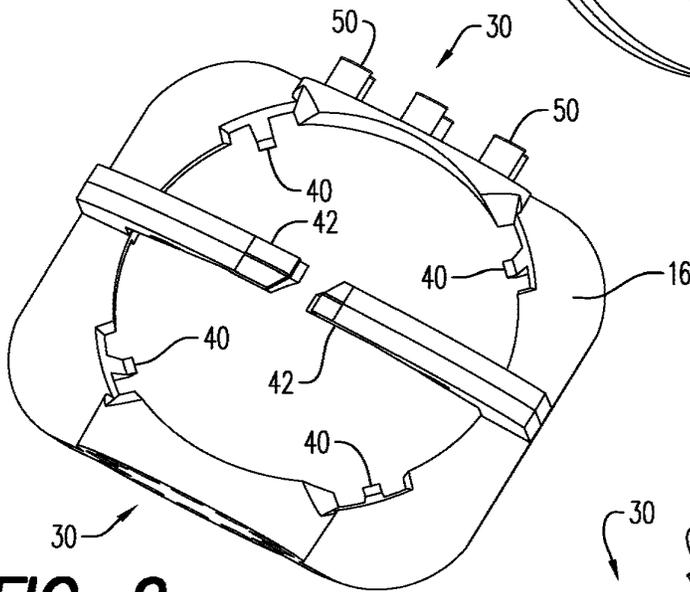


**FIG. 7**

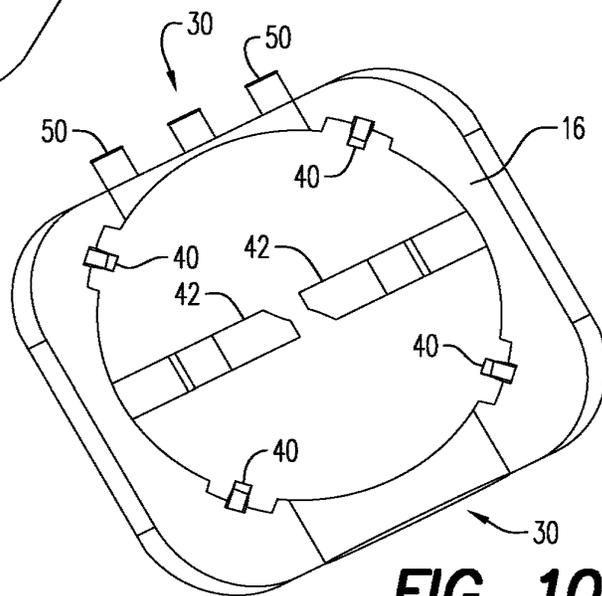
**FIG. 8**



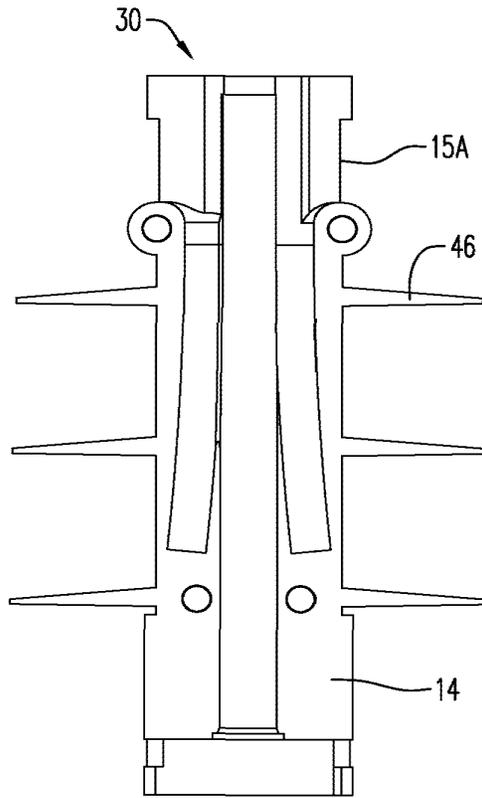
**FIG. 9**



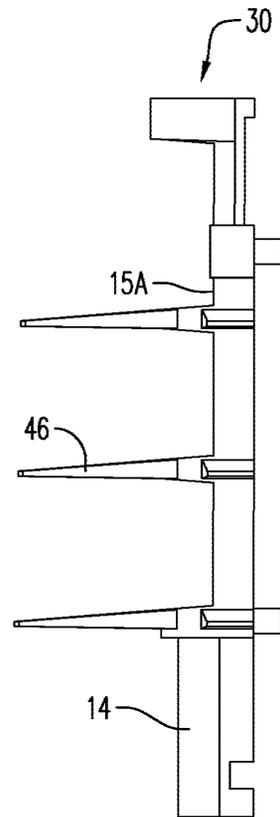
**FIG. 10**



6/18

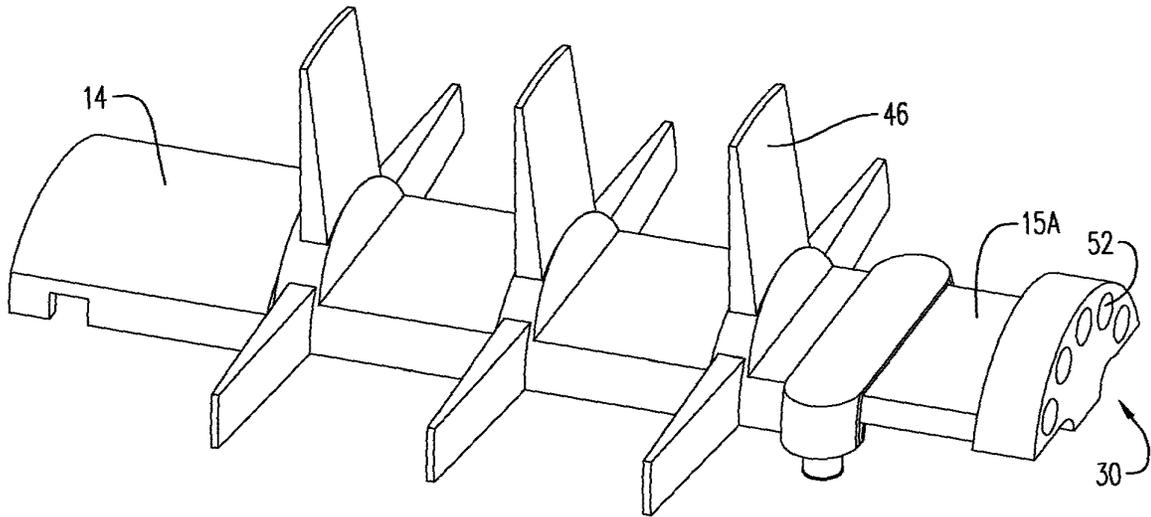


**FIG. 11**

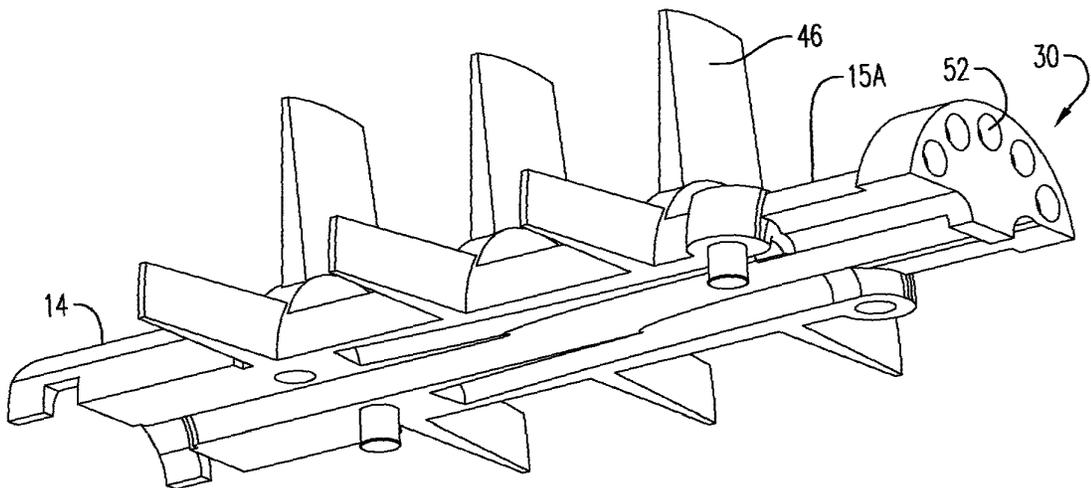


**FIG. 12**

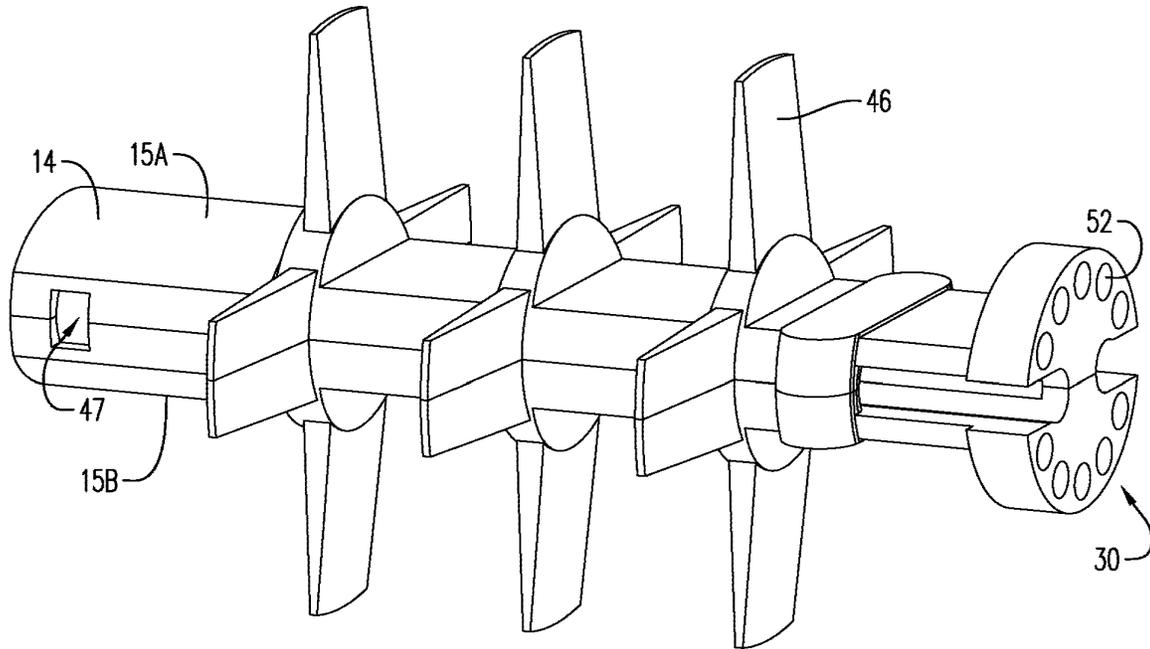
7/18



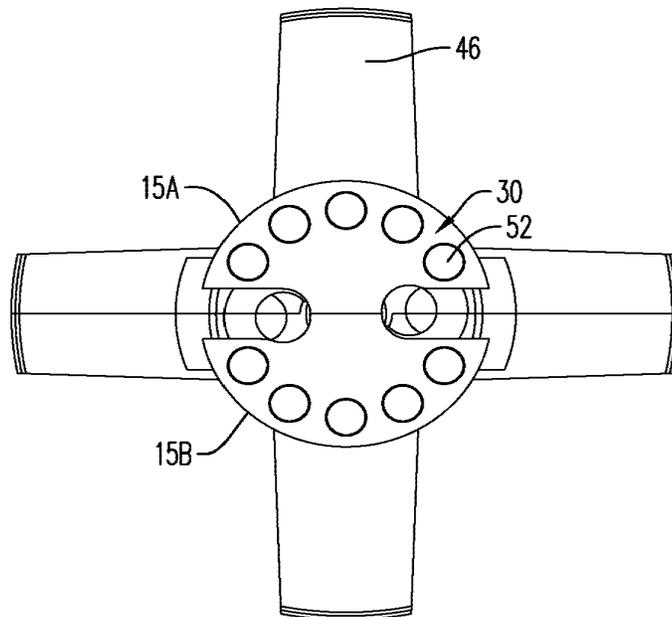
**FIG. 13**



**FIG. 14**

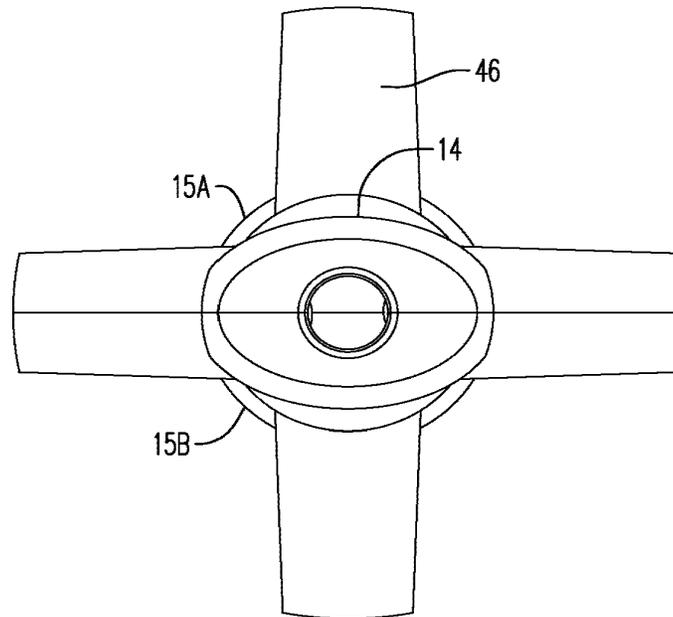


**FIG. 15**

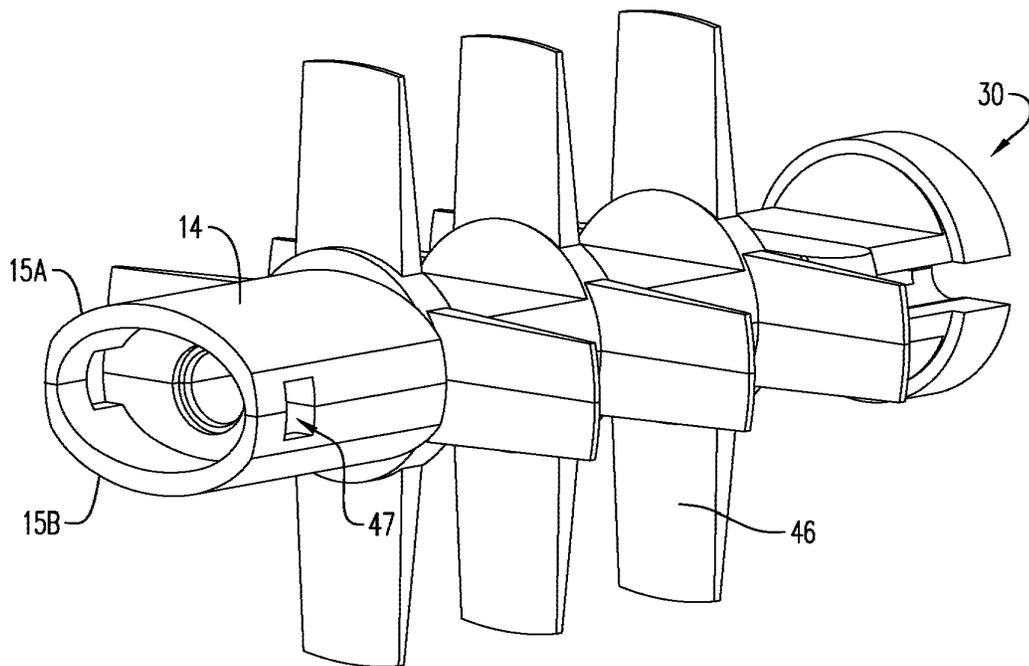


**FIG. 16**

9/18

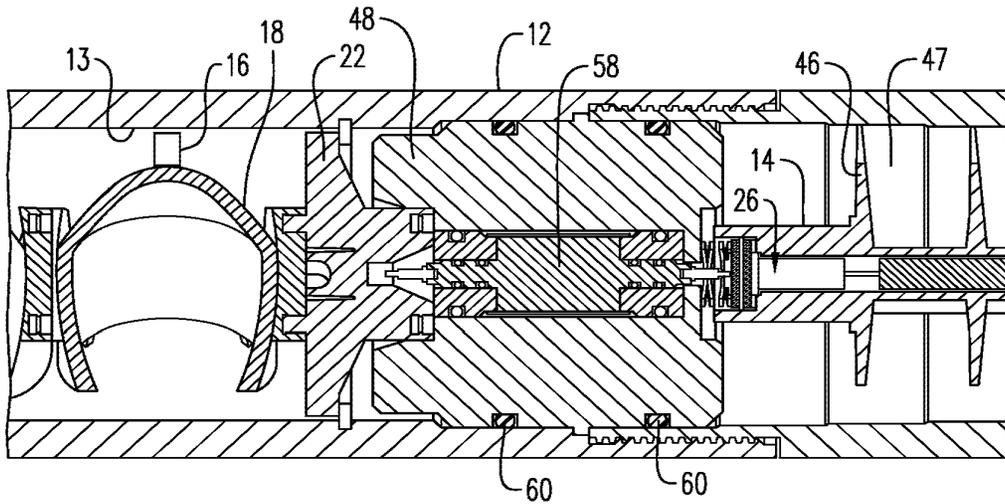


**FIG. 17**

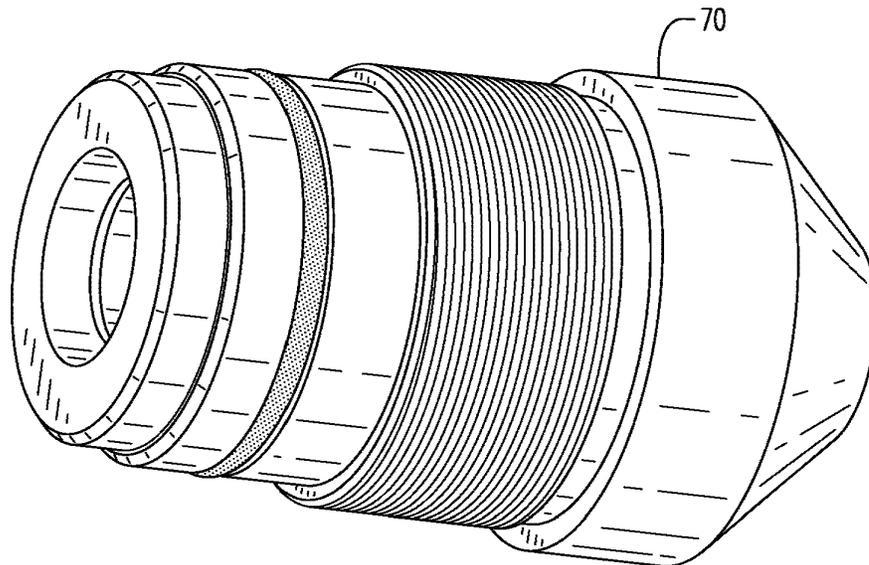


**FIG. 18**

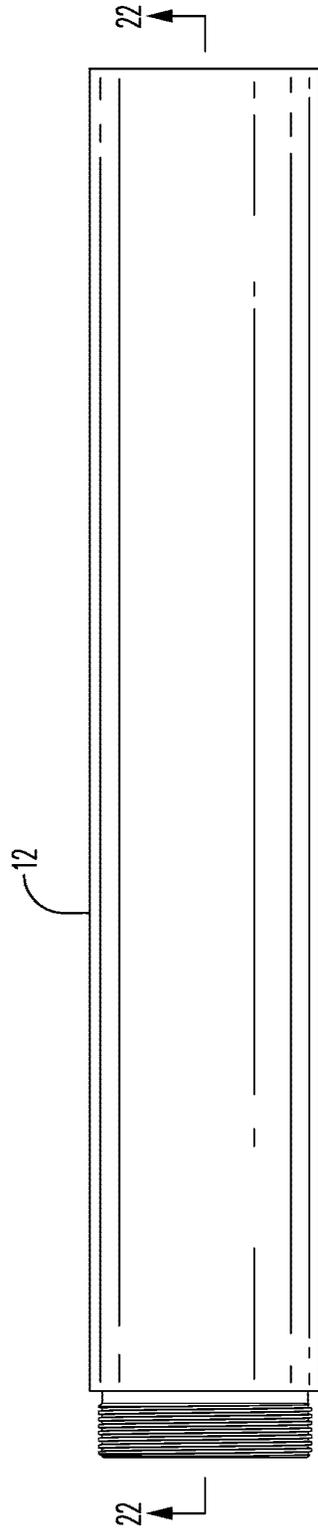
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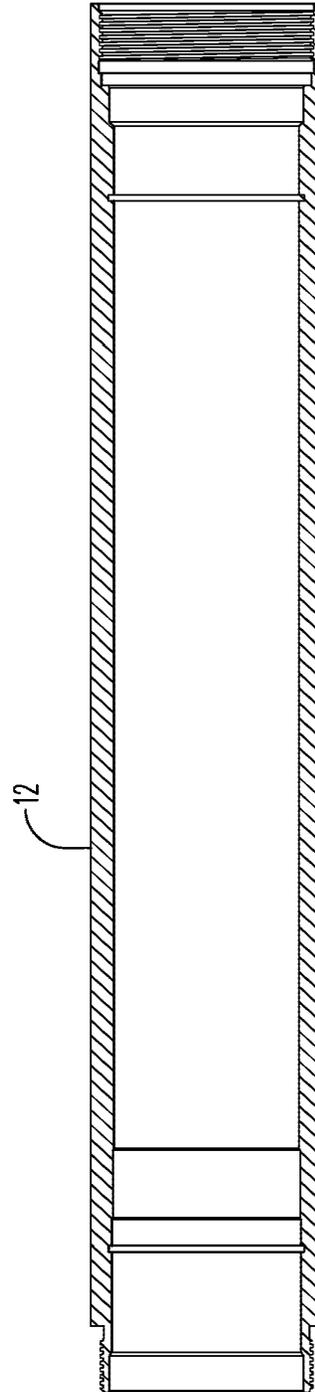
**FIG. 19**



**FIG. 20**

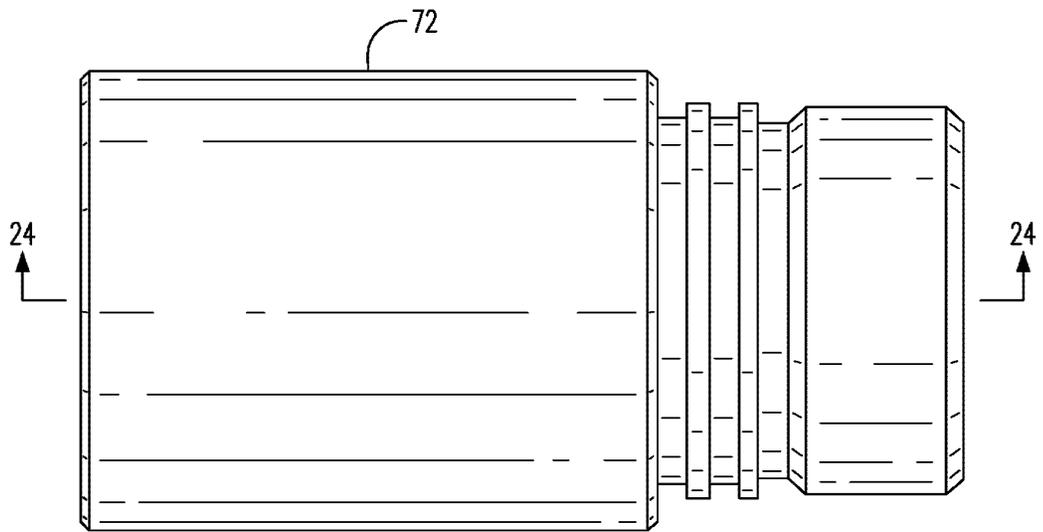


**FIG. 21**

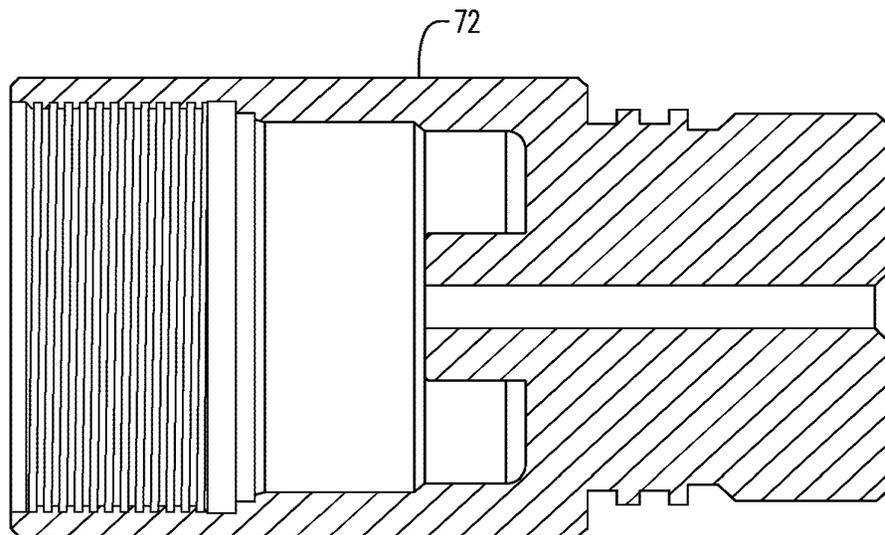


**FIG. 22**

12/18

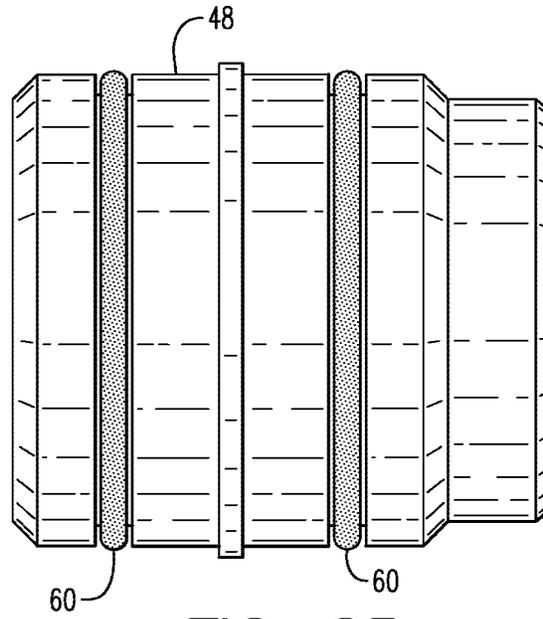


**FIG. 23**

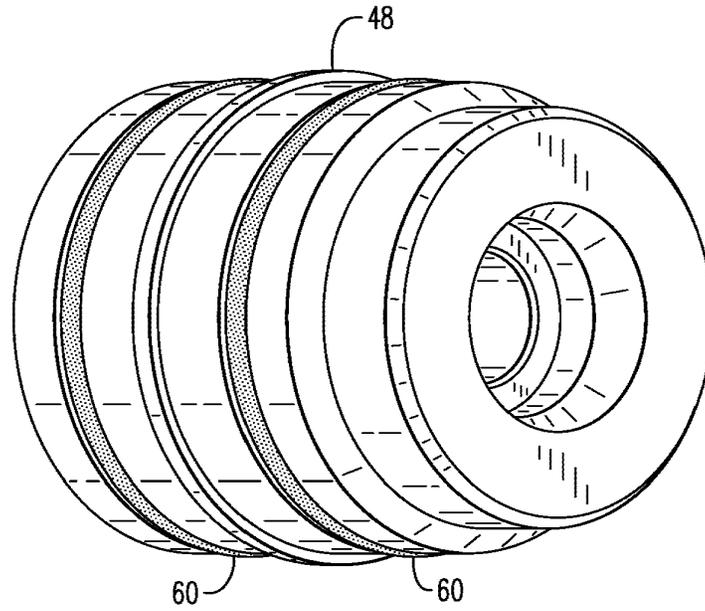


**FIG. 24**

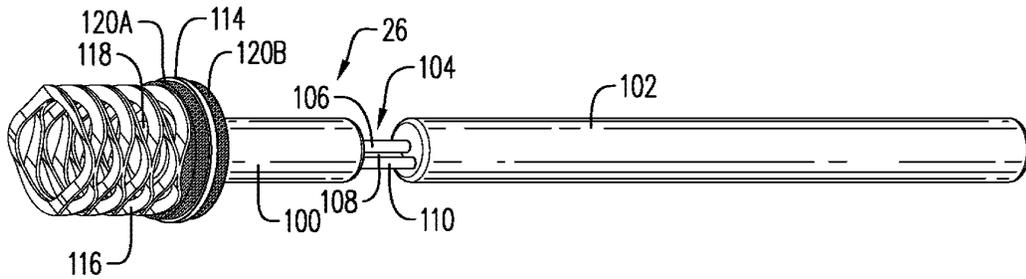
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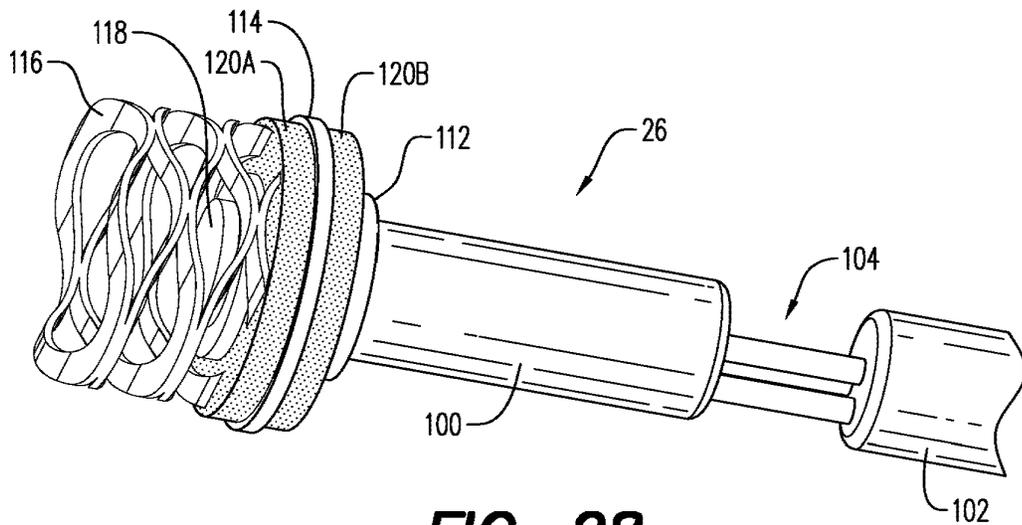
**FIG. 25**



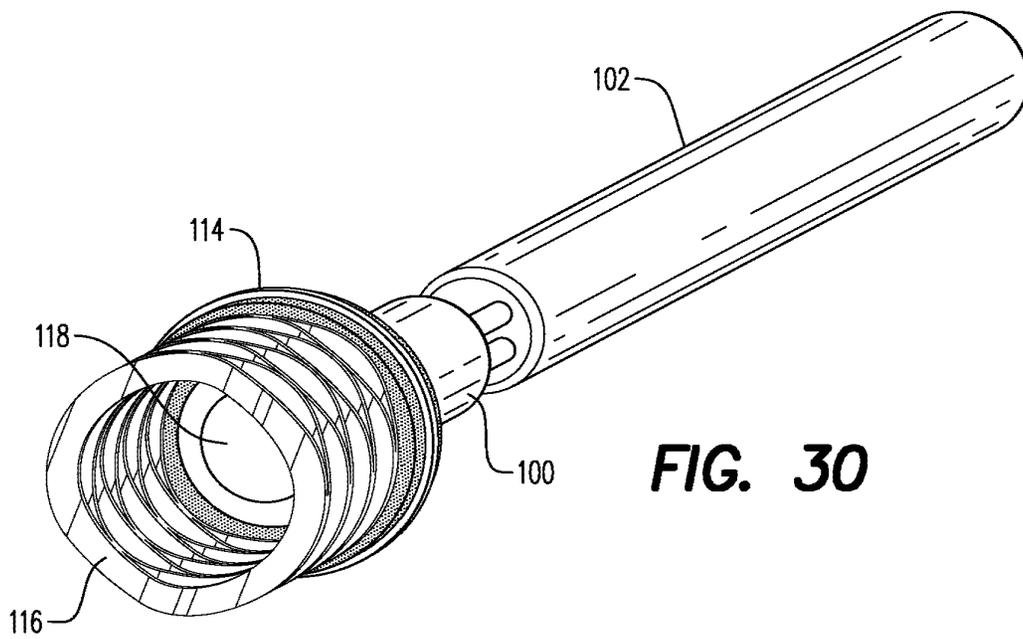
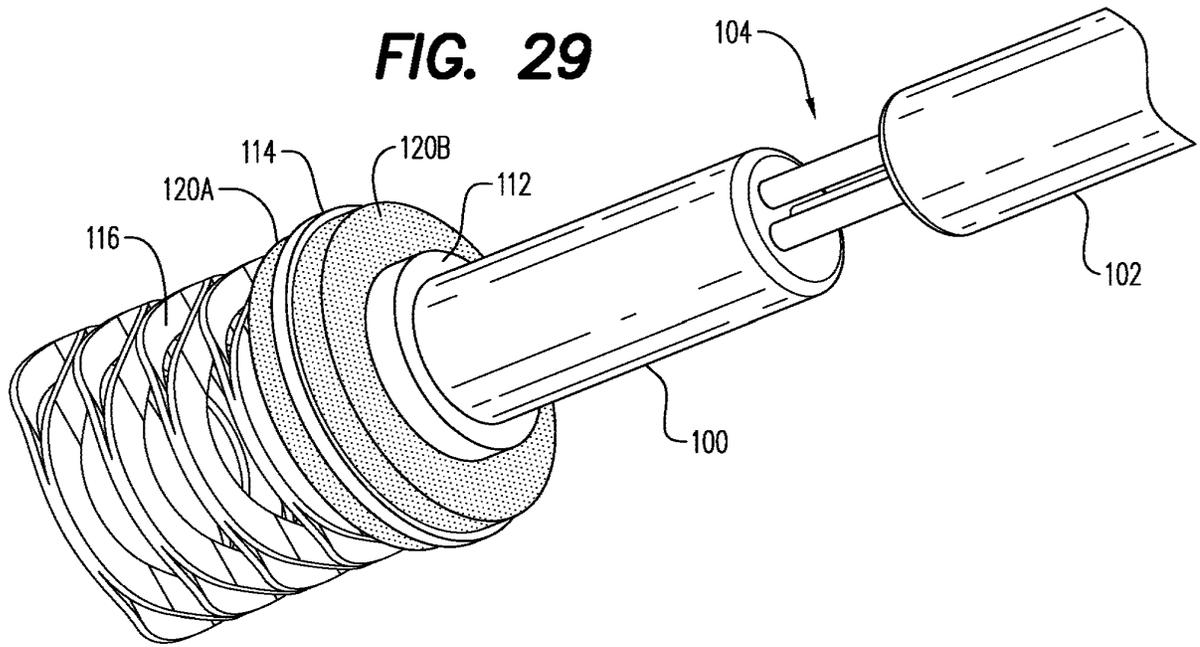
**FIG. 26**



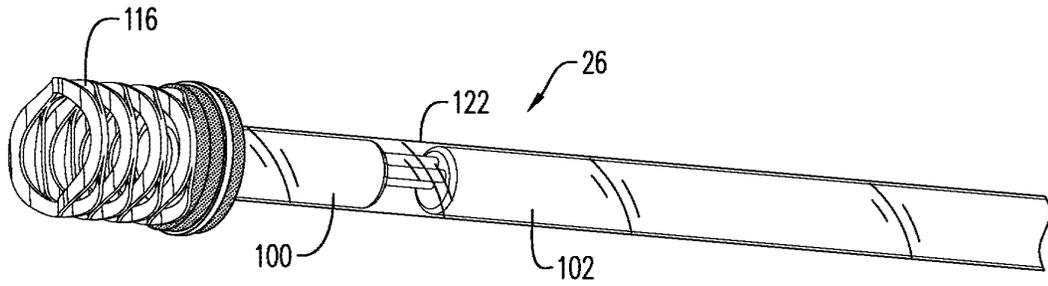
**FIG. 27**



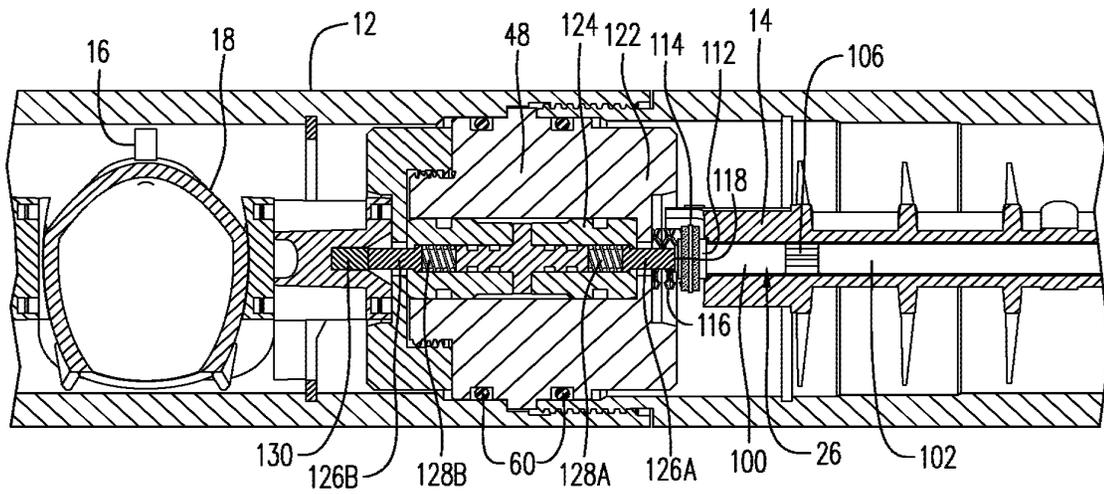
**FIG. 28**



16/18

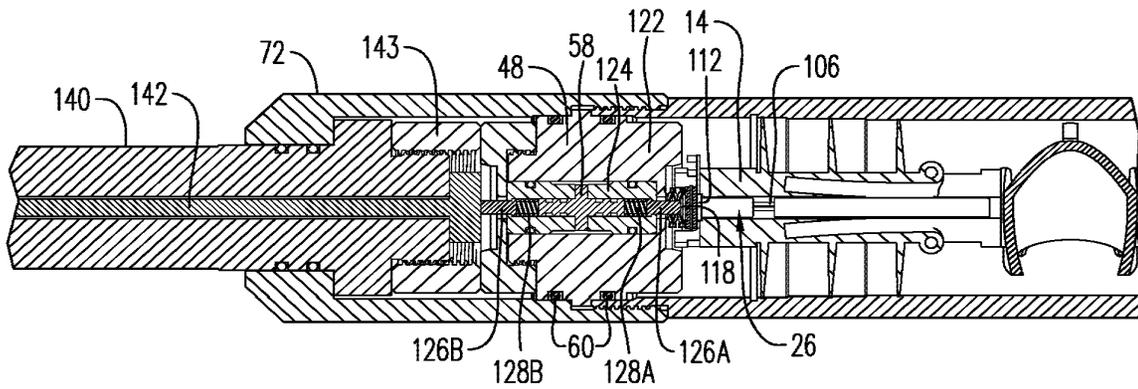


**FIG. 31**

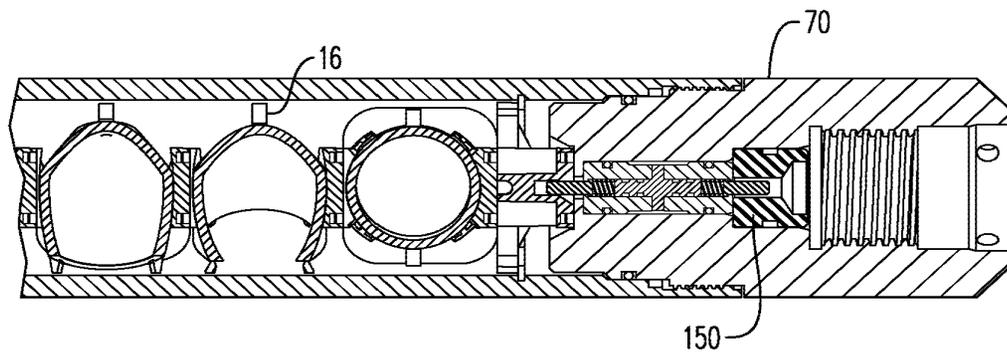


**FIG. 32**

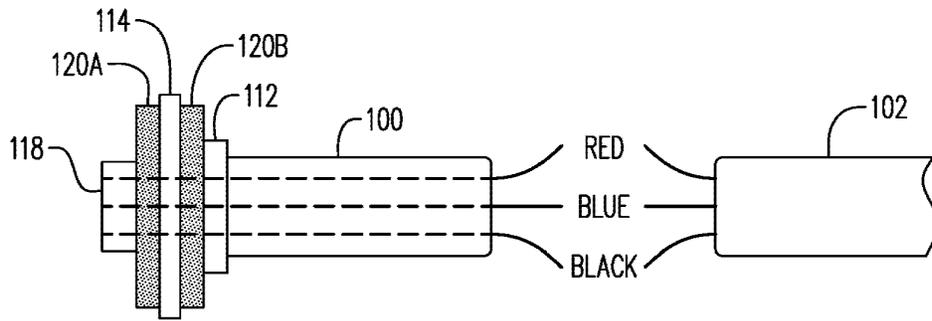
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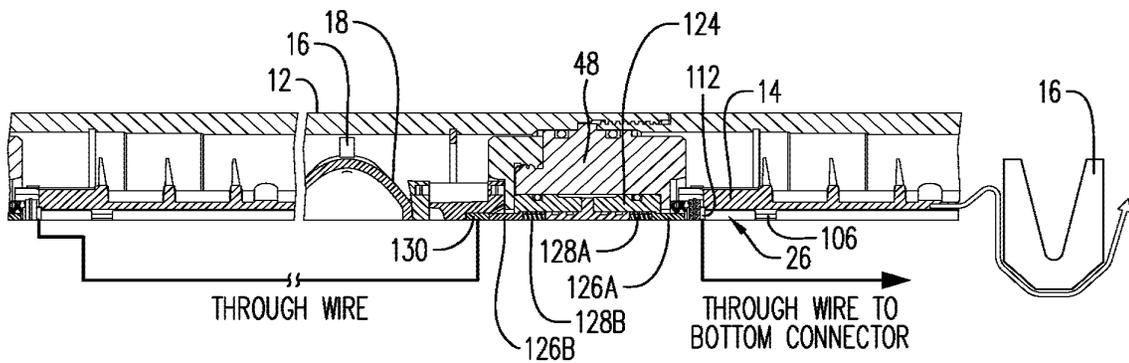
**FIG. 33**



**FIG. 34**



**FIG. 35A**



**FIG. 35B**

**INTERNATIONAL SEARCH REPORT**

International application No.  
**PCT/CA2014/050673**

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC: <b>E21B 43/116</b> (2006.01)</p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>																	
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) <b>E21B 43/116</b> (2006.01)</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used) TotalPatent, Questel-Orbit (Fampat) (Keywords: gun, perforating, charge, holder, cord, detonator, explosive)</p>																	
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:10%;">Category*</th> <th style="width:60%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width:30%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td align="center">X</td> <td>US 4598775 A (VANN, R. R., et al.) 08 July 1986 (08-07-1986) *Abstract; Figs. 1-9; Col. 1, line 10 – Col. 7, line 36; Claims*</td> <td align="center">1 to 8, 10, 17, 19, 20 to 22, 24</td> </tr> <tr> <td align="center">A</td> <td>US 7762351 B2 (VIDAL, M.) 27 July 2010 (27-07-2010) *Whole document*</td> <td align="center">1 to 26</td> </tr> <tr> <td align="center">A</td> <td>US 2008149338 A1 (GOODMAN, K., et al.) 26 June 2008 (26-06-2008) *Whole document*</td> <td align="center">1 to 26</td> </tr> <tr> <td align="center">A</td> <td>US 2012298361A1 (SAMPSON, T. W.) 29 November 2012 (29-11-2012) *Whole document*</td> <td align="center">1 to 26</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 4598775 A (VANN, R. R., et al.) 08 July 1986 (08-07-1986) *Abstract; Figs. 1-9; Col. 1, line 10 – Col. 7, line 36; Claims*	1 to 8, 10, 17, 19, 20 to 22, 24	A	US 7762351 B2 (VIDAL, M.) 27 July 2010 (27-07-2010) *Whole document*	1 to 26	A	US 2008149338 A1 (GOODMAN, K., et al.) 26 June 2008 (26-06-2008) *Whole document*	1 to 26	A	US 2012298361A1 (SAMPSON, T. W.) 29 November 2012 (29-11-2012) *Whole document*	1 to 26
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C.      <input checked="" type="checkbox"/> See patent family annex.</p>																	
<p>* 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</p>	<p>"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 "&amp;" document member of the same patent family</p>																
<p>Date of the actual completion of the international search 23 September 2014 (23-09-2014)</p>		<p>Date of mailing of the international search report 09 October 2014 (09-10-2014)</p>															
<p>Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476</p>		<p>Authorized officer  <b>Colin Watts (819) 934-9085</b></p>															

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

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Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US 4598775 A	08 July 1986 (08-07-1986)	None	
US 7762351 B2	27 July 2010 (27-07-2010)	US2010089643A1 MX2011003709A WO2010043941A1	15 April 2010 (15-04-2010) 25 May 2011 (25-05-2011) 22 April 2010 (22-04-2010)
US 2008149338 A1	26 June 2008 (26-06-2008)	US2008149338A1 US7762331B2 AU2007338622A1 AU2007338622B2 BRPI0720365A2 CA2673082A1 CN101454635A GB0910392D0 GB2457208A GB2457208B MX2009006516A NO20092492A RU2009128048A RU2434122C2 US2010252323A1 WO2008079481A1	26 June 2008 (26-06-2008) 27 July 2010 (27-07-2010) 03 July 2008 (03-07-2008) 06 September 2012 (06-09-2012) 01 July 2014 (01-07-2014) 03 July 2008 (03-07-2008) 10 June 2009 (10-06-2009) 29 July 2009 (29-07-2009) 12 August 2009 (12-08-2009) 15 June 2011 (15-06-2011) 10 July 2009 (10-07-2009) 16 September 2009 (16-09-2009) 27 January 2011 (27-01-2011) 20 November 2011 (20-11-2011) 07 October 2010 (07-10-2010) 03 July 2008 (03-07-2008)
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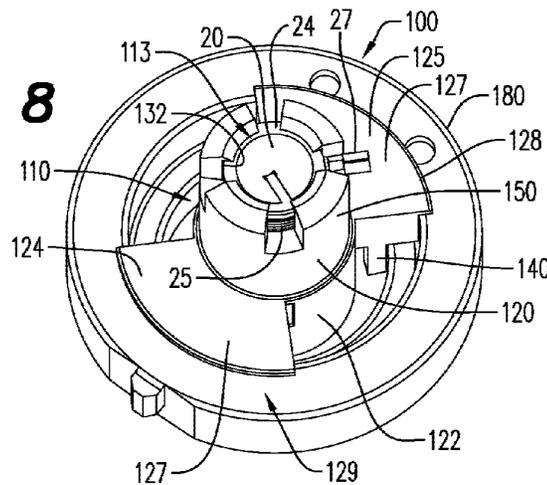
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(54) Title: DEVICE AND METHOD FOR POSITIONING A DETONATOR WITHIN A PERFORATING GUN ASSEMBLY

**FIG. 8**



(57) Abstract: According to an aspect, a detonator positioning device is provided for use with a wireless detonator in a perforating gun assembly. The detonator positioning device includes a single mechanism for physical electrical connection, while the remaining electrical connections are made via electrically contactable components. A method of assembling the perforating gun assembly is also provided, including a detonator positioning device configured to receive and hold the wireless detonator.



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— *with international search report (Art. 21(3))*

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**DEVICE AND METHOD FOR POSITIONING A DETONATOR  
WITHIN A PERFORATING GUN ASSEMBLY**

**Field**

[0001] A device and method for positioning a detonator within a perforating gun assembly is generally described.

**Background**

[0002] Hydrocarbons, such as fossil fuels (e.g. oil) and natural gas, are extracted from underground wellbores extending deeply below the surface using complex machinery and explosive devices. Once the wellbore is established by placement of cases after drilling, a perforating gun assembly, or train or string of multiple perforating gun assemblies, are lowered into the wellbore, and positioned adjacent one or more hydrocarbon reservoirs in underground formations. The perforating gun has explosive charges, typically shaped, hollow or projectile charges, which are ignited to create holes in the casing and to blast through the formation so that the hydrocarbons can flow through the casing. Once the perforating gun(s) is properly positioned, a surface signal actuates an ignition of a fuse, which in turn initiates a detonating cord, which detonates the shaped charges to penetrate/perforate the casing and thereby allow formation fluids to flow through the perforations thus formed and into a production string. The surface signal typically travels from the surface along electrical wires that run from the surface to one or more detonators positioned within the perforating gun assembly.

[0003] Assembly of a perforating gun requires assembly of multiple parts, which typically include at least the following components: a housing or outer gun barrel within which is positioned an electrical wire for communicating from the surface to initiate ignition, a percussion initiator and/or a detonator, a detonating cord, one or more charges which are held in an inner tube, strip or carrying device and, where necessary, one or more boosters. Assembly typically includes threaded

insertion of one component into another by screwing or twisting the components into place, optionally by use of a tandem adapter. Since the electrical wire must extend through much of the perforating gun assembly, it is easily twisted and crimped during assembly. In addition, when a wired detonator is used it must be manually connected to the electrical wire, which has lead to multiple problems. Due to the rotating assembly of parts, the wires can become torn, twisted and/or crimped/nicked, the wires may be inadvertently disconnected, or even mis-connected in error during assembly, not to mention the safety issues associated with physically and manually wiring live explosives.

[0004] According to the prior art and as shown in Fig. 1, the wired detonator 60 has typically been configured such that wires must be physically, manually connected upon configuration of the perforating gun assembly. As shown herein, the wired detonator 60 typically has three (or more or less) wires, which require manual, physical connection once the wired detonator is placed into the perforating gun assembly. For detonators with a wired integrated switch for selective perforating, the wires typically include at least a signal-in wire 61, a signal-out wire 62 and a ground wire 63. In a typical manual, physical connection, the wires extending along the perforating gun are matched to the wires of the detonator, and an inner metallic portion of one wire is twisted together with an inner metallic portion of the matched wire using an electrical connector cap or wire nut or a scotch-lock type connector.

[0005] What is needed is a detonator positioning device capable of positioning a wireless detonator including a spring-contact, single wire (not two or more wires as described above) connection within a perforating gun assembly, particularly a typical perforating gun assembly that has traditionally used a fully-wired detonator.

### **Brief Description**

[0006] An embodiment provides a detonator positioning device for positioning a detonator in a perforating gun assembly. In an embodiment, the detonator positioning device is formed of a multi-part cylindrical body.

[0007] Another embodiment provides a perforating gun assembly including the detonator positioning device for positioning a wireless detonator.

[0008] Another embodiment provides a method of assembling the perforating gun assembly including a detonator positioning device and a detonator.

### **Brief Description of the Figures**

[0009] A more particular description will be rendered by reference to specific embodiments thereof that are illustrated in the appended drawings.

Understanding that these drawings depict only typical embodiments and are not therefore to be considered to be limiting of its scope, exemplary embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0010] Fig. 1 is a perspective view of a wired detonator according to the prior art;

[0011] Fig. 2 is a cross-sectional side view of a wireless detonator useful with a detonator positioning device according to an embodiment;

[0012] Fig. 3 is a perspective view of the detonator according to Fig. 2;

[0013] Fig. 4 is a partial semi-cross-sectional side perspective view of a perforating gun assembly including the detonator of Figs. 2-3 seated within a detonator positioning device in which the detonator positioning device includes a multi-part cylindrical body according to an embodiment;

[0014] Fig. 5 is a cross-sectional side view of the detonator positioning device formed as a unitary member according to an embodiment;

[0015] Fig. 6 is a perspective view of the detonator positioning device including a multi-part cylindrical body of Fig. 4 according to an embodiment;

[0016] Fig. 7 is a perspective view of one part of the detonator positioning device of Fig. 6 positioned within an end plate according to an embodiment;

[0017] Fig. 8 is a forward end perspective view of the detonator positioning device according to an embodiment;

[0018] Fig. 9 is another perspective view of the detonator positioning device tilted at an angle from Fig. 8 according to an embodiment;

[0019] Fig. 10 is a partial cross-sectional view of another embodiment of the detonator positioning device assembly within a perforating gun assembly; and

[0020] Fig. 11 is a perspective view of a ground rib according an embodiment.

[0021] Various features, aspects, and advantages of the embodiments will become more apparent from the following detailed description, along with the accompanying figures in which like numerals represent like components throughout the figures and text. The various described features are not necessarily drawn to scale, but are drawn to emphasize specific features relevant to embodiments.

### **Detailed Description**

[0022] Reference will now be made in detail to various embodiments. Each example is provided by way of explanation, and is not meant as a limitation and does not constitute a definition of all possible embodiments.

[0023] A detonator is provided that is capable of being positioned or placed into a perforating gun assembly with minimal effort by means of placement/positioning within a detonator positioning device according to an aspect. In an embodiment, the detonator positioning device includes a detonator positioned within the detonator positioning device, wherein the detonator electrically contactably forms an electrical connection with minimal need to manually and physically connect,

cut or crimp multiple wires as required in a fully wired electrical connection. Such a wireless detonator has been generally described in commonly assigned DE Application No. 102013109227.6 filed August 26, 2013, which is incorporated herein by reference in its entirety. In other words, the electrical connection is made only by making electrical contact with electrically contactable components as described in greater detail hereinbelow...that is by merely physically touching. Thus, as used herein, the term “wireless” means that the detonator itself is not manually, physically connected within the perforating gun assembly as has been traditionally done with wired connections, but rather merely makes electrical contact through various components as described herein to form the electrical connections. Thus, the signal is not being wirelessly transmitted, but is rather being relayed through electrical cables/wiring within the perforating gun assembly through the electrical contacts. In particular, the electrical connection is made through contact between a line-in contact-initiating pin 38 and a line-in portion 20 as described in greater detail below.

[0024] Now referring to Figs. 2 and 3 such a detonator 10 includes a detonator shell 12 and a detonator head 18 and is configured for being electrically contactably received within a perforating gun assembly 40 (see, for instance, Fig. 4) without using a wired electrical connection directly to the detonator. Rather, a single line-out wire (not shown) is connected to the detonator positioning assembly as described in more detail hereinbelow.

[0025] Only a portion of the perforating gun assembly 40 is depicted herein, including a perforating gun body or barrel or carrier or housing 42 for housing the various components of the assembly. Also shown is a distal end of a typical tandem seal adapter or tandem sub 44, in which a bulkhead assembly 46 is shown assembled within the perforating gun assembly 40. The tandem sub 44 is configured to seal inner components within the perforating gun housing 42 from the outside environment using sealing means. The tandem seal adapter 44 seals

adjacent perforating gun assemblies (not shown) from each other, and houses the bulkhead assembly 46.

[0026] The bulkhead assembly 46 functions to relay a line-in contact-initiating pin 38 for wirelessly electrically contacting a line-in portion 20 of the detonator head 18 as described in greater detail hereinbelow. As shown in Fig. 4, for instance, bulkhead wires 48 are depicted with a coating or insulating member, typically using heat shrinking, over the wires 48 for supplying current to the bulkhead assembly 46. With reference to Figs. 4 and 10, a bulkhead retaining mechanism 49 is provided to secure the bulkhead assembly 46 within the tandem sub 44. In the embodiment of Fig. 4, the retaining mechanism 49 abuts the end of the bulkhead assembly 46 from which the line-in contact-initiating pin 38 extends, while in the embodiment depicted in Fig. 10, the retaining mechanism 49 abuts the opposite end of the bulkhead assembly 46.

[0027] The detonator shell 12 of the detonator 10 useful herein is configured as a housing or casing 11, typically a metallic housing, which houses at least a detonator head plug 14, a fuse head 15, an electronic circuit board 16 and explosive components. The fuse head 15 could be any device capable of converting an electric signal into an explosion. As shown in Fig. 2, the detonator shell 12 is shaped as a hollow cylinder. The electronic circuit board 16 is connected to the fuse head 15 and is configured to allow for selective detonation of the detonator 10. The electronic circuit board 16 is configured to wirelessly and selectively receive an ignition signal I, (typically a digital code uniquely configured for a specific detonator), to fire the perforating gun assembly 40. By “selective” what is meant is that the detonator is configured to receive one or more specific digital sequence(s), which differs from a digital sequence that might be used to arm and/or detonate another detonator in a different, adjacent perforating gun assembly, for instance, a train of perforating gun assemblies. So, detonation of the various assemblies does not necessarily have to occur in a

specified sequence. Any specific assembly can be selectively detonated. In an embodiment, the detonation occurs in a bottom-up sequence.

[0028] The detonator head 18 extends from one end of the detonator shell 12, and includes more than one electrical contacting component including an electrically contactable line-in portion 20 and an electrically contactable line-out portion 22. According to one embodiment, the detonator head 18 may also include an electrically contactable ground portion 13 (not shown). In an embodiment, the detonator head 18 may be disk-shaped. In another embodiment, at least a portion of the detonator housing 11 is configured as the ground portion 13. The line-in portion 20, the line-out portion 22 and the ground portion 13 are configured to replace the wired connection of the prior art wired detonator 60 and to complete the electrical connection merely by contact with other electrical contacting components. In this way, the line-in portion 20 of the detonator 10 replaces the signal-in wire 61 of the wired detonator 60, the line-out portion 22 replaces the signal-out wire 60 and the ground portion 13 replaces the ground wire 63. Thus, when placed into a detonator positioning device 100 (see, for instance, Fig. 4) as discussed in greater detail below, the line-in portion 20, the line-out portion 22 and the ground portion 13 make an electrical connection by merely making contact with corresponding electrical contacting components (also as discussed in greater detail below). That is, the detonator 10 is wirelessly connectable only by making and maintaining electrical contact of the electrical contacting components to replace the wired electrical connection and without using a wired electrical connection.

[0029] The detonator head 18 also includes an insulator 24, which is positioned between the line-in portion 20 and the line-out portion 22. The insulator 24 functions to electrically isolate the line-in portion 20 from the line-out portion 22. Insulation may also be positioned between other lines of the detonator head. As discussed above and in an embodiment, it is possible for all of the contacts to be configured as part of the detonator head 18 (not shown), as found, for instance,

in a banana connector used in a headphone wire assembly in which the contacts are stacked longitudinally along a central axis of the connector, with the insulating portion situated between them.

[0030] In an embodiment, a capacitor 17 is positioned or otherwise assembled as part of the electronic circuit board 16. The capacitor 17 is configured to be discharged to initiate the detonator 10 upon receipt of a digital firing sequence via the ignition signal I, the ignition signal being electrically relayed directly through the line-in portion 20 and the line-out portion 22 of the detonator head 18. In a typical arrangement, a first digital code is transmitted down-hole to and received by the electronic circuit board. Once it is confirmed that the first digital code is the correct code for that specific detonator, an electronic gate is closed and the capacitor is charged. Then, as a safety feature, a second digital code is transmitted to and received by the electronic circuit board. The second digital code, which is also confirmed as the proper code for the particular detonator, closes a second gate, which in turn discharges the capacitor via the fuse head to initiate the detonation.

[0031] In an embodiment, the detonator 10 may be fluid disabled. "Fluid disabled" means that if the perforating gun has a leak and fluid enters the gun system then the detonator is disabled by the presence of the fluid and hence the explosive train is broken. This prevents a perforating gun from splitting open inside a well if it has a leak and plugging the wellbore, as the hardware would burst open. In an embodiment, the detonator 10 is a selective fluid disabled electronic (SFDE) detonator.

[0032] The detonator 10 according to an embodiment can be either an electric or an electronic detonator. In an electric detonator, a direct wire from the surface is electrically contactingly connected to the detonator and power is increased to directly initiate the fuse head. In an electronic detonator, circuitry of the electronic circuit board within the detonator is used to initiate the fuse head.

[0033] The detonator 10 may be immune to stray current or voltage and/or radiofrequency (RF) signals to avoid inadvertent firing of the perforating gun. Thus, the assembly is provided with means for ensuring immunity to stray current or voltage and/or RF signals, such that the detonator 10 is not initiated through random radio frequency signals, stray voltage or stray current. In other words, the detonator 10 is configured to avoid unintended initiation.

[0034] The detonator 10 is configured to be electrically contactingly received within the detonator positioning device 100, which is seated or positioned within the perforating gun assembly 40, without using a wired electrical connection to the detonator 10 itself, as shown in Figs. 4, 5, 7-9 and 10.

[0035] In an embodiment and as shown in Figs. 4, 6 and 7, the detonator positioning device 100 includes a cylindrical body 110' depicted as a multi-part member, that is a body that is formed using a plurality of parts or sections, which may facilitate ease of assembly. With reference to the embodiment of Fig. 5, the cylindrical body 110 may also be provided as an unitary body, one that is formed as a whole, for instance by machining or molding processes known by those of ordinary skill in the art. As used herein, the prime symbol ' in the various figures designates the difference between embodiments of the unitary body (no prime used) as compared to features of the multi-part body (prime used), and will not generally be used in the description. As an example, with reference to a central bore 130, the central bore will be depicted as central bore 130' in the embodiment wherein multiple parts are used to form the body 110', while the central bore 130 (without the prime) will be used to depict the bore of the unitary body 100. In an embodiment and with reference to, for instance, Fig. 7, one or more passages 102 are provided in the closed end of the cylindrical body 110 to accommodate passage of a detonating cord (not shown) positioned within the detonator positioning device 100.

[0036] With reference again in particular to Figs. 4-9, the cylindrical body 110 includes an open end 113, a closed end 114, and a central bore 130 adapted for

receiving the detonator 10. The cylindrical body 110 also includes a plurality of portions, including at least a first portion 120 and a second portion 122, and in an embodiment a third portion 124, which will be discussed in greater detail below. The central bore 130 extends along at least some of a length of the cylindrical body 110, and typically includes an enlarged bore portion 132 adjacent the open end 113 of the cylindrical body 110. The enlarged bore portion 132 is adapted to receive the head 18 portion of the detonator 10, while the central bore 130 is adapted to receive the housing 11 portion of the detonator 10. In an embodiment, the enlarged bore portion 132 is positioned within the first portion 120 of the cylindrical body 110 and the central bore 130 extends along a majority of the length of the cylindrical body 110. In an embodiment, the enlarged bore portion 132 and the detonator head 18 are complementarily sized and shaped to receive and seat/be received and seated, respectively, in at least a semi-fixed position within the detonator positioning device 100.

[0037] In an embodiment, a plurality of arms 150 extend toward the open end 113 of the cylindrical body 110 and at least partially enclose the enlarged bore portion 132 of the central bore 130. In this way, each of the plurality of arms 150 is adapted to retain, hold or otherwise embrace the detonator head 18 portion of the detonator 10 when the detonator 10 is positioned within the enlarged bore portion 132 of the central bore 130. Typically, the arms 150 are made of a flexible and resilient material that is capable of being bent or otherwise moved circumferentially outward, yet return to their original position once the movement force has been removed, (e.g. once the detonator is positioned within the detonator positioning device 100). Thus, the arms 150 will enclose and typically contact at least a peripheral surface of the head 18 of the detonator 10. Although the plurality of arms 150 are depicted as having four arms, it would be understood that more or less arms may be sufficient to perform the stated function, i.e., to retain the detonator head. For instance, the plurality of arms 150 could include 2, 3, 4, 5, 6, 7, 8 or more arms. As shown in Figs. 4-9 and in an

embodiment, the arms may include a retainer 152 positioned at a distal end of the arms to assist in retaining and maintaining the head 18 of the detonator 10 within the detonator positioning device 100. As shown herein, the detonator head 18 is slidably received within the enlarged bore portion 132, meaning the detonator head 18 is capable of sliding along at least a portion of the length of the enlarged bore portion 132 created by the arms 150. In an embodiment, the plurality of arms 150 form at least a portion of a forward end 121 of the first portion 120 of the cylindrical body 110.

[0038] Although not shown, it is possible to provide a window or opening in the cylindrical body 110 of the detonator positioning device 100 to facilitate visual verification of proper seating of the detonating cord (not shown), once the detonating cord has been connected to the assembly through the passage 102.

[0039] Turning to the other end of the detonator positioning device 100, a plurality of legs 140 are adapted to assist in positioning the device 100 within the perforating gun assembly 40. In the embodiment shown in Figs. 4-8, the plurality of legs 140 extend from the cylindrical body 110 toward the closed end 114 of the cylindrical body 110. Similar to the arms 150, the legs 140 may be made from a resilient material, and typically include protrusions 142 at the distal ends thereof adapted for positioning and holding the device 100 in place. In an embodiment, each protrusion 142 extends away from the cylindrical body 110.

[0040] Although the plurality of legs 140 are depicted as having four legs, it would be understood that more or less legs may be sufficient to perform the stated function, i.e., to position the detonator positioning device within a perforating gun assembly. For instance, the plurality of legs 140 could comprise 3, 4, 5, 6, 7, 8 or more legs. Having more legs (or arms as referenced above) means each individual leg/arm is ultimately thinner than if fewer legs/arms are used. Similarly, thinner legs/arms means the individual legs/arms are less rigid, so there will ultimately be a trade-off in number of legs/arms selected between rigidity and/or flexibility of the detonator positioning device and the ability to

stabilize the detonator positioning device within the perforating gun assembly and/or retain the detonator head, as the case may be.

[0041] Further, in an embodiment, each of the plurality of arms 150 and the plurality of legs 140 are adapted to provide a snap fit upon insertion of the detonator 10 within the central bore 130 and insertion of the cylindrical body 110 within the perforating gun assembly 40.

[0042] As mentioned above, a third portion 124 may also be formed as a portion of the cylindrical body 110. As shown in Figs. 4-9 and in an embodiment, the third portion 124 is formed integrally as part of the second portion 122, while it is contemplated that the third portion 124 could be formed as a separate unit that is attached to the cylindrical body 110. The third portion 124 has a forward face 125 and a rearward face 126, and as shown in this embodiment, the plurality of legs 140 extend from the rearward face 126 of the third portion 124. As depicted herein, the third portion 124, extends circumferentially from an outer surface 123 of the second portion 122 and the third portion 124 is discontinuous about the outer surface 123 of the second portion 122 of the cylindrical body 110, thus forming a plurality of sections 127. Such an arrangement typically minimized overall weight and associated costs with fabricating the unit, while maintaining sufficient structural integrity to perform the stated functions. Further as depicted in this embodiment, the third portion 124 includes a circumferentially-extending lip 128 at a distal end 129 of the third portion 124. In this arrangement, the distal end 129 is positioned opposite the plurality of legs 140. The lip 128 is further adapted for positioning the detonator positioning device 100 by working in concert with the plurality of legs 140 to hold the detonator positioning device 100 in place within the perforating gun assembly 40.

[0043] As stated above, the central bore 130 is adapted to receive and retain the detonator 10, wherein the central bore 130 extends from the open end 113 to the closed end 114 of the cylindrical body 110, and the enlarged bore portion 132 is positioned adjacent the open end 113. Thus, when the detonator 10 is

positioned within the central bore 110 of the detonator positioning device 100, the detonator housing 11 extends along a length of the central bore 130, while the detonator head 18 is received within the enlarged bore portion 132.

[0044] In an embodiment, a line-out connector biasing member 25 is positioned or otherwise situated within the central bore 130 of the cylindrical body 110, at a base 134 of the enlarged bore portion 132, while a ground connector biasing member 28 is positioned or otherwise situated within the central bore 130 of the cylindrical body 110, at a base 136 of the central bore 130. Thus, the ground connector biasing member 28 is positioned within the central bore 130 between the detonator housing 11 of the detonator 10 and the closed end 114 of the cylindrical body 110. In addition, a terminal 26 is typically positioned adjacent the line-out connector biasing member 25.

[0045] In an embodiment, the terminal 26 is formed as a semi-round metallic material, with a slotted nipple 27 extending from an outer circumferential surface of the terminal 26. The slotted nipple 27 is adapted for connection to the single electrical line-out wire needed to complete the electrical connection for this assembly (not shown). Although a slotted nipple 27 is depicted, it will be understood by those of ordinary skill in the art that other mechanisms may be provided to create the electrical connection between the single wire and the terminal 26.

[0046] The line-out connector biasing member 25 and the ground connector biasing member 28 may be formed from a spring-like material for assisting in maintenance of physical and electrical contact between the line-in contact-initiating pin 38 extending from the bulkhead assembly 46, and may also be formed of materials suitable to facilitate electrical connectivity. Typically, these components are also metallic, that is to say they are formed from an electrically conductive metal material.

[0047] Once received within the central bore 130, therefore, the detonator 10 is electrically contactingly connected to the terminal 26 that is positioned between the line-out portion 22 of the detonating head 18 of the detonator 10 and the line-out connector biasing member 25. Thus, once the detonator 10 is positioned within the central bore 130, and the line-in contact-initiating pin 38 of the bulkhead assembly 46 makes contact with, and thus electrically contactably connects to the line-in portion 20 of the detonator head 18. The line-out connector biasing member 25 will thus compress, causing the line-out portion 22 of the detonator head 18 to electrically contactably connect with the terminal 26. The grounding connection will be discussed in more detail hereinbelow.

[0048] With reference to the closed end 114 of the detonator positioning device 100 and in an embodiment, a grounding strip or wire 29 is provided for completing the electrical connection and is also typically formed from an electrically conductive metal material. In an embodiment, the grounding strip 29 is embedded in the closed end 114 of the cylindrical body 110. As shown in the embodiment of Figs. 4-7, the grounding strip 29 extends from one side of the cylindrical body 110 through to the opposite side of the cylindrical body 110 in a way that a central portion of the grounding strip 29 is positioned adjacent one end of the ground connector biasing member 28, opposite from the housing 11 of the detonator 10. Thus, the ends of the grounding strip 29 extend beyond the outer surface of the cylindrical body 110. When the detonator 10 is positioned within the central bore 130 of the detonator positioning device 100, and the detonator 10 is compressed by the contact of the bulkhead assembly 44, the ground connector biasing member 28 compresses and electrically contactably connects the ground portion 13 of the housing 11 with the ground connector biasing member 28 and the grounding strip 29, which completes a ground loop via connection with the perforating gun housing 42. As shown in Fig. 4, the grounding strip is deformed upon insertion of the detonator positioning device

100 into an end plate 180, the entire assembly of which is inserted within the perforating gun body 42, thus completing the ground loop/connection.

[0049] As mentioned above, and with particular reference to Figs. 4, 6 and 7, the cylindrical body 110 may be formed as a multi-part cylindrical body 110' including at least a first part 111 and a second part 112. As shown herein, the first part 111 of the cylindrical body 110 can be removably connected, (or otherwise joined, fastened, united) to the second part 112 of the cylindrical body 110' to form an assembled cylindrical body 109. In this way, each of the first part 111 and the second part 112 include at least a first portion 120' and a second portion 122', the assembled cylindrical body 109 comprising an open end 113', a closed end 114', and a central bore 130' adapted for receiving the detonator 10, the central bore 130' extending along at least some of a length of the assembled cylindrical body 109, the central bore 130' including an enlarged bore portion 132' adjacent the open end 113' of the assembled cylindrical body 109. In this embodiment, a plurality of arms 150' extend toward the open end 113' of the assembled cylindrical body 109 and at least partially enclose the enlarged bore portion 132' of the central bore 130'. Further, each of the plurality of arms 150' include a retainer 152' adapted to retain the detonator head 18 of the detonator 10 positioned within the enlarged bore portion 132' of the central bore 130'. In an embodiment, a plurality of legs 140' extend from the assembled cylindrical body 109 and toward the closed end 114' of the assembled cylindrical body 109, and each of the plurality of legs 140' include a protrusion 142' extending away from the assembled cylindrical body 109 and adapted for positioning the assembled cylindrical body 109 in the perforating gun assembly 40.

[0050] Since the assembled cylindrical body 109 according to this embodiment requires assembly in the field, a plurality of couplers 170 are provided that are adapted for attaching the first part 111 of the assembled cylindrical body 109 to the second part 112 of the assembled cylindrical body 109. It would be understood by one of ordinary skill in the art that it is possible to attach the first

part 111 to the second part 112 by any number of fasteners 172, including screws, bolts/nuts and the like that may be received in a socket or cavity 174 through threading, frictional fit and the like. As shown best in Fig. 7 and in an embodiment, the fastener 172 is a protrusion including a distal nob extending from the first part 111, which is matingly inserted into an oppositely positioned cavity 174 of the second part 112 (not shown). In an embodiment, the fastener 172 snap fits into the cavity 174.

[0051] In an embodiment, the first part 111 and the second part 112 may be configured as symmetrical or non-symmetrical halves.

[0052] According to an aspect the perforating gun assembly 40 and a method for assembling the perforating gun assembly 40 including a wireless detonator 10 and detonator positioning device 100 as described hereinabove is provided.

[0053] In an aspect, the method of assembling the perforating gun assembly 40 while using a semi-wired electrical connection includes at least the following steps: positioning the detonator positioning device 100 within the perforating gun assembly 40, the detonator positioning device 100 including the central bore 130; positioning the ground connector biasing member 28 at the base 136 of the central bore 130; positioning the line-out connector biasing member 25 at the base 134 of the enlarged portion 132 of the central bore 130; positioning the terminal 26 for receiving the single line-out wire adjacent the line-out connector biasing member 25; positioning the wireless detonator 10 within the central bore 130 such that the housing 11 of the detonator 10 extends along at least a portion of the central bore 130 and the ground portion 13 of the housing 11 electrically contacts the ground connector biasing member 28, and positioning the head 18 of the detonator 10 within the enlarged portion 132 of central bore 130 such that the line-out portion 22 of the detonator 10 electrically contacts the terminal 26, and the line-in contact-initiating pin 38 electrically contacts the line-in portion 20 of the detonator 10.

[0054] According to an aspect, the step of positioning the detonator positioning device 100 within the perforating gun assembly 40 includes positioning the detonator positioning device within a support member or end plate 180, as seen, for instance, Figs. 4, 5 and 7-10, and as discussed briefly above. As shown herein the end plate 180 has an inner cavity that is sufficiently sized to receive the closed end 114 of the cylindrical body 110, and in particular to receive at least the second portion 122 (and/or the third portion 124) by interlocking and/or snap-fit action with the plurality of legs 140 at a rearward end of the endplate 180 (see Figs. 4, 5 and 7) and by abutting the circumferentially-extending lip against the outer surface of the end plate 180 (see in particular Figs. 8 and 9) at the opposite end of the end plate 180. Similarly, the outer dimension or exterior surface of the end plate 180 is sufficiently sized to be received within the perforating gun barrel 42. Although not specifically shown, it will be understood by one of ordinary skill in the art that it is possible to form various members and components described herein as integrated units.

[0055] Turning to the embodiment found in Fig. 10, a separate component is provided to facilitate the ground loop discussed hereinabove. As shown herein, a grounding rib 182 is attached to the exterior surface of the end plate 180 to complete the ground loop upon positioning of the detonator positioning device 100 within the perforating gun assembly 40. In an embodiment, the grounding rib 182 is formed as a long, narrow, thin, semi-curved, flexible and resilient, metallic member, as seen best in Fig. 11. As shown herein, a securing mechanism 184 is provided for attaching the grounding rib to the exterior surface of the end plate 180. Thus, when the assembly is inserted into the perforating gun barrel 42, the grounding rib is flexed circumferentially inwardly to complete the ground loop

[0056] As used herein, "hold" means to enclose within bounds, to limit or hold back from movement or to keep in a certain position. The detonator positioning device 100 is positioned within the perforating gun assembly 40 and functions to receive and hold in place the detonator 10 according to an embodiment. In

addition, the detonator positioning device 100 also functions to provide electrical contacting components for wirelessly-connectably electrically receiving the detonator 10, while providing for a single wired connection to the detonator positioning device 100 itself.

[0057] The components and methods illustrated are not limited to the specific embodiments described herein, but rather, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the device and method include such modifications and variations. Further, steps described in the method may be utilized independently and separately from other steps described herein.

[0058] While the device and method have been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope contemplated. In addition, many modifications may be made to adapt a particular situation or material to the teachings found herein without departing from the essential scope thereof.

[0059] In this specification and the claims that follow, reference will be made to a number of terms that have the following meanings. The singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Furthermore, references to "one embodiment," "some embodiments," "an embodiment" and the like are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Terms such as "first," "second," "forward," "rearward," etc. are used to identify one element from another, and unless otherwise specified are not meant to refer to a particular order or number of elements.

[0060] As used herein, the terms "may" and "may be" indicate a possibility of an occurrence within a set of circumstances; a possession of a specified property,

characteristic or function; and/or qualify another verb by expressing one or more of an ability, capability, or possibility associated with the qualified verb. Accordingly, usage of "may" and "may be" indicates that a modified term is apparently appropriate, capable, or suitable for an indicated capacity, function, or usage, while taking into account that in some circumstances the modified term may sometimes not be appropriate, capable, or suitable. For example, in some circumstances an event or capacity can be expected, while in other circumstances the event or capacity cannot occur--this distinction is captured by the terms "may" and "may be."

[0061] As used in the claims, the word "comprises" and its grammatical variants logically also subtend and include phrases of varying and differing extent such as for example, but not limited thereto, "consisting essentially of" and "consisting of."

[0062] Advances in science and technology may make equivalents and substitutions possible that are not now contemplated by reason of the imprecision of language; these variations should be covered by the appended claims. This written description uses examples to disclose the device and method, including the best mode, and also to enable any person of ordinary skill in the art to practice the device and method, including making and using any devices or systems and performing any incorporated methods. The patentable scope thereof is defined by the claims, and may include other examples that occur to those of ordinary skill in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

## WHAT IS CLAIMED IS:

1. A detonator positioning device for positioning a wireless detonator in a perforating gun assembly, the device comprising:

a cylindrical body comprising an open end, a closed end, and a central bore adapted for receiving the detonator, the central bore extending along at least some of a length of the cylindrical body, the central bore including an enlarged bore portion adjacent the open end of the cylindrical body,

a plurality of arms extending toward the open end of the cylindrical body and at least partially enclosing the enlarged bore portion of the central bore, each of the plurality of arms adapted to retain a detonator head of the detonator when the detonator is positioned within the enlarged bore portion of the central bore, and

a plurality of legs extending from the cylindrical body and toward the closed end of the cylindrical body, each of the plurality of legs adapted to position the cylindrical body in the perforating gun assembly.

2. The detonator positioning device of Claim 1, the device further comprising:

a line-out connector biasing member positioned within the central bore of the cylindrical body between the detonator head and a base of the enlarged bore portion,

a terminal adapted for connecting a line-out wire, the terminal positioned between the detonator head and the line-out connector biasing member, and

a ground connector biasing member positioned within the central bore between a detonator housing of the detonator and the closed end of the cylindrical body.

3. The detonator positioning device of Claim 2, the device further comprising:

a grounding strip/wire embedded in the closed end of the cylindrical body, the grounding strip positioned in contact with the ground connector biasing member.

4. The detonator positioning device of any of the preceding Claims, wherein each of the plurality of arms comprising a retainer adapted for the retaining of the detonator head, each of the plurality of legs comprising a protrusion extending away from the cylindrical body and adapted for the positioning of the cylindrical body, and each of the plurality of arms and the plurality of legs being flexible such that insertion of the detonator within the central bore and insertion of the cylindrical body within the perforating gun assembly is accomplished with a snap fit.
5. The detonator positioning device of any of the preceding Claims, wherein the device is made from plastic and formed as a unitary member.
6. The detonator positioning device of any of the preceding Claims, wherein the cylindrical body further comprising:
  - a first portion, wherein the plurality of arms form at least a portion of a forward end of the first portion,
  - a second portion, and
  - a third portion extending circumferentially from an outer surface of the second portion, the third portion having a forward face and a rearward face, and the plurality of legs extending from the rearward face of the third portion.
7. The detonator positioning device of Claim 6, wherein the third portion being discontinuous about the outer surface of the second portion to form a plurality of sections.
8. The detonator positioning device of Claims 6 or 7, wherein the enlarged bore portion is positioned within the first portion of the cylindrical body and the central bore extends along a majority of the length of the cylindrical body.
9. The detonator positioning device of Claims 6, 7 or 8, wherein the third portion comprising a circumferentially-extending lip at a distal end thereof, the

distal end being positioned opposite the plurality of legs, the lip adapted for positioning the detonator positioning device by working in concert with the plurality of legs to hold the detonator positioning device in place within the perforating gun assembly.

10. A detonator positioning device for positioning a detonator in a perforating gun assembly, the device comprising:

a multi-part cylindrical body comprising at least a first part and a second part, wherein the first part is removably connected to the second part of the cylindrical body to form an assembled cylindrical body, each of the first part and the second part including at least a first portion and a second portion, the assembled cylindrical body comprising an open end, a closed end, and a central bore adapted for receiving the detonator, the central bore extending along at least some of a length of the assembled cylindrical body, the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body,

a plurality of arms extending toward the open end of the assembled cylindrical body and at least partially enclosing the enlarged bore portion of the central bore, each of the plurality of arms comprising a retainer adapted to retain a detonator head of the detonator positioned within the enlarged bore portion of the central bore, and

a plurality of legs extending from the assembled cylindrical body and toward the closed end of the assembled cylindrical body, each of the plurality of legs comprising a protrusion extending away from the assembled cylindrical body and adapted for positioning the assembled cylindrical body in the perforating gun assembly.

11. The detonator positioning device of Claim 10, further comprising:

a plurality of couplers adapted for attaching the first part of the assembled cylindrical body to the second part of the assembled cylindrical body.

12. The detonator positioning device of Claims 10 or 11, wherein the first part and the second part are configured as symmetrical halves.

13. A perforating gun assembly comprising a detonator positioning device and a wireless detonator, the assembly comprising:

a detonator, and

a detonator positioning device for positioning the detonator in a perforating gun assembly, the device comprising:

a multi-part cylindrical body comprising at least a first part and a second part, wherein the first part is removably connected to the second part of the cylindrical body to form an assembled cylindrical body, each of the first part and the second part including at least a first portion and a second portion, the assembled cylindrical body comprising an open end, a closed end, and a central bore adapted for receiving the detonator, the central bore extending along at least some of a length of the assembled cylindrical body, the central bore including an enlarged bore portion adjacent the open end of the assembled cylindrical body,

a plurality of arms extending toward the open end of the assembled cylindrical body and at least partially enclosing the enlarged bore portion of the central bore, each of the plurality of arms comprising a retainer adapted to retain a detonator head of the detonator when positioned within the enlarged bore portion of the central bore, and

a plurality of legs extending from the assembled cylindrical body and toward the closed end of the assembled cylindrical body, each of the plurality of legs comprising a protrusion extending away the assembled cylindrical body and adapted for positioning the assembled cylindrical body in the perforating gun assembly.

14. A method of assembling a perforating gun assembly while using a semi-wired electrical connection; comprising:

positioning a detonator positioning device within the perforating gun assembly, the detonator positioning device comprising a central bore,

positioning a ground connector biasing member at a base of the central bore,

positioning a line-out connector biasing member at a base of an enlarged portion of the central bore,

positioning a terminal for receiving a single line-out wire adjacent the line-out connector biasing member,

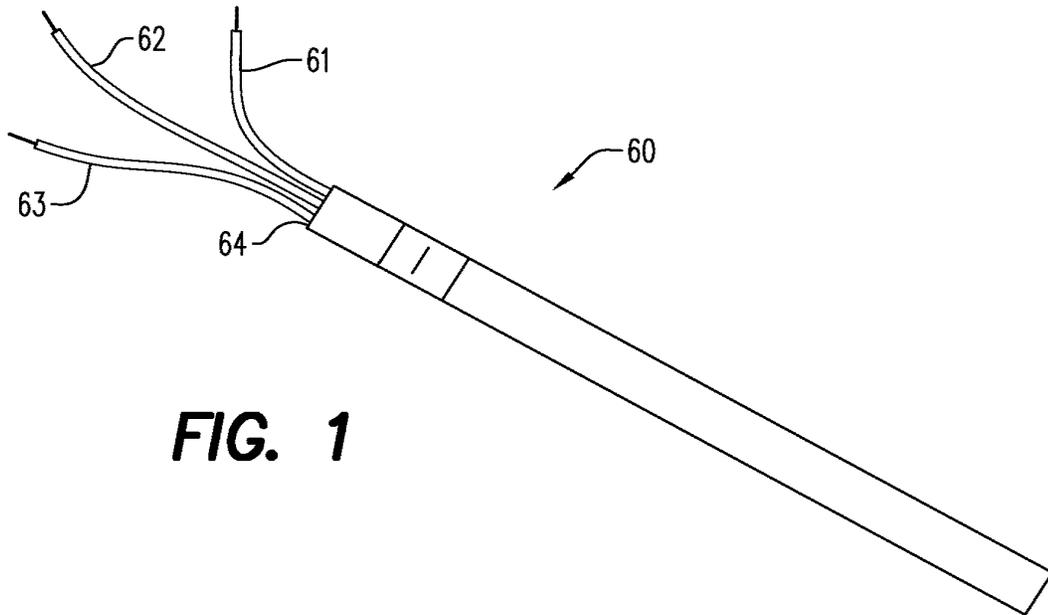
positioning a wireless detonator within the central bore such that a housing of the detonator extends along at least a portion of the central bore and a ground portion of the housing electrically contacts the ground connector biasing member, and

positioning a head of the detonator within the enlarged portion of central bore such that a line-out portion of the detonator electrically contacts the terminal, and a line-in contact-initiating pin electrically contacts a line-in portion of the detonator.

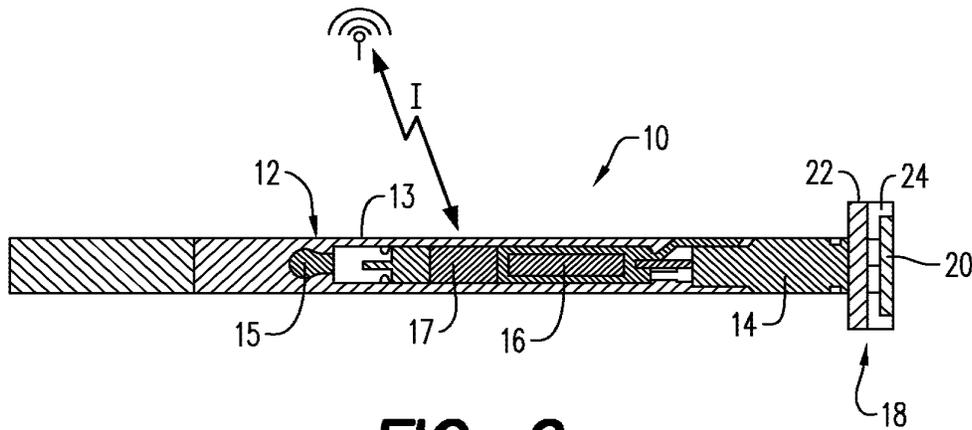
15. The method of Claim 14, wherein the step of positioning the detonator positioning device within the perforating gun assembly includes positioning the detonator positioning device within an end plate.

16. The method of Claims 14 or 15, further comprising attaching a grounding rib to an exterior surface of the end plate to complete a ground loop upon positioning of the detonator positioning device within the perforating gun assembly.

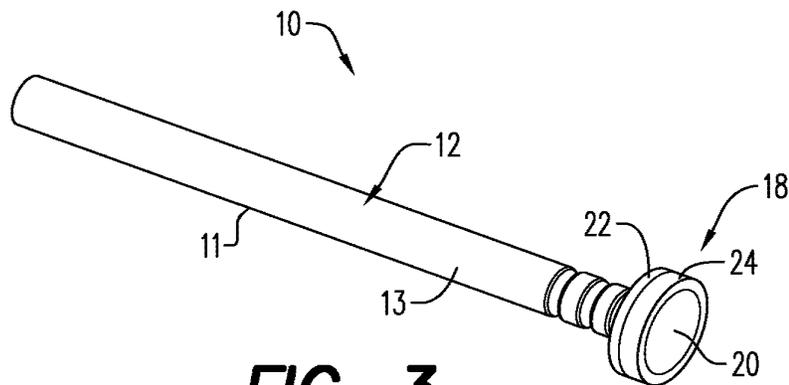
17. The method of Claims 14, 15 or 16, wherein deforming ends of a grounding strip upon positioning of the detonator positioning device within the perforating gun assembly completes a ground loop.



**FIG. 1**

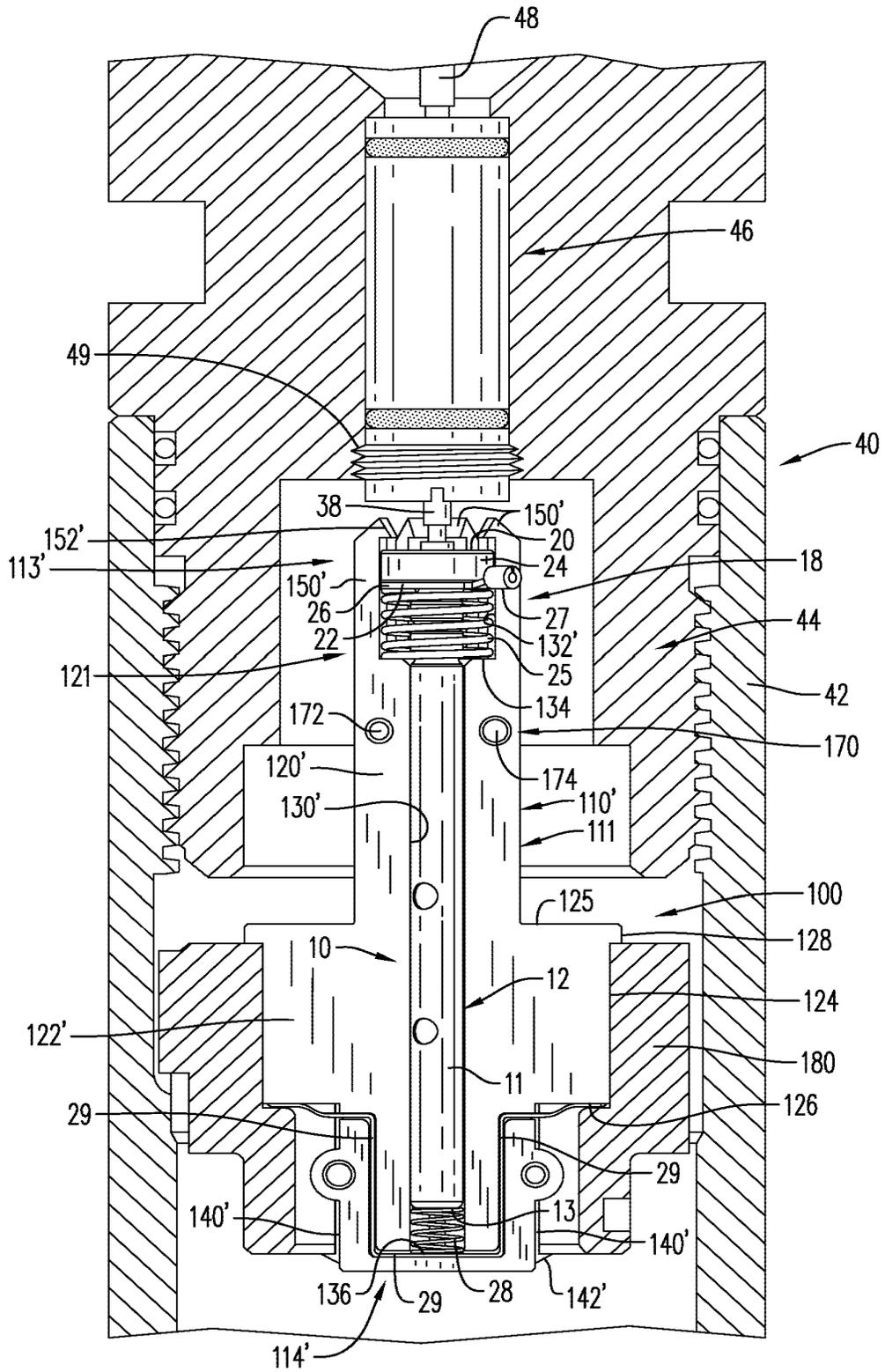


**FIG. 2**

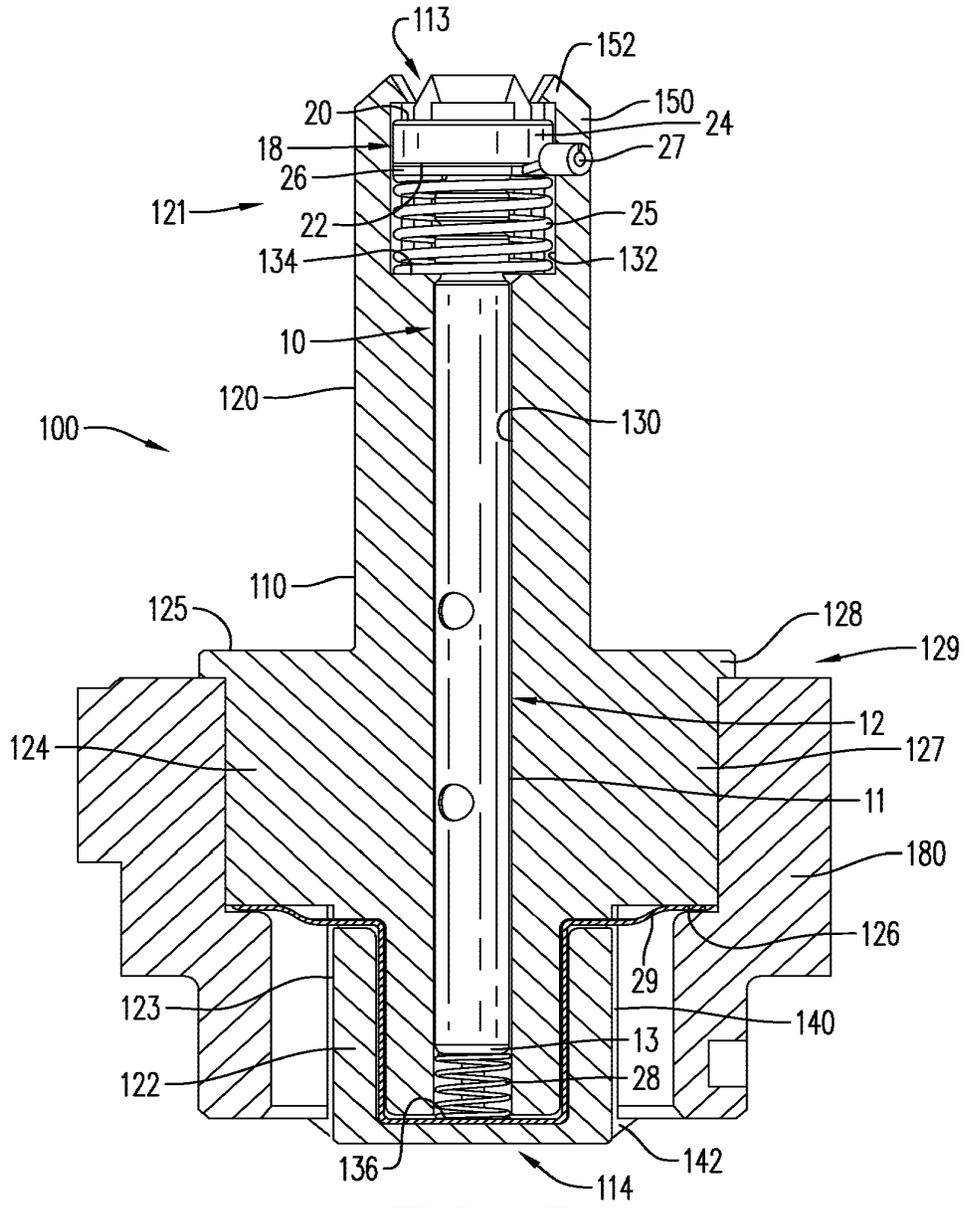


**FIG. 3**

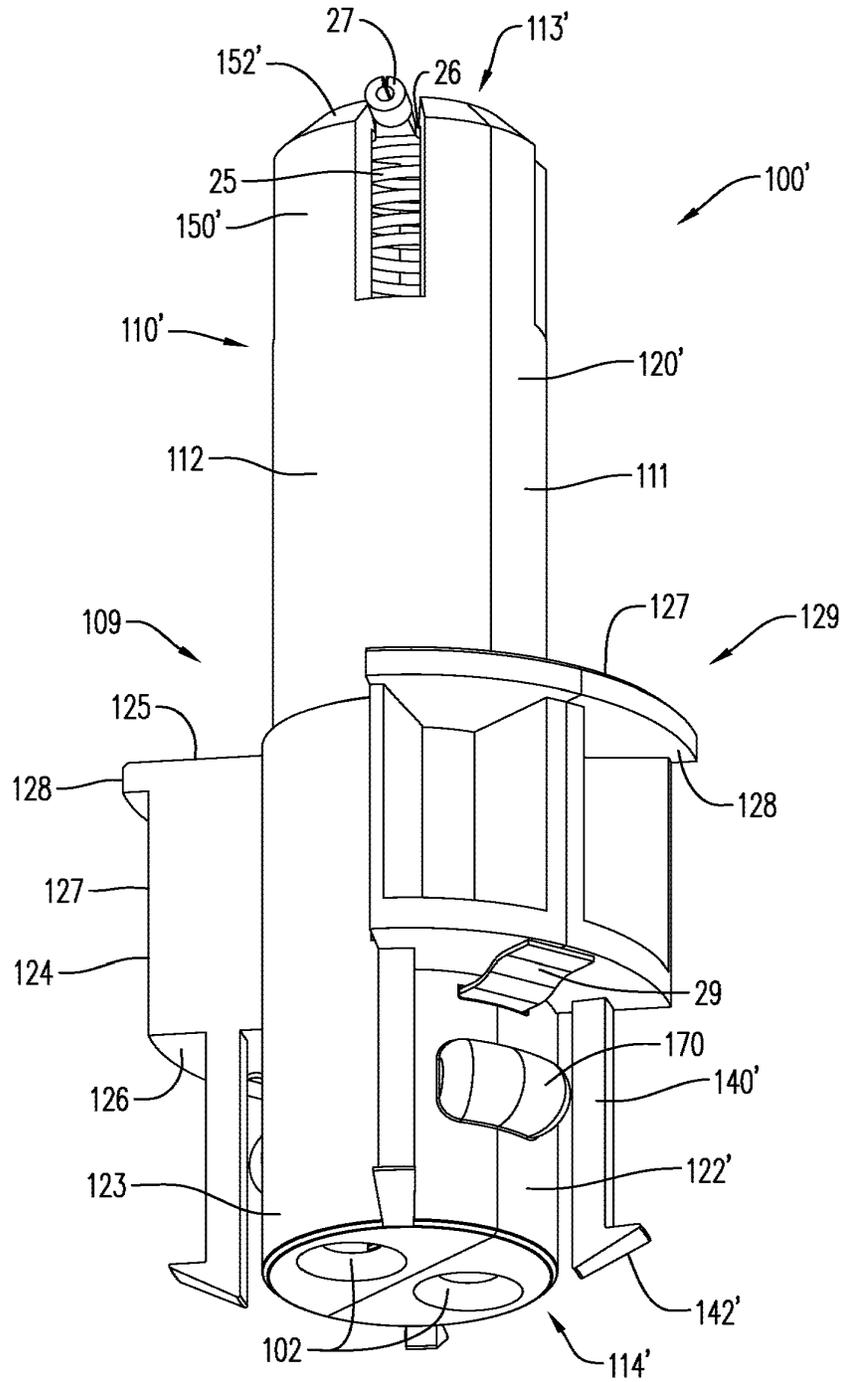
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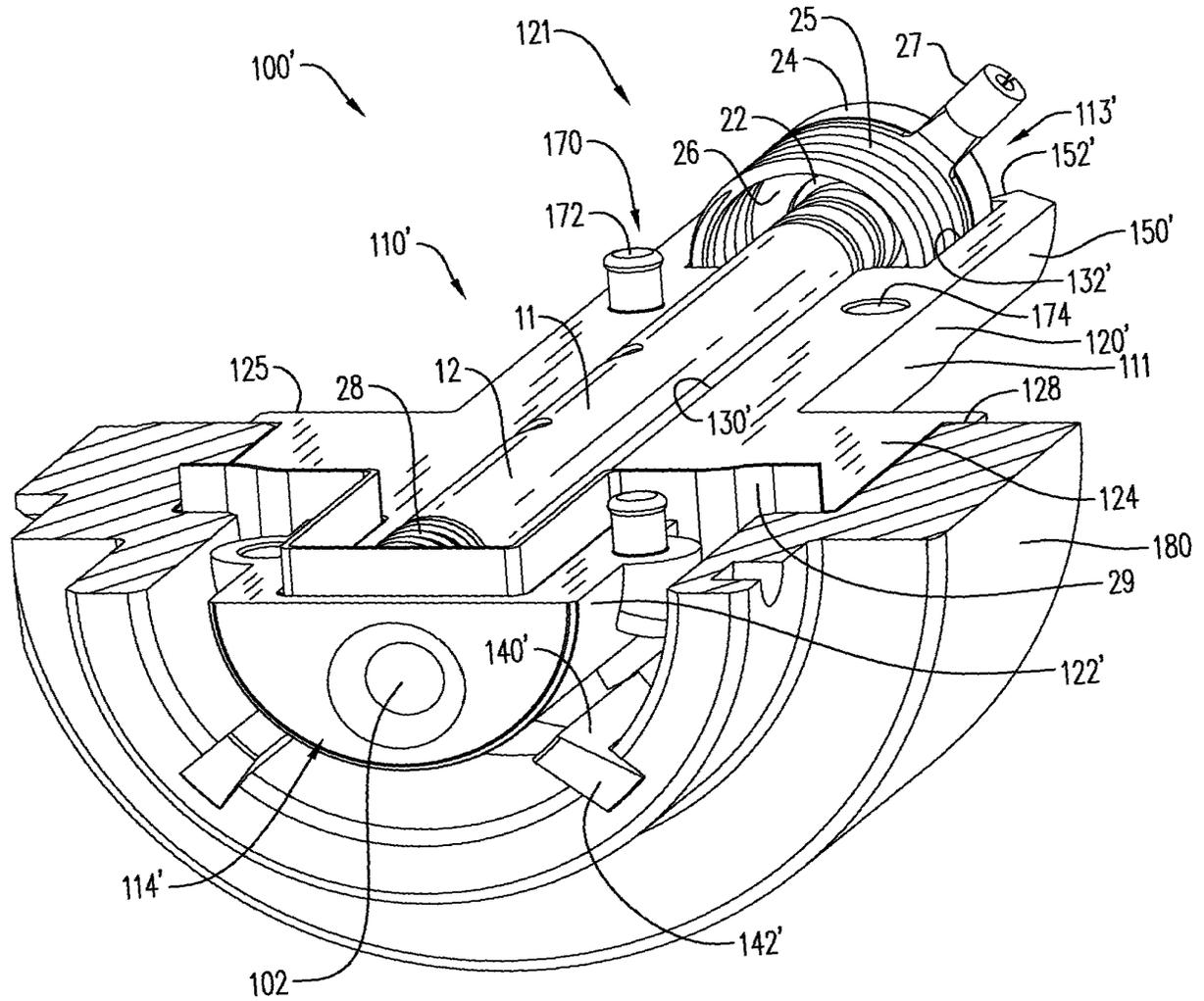
**FIG. 4**



**FIG. 5**

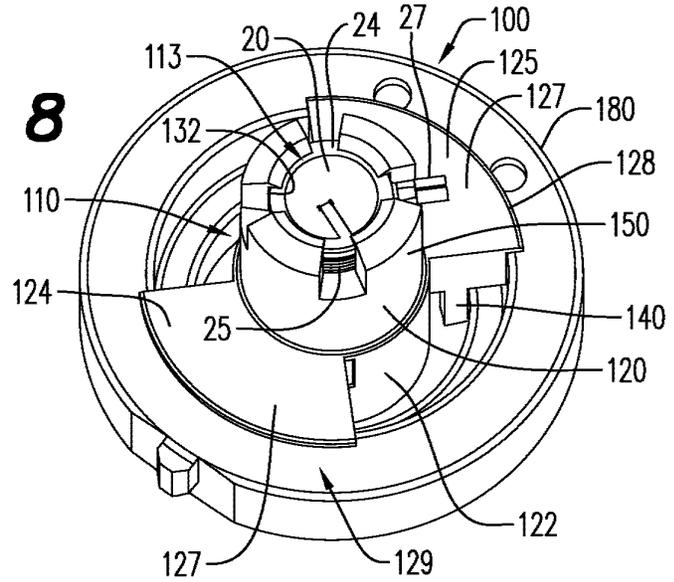


**FIG. 6**

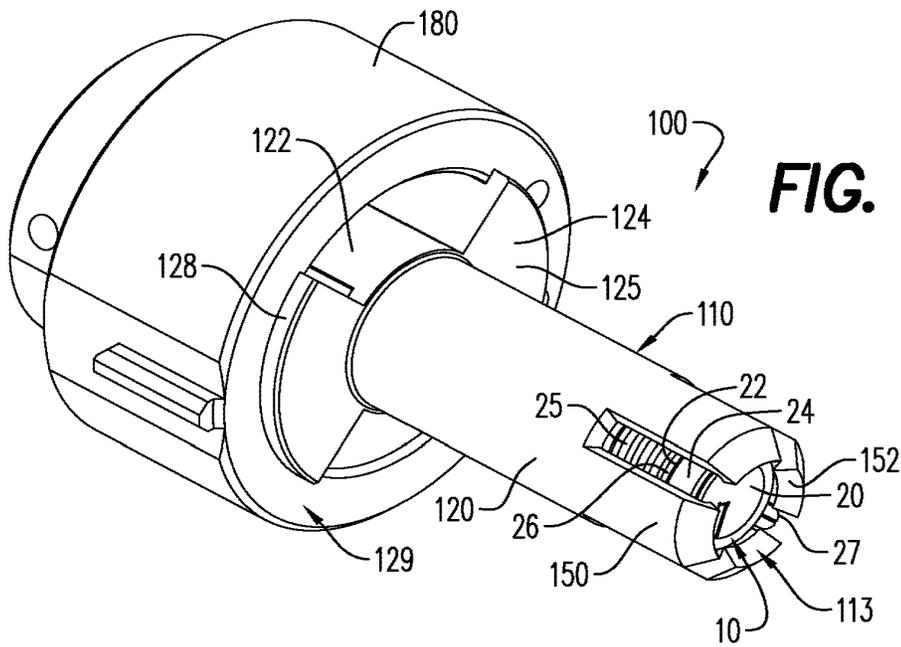


**FIG. 7**

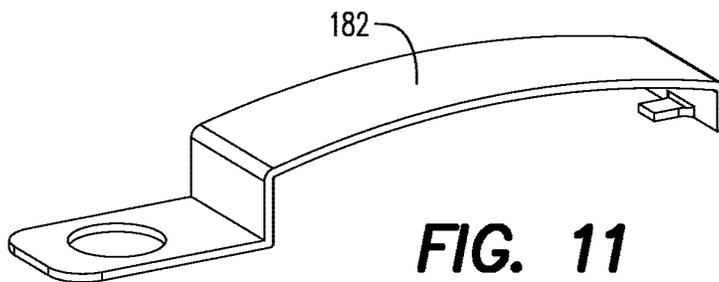
**FIG. 8**



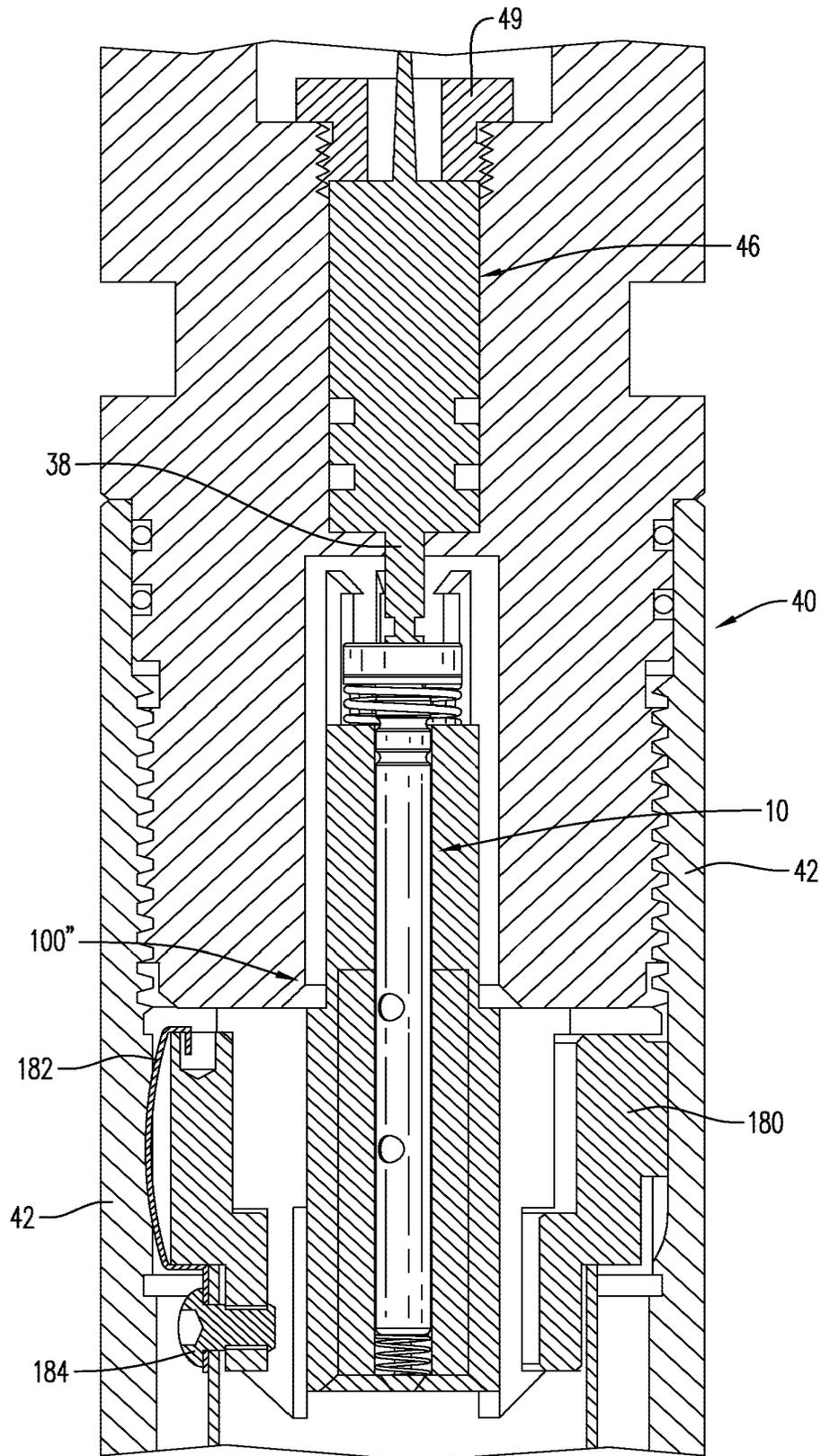
**FIG. 9**



**FIG. 11**



7/7



**FIG. 10**

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/18906

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(8) - E21B 29/02, 43/11, 43/116, 43/117, 43/1185, 43/119, 43/263 (2015.01) CPC - E21B 43/119, 43/11 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC(8) - E21B 29/02, 43/11, 43/116, 43/117, 43/1185, 43/119, 43/263 (2015.01) CPC - E21B 43/119, 43/11 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - E21B 29/02, 43/116, 43/117, 43/263 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Patbase; Google Patents; Google Scholar; Google Web; Espacenet; Search Terms: arm*, body*, borehole*, cas*, center*, central*, clip*, closed end, compress*, cylind*, deflect*, deform*, detonat*, downhole*, explo*, ground*, hold*, hous*, leg*, locat*, perforat*, position*, protrusion*, retain*, rib*, secur*, snap*, wellbore*, wireless*		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,889,183 A (Sommers et al.) 26 December 1989 (26.12.1989), Figs. 1-3A, col. 1, ln. 6-9, col. 3, ln. 47-66	1-4 and 10-13
A	US 4,058,061 A (Mansur Jr. et al.) 15 November 1977 (15.11.1977), Fig. 1, col. 3, ln. 44-56	1-4 and 10-13
A	US 2013/0118342 A1 (Tassaroli) 16 May 2013 (16.05.2013), Fig. 6	1-4 and 10-13
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* 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 23 June 2015 (23.06.2015)		Date of mailing of the international search report 10 JUL 2015
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300		Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/18906

**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.: 5-9 and 17  
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:  
--- See extra 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.:  
1-4 and 10-13

- 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 15/18906

Continuation of Box No. III - Observations where unity of invention is lacking

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. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-4 and 10-13, directed to a detonator positioning device and perforating gun using the device.

Group II: Claims 14-16, directed to a method of assembling a perforating gun assembly while using a semiwired electrical connection.

The inventions listed as Groups I-II do not relate to a single inventive concept under PCT Rule 13.1 because under PCT Rule 13.2 they lack the same or corresponding technical features for the following reasons:

Special Technical Features

Group I includes the special technical features of a cylindrical body comprising an open end, a closed end, and a central bore adapted for receiving the detonator, the central bore extending along at least some of a length of the cylindrical body, the central bore including an enlarged bore portion adjacent the open end of the cylindrical body, a plurality of arms extending toward the open end of the cylindrical body and at least partially enclosing the enlarged bore portion of the central bore, each of the plurality of arms adapted to retain a detonator head of the detonator when the detonator is positioned within the enlarged bore portion of the central bore, and a plurality of legs extending from the cylindrical body and toward the closed end of the cylindrical body, each of the plurality of legs adapted to position the cylindrical body in the perforating gun assembly that are not required by Group II.

Group II includes the special technical features of positioning a ground connector biasing member at a base of an enlarged portion of the central bore, positioning a line-out connector biasing member at a base of an enlarged portion of the central bore, positioning a terminal for receiving a single line-out wire adjacent the lineout connector biasing member, and a ground portion of the housing electrically contacts the ground connector biasing member, and positioning a head of the detonator within the enlarged portion of central bore such that a line-out portion of the detonator electrically contacts the terminal, and a line-in contact-initiating pin electrically contacts a line-in portion of the detonator that are not required by Group I.

Groups I-II share the technical feature of a detonator positioning device within a perforating gun assembly, the detonator device comprising a central bore, and positioning a detonator within the central bore such that a housing of the detonator extends along at least a portion of the central bore.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 4,574,892 A to Grigar et al. (hereinafter 'Grigar') which discloses a detonator positioning device (50) within a perforating gun assembly (Fig. 1; col. 3, ln. 21-25), the detonator device (76) comprising a central bore (Figs. 1-2; col. 4, ln. 59, 'detonator housing 76 is hollow'), and positioning a detonator (detonator cap 82) within the central bore such that a housing of the detonator extends along at least a portion of the central bore (Figs 1-2).

Claims 1 and 13 of Group I and Group II share the technical feature of a wireless detonator. However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 2009/0050322 A1 to Hill et al. (hereinafter 'Hill') which discloses a wireless detonator (para [0015], 'a perforating system configured to initiate perforating gun detonation by transmitting wireless signals from a portion of the perforating string selectively to individual perforating guns or sets of perforating guns').

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding technical feature.

Note: Claims 5-9 and 17 are dependent claims that are not drafted in accordance with the second and third sentences of Rule 6.4(a).

# PATENT COOPERATION TREATY

# PCT

From the INTERNATIONAL SEARCHING AUTHORITY

**NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT AND  
THE WRITTEN OPINION OF THE INTERNATIONAL  
SEARCHING AUTHORITY, OR THE DECLARATION**

To:

Zimmermann & Partner  
Patentanwalte mbB  
Josephspitalstrasse 15  
80331 Munchen  
ALLEMAGNE

(PCT Rule 44.1)

	Date of mailing (day/month/year)
	4 May 2015 (04-05-2015)
Applicant's or agent's file reference 18898P-WO	<b>FOR FURTHER ACTION</b> See paragraphs 1 and 4 below
International application No. PCT/EP2014/065752	International filing date (day/month/year)
	22 July 2014 (22-07-2014)
Applicant DYNAENERGETICS GMBH & CO. KG	

1.  The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

**Filing of amendments and statement under Article 19:**  
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

**How?** Directly to the International Bureau of WIPO, 34 chemin des Colombettes  
1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2.  The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3.  **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

the protest together with the decision thereon has been transmitted to the International Bureau together with any applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see [www.wipo.int/pct/en/texts/time\\_limits.html](http://www.wipo.int/pct/en/texts/time_limits.html) and the *PCT Applicant's Guide*, National Chapters.

Within **19 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

<p>Name and mailing address of the International Searching Authority</p> <p>European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016</p>	<p>Authorized officer</p> <p>KERMANI, Nathalie Tel: +49 (0)89 2399-7740</p>
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**PATENT COOPERATION TREATY**

**PCT**

**INTERNATIONAL SEARCH REPORT**

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 18898P-WO	<b>FOR FURTHER ACTION</b>		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/EP2014/065752	International filing date (day/month/year) 22 July 2014 (22-07-2014)	(Earliest) Priority Date (day/month/year) 26 August 2013 (26-08-2013)	
Applicant  DYNAENERGETICS GMBH & CO. KG			

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

- the international application in the language in which it was filed
- a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b.  This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c.  With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2.  **Certain claims were found unsearchable** (See Box No. II)

3.  **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

- the text is approved as submitted by the applicant
- the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- the text is approved as submitted by the applicant
- the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 2
  - as suggested by the applicant
  - as selected by this Authority, because the applicant failed to suggest a figure
  - as selected by this Authority, because this figure better characterizes the invention
- b.  none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2014/065752

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. E21B43/11 E21B43/1185  
 ADD.

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)  
 E21B F42B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/158071 A1 (MOONEY JAMES D JR [US] ET AL MOONEY JR JAMES D [US] ET AL) 12 July 2007 (2007-07-12) paragraph [0020]; figure 2 -----	1-20
A	US 2010/230104 A1 (NOELKE ROLF-DIETER [DE] ET AL) 16 September 2010 (2010-09-16) the whole document -----	1-20
A	US 5 105 742 A (SUMNER CYRIL R [US]) 21 April 1992 (1992-04-21) the whole document -----	1-20
A	US 2005/178282 A1 (BROOKS JAMES E [US] ET AL) 18 August 2005 (2005-08-18) the whole document -----	1-20

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

10 April 2015

Date of mailing of the international search report

04/05/2015

Name and mailing address of the ISA/  
 European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040,  
 Fax: (+31-70) 340-3016

Authorized officer

Simunec, Duro

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/065752

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007158071	A1	12-07-2007	
		AU 2007204686 A1	19-07-2007
		CA 2637035 A1	19-07-2007
		CN 101389826 A	18-03-2009
		EP 1971751 A2	24-09-2008
		US 2007158071 A1	12-07-2007
		WO 2007082225 A2	19-07-2007
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US 2010230104	A1	16-09-2010	
		BR PI0812294 A2	25-11-2014
		CA 2689315 A1	04-12-2008
		DE 102008026079 A1	04-12-2008
		EP 2156013 A1	24-02-2010
		US 2010230104 A1	16-09-2010
		WO 2008145726 A1	04-12-2008
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US 5105742	A	21-04-1992	NONE
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US 2005178282	A1	18-08-2005	
		CA 2497099 A1	19-08-2005
		CA 2880368 A1	19-08-2005
		FR 2866703 A1	26-08-2005
		GB 2411222 A	24-08-2005
		RU 2295694 C2	20-03-2007
		US 2005178282 A1	18-08-2005
		US 2012168226 A1	05-07-2012
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# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

# PCT

To:  
  
see form PCT/ISA/220

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY  
(PCT Rule 43bis.1)**

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/EP2014/065752

International filing date (day/month/year)  
22.07.2014

Priority date (day/month/year)  
26.08.2013

International Patent Classification (IPC) or both national classification and IPC  
INV. E21B43/11 E21B43/1185

Applicant  
DYNAENERGETICS GMBH & CO. KG

**1. This opinion contains indications relating to the following items:**

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

**2. FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0  
Fax: +49 89 2399 - 4465

Date of completion of  
this opinion

see form  
PCT/ISA/210

Authorized Officer

Telephone No. +49 89 2399-0



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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of:
  - the international application in the language in which it was filed.
  - a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2.  This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))
3.  With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
  - a.  forming part of the international application as filed:
    - in the form of an Annex C/ST.25 text file.
    - on paper or in the form of an image file.
  - b.  furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
  - c.  furnished subsequent to the international filing date for the purposes of international search only:
    - in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
    - on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4.  In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

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**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	<u>1-20</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-20</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-20</u>
	No: Claims	

2. Citations and explanations

see separate sheet

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

see separate sheet

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**Box No. VIII Certain observations on the international application**

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The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1 Reference is made to the following documents:

- D1 US 2007/158071 A1 (MOONEY JAMES D JR [US] ET AL MOONEY JR JAMES D [US] ET AL) 12 July 2007 (2007-07-12)
- D2 US 2010/230104 A1 (NOELKE ROLF-DIETER [DE] ET AL) 16 September 2010 (2010-09-16)
- D3 US 5 105 742 A (SUMNER CYRIL R [US]) 21 April 1992 (1992-04-21)
- D4 US 2005/178282 A1 (BROOKS JAMES E [US] ET AL) 18 August 2005 (2005-08-18)

2 CLARITY

2.1 Independent claims 1, 8 and 20 are not clear.

2.2 The positive statements regarding novelty and inventive step made in the following paragraphs are conditional on overcoming the clarity issues as formulated in Item VIII of this written opinion.

3 INDEPENDENT CLAIM 1

3.1 D1 is regarded as being the prior art closest to the subject-matter of apparatus claim 1, and discloses (see fig. 2):

a wirelessly-connectable selective detonator assembly (60) configured for being electrically contactably received within a perforating gun assembly (36).

3.2 The subject-matter of claim 1 therefore differs from this known apparatus in that the detonator assembly is electrically received within a perforating gun without using a wired electrical connection, comprising:

a detonator shell configured for housing a fuse head and an electronic circuit board, the electronic circuit board is connected to the fuse head and is configured to allow for selective detonation of the detonator assembly;  
a detonator head extending from one end of the detonator shell, the detonator head comprising an electrically contactable line-in portion, an electrically

contactable line-out portion, and an insulator positioned between the line-in portion and the line-out portion, and the insulator electrically isolates the line-in portion from the line-out portion; and an electrically contactable ground portion;

wherein the ground portion in combination with the line-in portion and the line-out portion are configured to replace the wired electrical connection and complete the electrical connection merely by contact;

wherein the detonator assembly is configured to be electrically contactingly received within a detonator positioning assembly within the perforating gun assembly without using the wired electrical connection, and to selectively receive an ignition signal to fire the perforating gun assembly and is therefore new (Article 33(2) PCT).

- 3.3 The problem to be solved by the present invention may be regarded as how to improve safety associated with physical and manual wiring of live explosive.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

The surface signal typically travels from the surface along electrical wires that run from the surface to one or more detonators positioned within the perforating gun assembly. Since the electrical wire must extend through much of the perforating gun assembly, it is easily twisted and crimped during assembly. In addition, when a wired detonator is used it must be manually connected to the electrical wire, which has lead to multiple problems. Wires may be inadvertently disconnected, or even misconnected in error during assembly.

In order to mitigate these issues a detonator is configured to be received within a detonator positioning assembly through a direct contact connection, that is without the need to attach wires to the detonator.

#### 4 DEPENDENT CLAIMS 2-7

- 4.1 Claims 2-7 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

5 INDEPENDENT CLAIMS 8 and 20

5.1 Since the subject-matter of independent apparatus and method claims 8 and 20 corresponds to the subject matter of claim 1, the same reasoning as given for claim 1 will apply mutatis mutandis. Therefore claims 8 and 20 also meet the requirements of the PCT in respect of novelty and inventive step (Article 33(2) and (3) PCT).

6 DEPENDENT CLAIMS 9-19

6.1 Claims 9-19 are dependent on claim 8 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

**Re Item VII**

**7 Certain defects in the international application**

- 7.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in D1 is not mentioned in the description, nor is this document identified therein.
- 7.2 Independent claim 1, 8 and 20 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art document D1 being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- 7.3 The statement "incorporated by reference" in the description on page 5 should be deleted from the present application. If matter in the document referred to is essential to satisfy the requirements of Article 5 PCT, this matter should be incorporated into the description, because the patent specification should, regarding the essential features of the invention, be self-contained, that is, capable of being understood without reference to any other document (see PCT Guidelines II, 4.26).
- 7.4 The applicant is invited to correct the following errors:  
the term "fuse head" disclosed in claims 1, 8 and 20 is denoted with reference (14) instead of (15) as in paragraph [0022] of the description.

**Re Item VIII**

**8 Certain observations on the international application**

- 8.1 The terms "electrically contactably" and "electrically contactingly" used in claims 1, 6, 8, 11, 14, 18 and 20 are vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT. For sake of clarity these terms should be omitted from the claims and should read that the electrical connection is made only by contact, that is by merely physically touching of individual components, as in paragraphs [0023] or [0036] of the description.
- 8.2 The term "wirelessly-connectable" used in claims 1, 8 and 20 is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT. For sake of clarity this term should be omitted from the claims and should be clarified so that the reader is able to

understand that signal is not being wirelessly transmitted (as in a wireless network), but is being relayed through various components via direct electrical connections, as in paragraphs [0020] and [0021].

- 8.3 The application does not meet the requirements of Article 6 PCT, because claims 1 and 8 are not concise.
- 8.4 Although claims 1 and 8 have been drafted as separate independent apparatus claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

## Electronic Patent Application Fee Transmittal

<b>Application Number:</b>				
<b>Filing Date:</b>				
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM			
<b>First Named Inventor/Applicant Name:</b>	David C. Parks			
<b>Filer:</b>	Jason Marshall Rockman/Theresa Syms			
<b>Attorney Docket Number:</b>	DMC007USCon3			
Filed as Large Entity				
<b>Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)</b>				
<b>Description</b>	<b>Fee Code</b>	<b>Quantity</b>	<b>Amount</b>	<b>Sub-Total in USD(\$)</b>
<b>Basic Filing:</b>				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
REQUEST FOR PRIORITIZED EXAMINATION	1817	1	4000	4000
<b>Pages:</b>				
<b>Claims:</b>				
<b>Miscellaneous-Filing:</b>				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140
<b>Petition:</b>				
<b>Patent-Appeals-and-Interference:</b>				
<b>Post-Allowance-and-Post-Issuance:</b>				
<b>Extension-of-Time:</b>				
<b>Miscellaneous:</b>				
<b>Total in USD (\$)</b>				<b>5860</b>

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	35478041
<b>Application Number:</b>	16359540
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	9246
<b>Title of Invention:</b>	PERFORATION GUN COMPONENTS AND SYSTEM
<b>First Named Inventor/Applicant Name:</b>	David C. Parks
<b>Customer Number:</b>	81796
<b>Filer:</b>	Jason Marshall Rockman
<b>Filer Authorized By:</b>	
<b>Attorney Docket Number:</b>	DMC007USCon3
<b>Receipt Date:</b>	20-MAR-2019
<b>Filing Date:</b>	
<b>Time Stamp:</b>	16:29:43
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$5860
RAM confirmation Number	032119INTEFSW16301600
Deposit Account	
Authorized User	

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

<b>File Listing:</b>					
<b>Document Number</b>	<b>Document Description</b>	<b>File Name</b>	<b>File Size(Bytes)/ Message Digest</b>	<b>Multi Part /.zip</b>	<b>Pages (if appl.)</b>
1	TrackOne Request	DMC007USCon3_Track_One_Request.pdf	140359 a8840e223a29db651e137c8e90b83257cfe8dda	no	2
<b>Warnings:</b>					
<b>Information:</b>					
2		DMC007USCon3_Patent_Application_Final.pdf	146608 0cd3894025a3fe7571b88faa8a8972f7544577e3	yes	21
	<b>Multipart Description/PDF files in .zip description</b>				
	<b>Document Description</b>		<b>Start</b>	<b>End</b>	
	Abstract		21	21	
	Claims		17	20	
	Specification		1	16	
<b>Warnings:</b>					
<b>Information:</b>					
3	Drawings-only black and white line drawings	DMC007USCon3_Formal_Figures_Final.pdf	1116280 3af40381708e4b671eb0768425276103e997aadd	no	18
<b>Warnings:</b>					
<b>Information:</b>					
4	Application Data Sheet	DMC007USCon3_ADS.pdf	1874740 3f4ff25a6f1afb31e73d4101c7c152e51b67c55f	no	10
<b>Warnings:</b>					
<b>Information:</b>					
5	Transmittal of New Application	DMC007USCon3_Transmittal_Letter.pdf	280875 d93c30326eee5c15d9ed80e06f69aadbec1507e6	no	2

<b>Warnings:</b>					
<b>Information:</b>					
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8	Miscellaneous Incoming Letter	DMC007USCon3_3_73_Statement_executed.pdf	360689 6f2207337d1f9431efd79de8722bec7966c4aab1	no	2
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11	Foreign Reference	CN85107897A_ABSTRACT.pdf	225491 a114ca8df693397d10e3d505488d91539855318a	no	2
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23	Non Patent Literature	CN201480040456_9_Search_Report_in_Chinese.pdf	778938	no	12
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24	Non Patent Literature	CN201480040456_9_Translation_of_Search_Report.pdf	117891	no	3
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25	Non Patent Literature	NPL_1-4B_Electronic-Detonator-Product_info-Sheet_16Dec11.pdf	694785	no	1
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26	Non Patent Literature	NPL_1-4S_Electronic-Detonator-Product-Info-Sheet_16Dec11.pdf	663261 5e5facb04fb29ef25c928d038ee69af262ca89d4	no	1
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28	Non Patent Literature	NPL_Electronic-Top-Fire-Detonator_30Jul13.pdf	582283 8d0f13237fb38f9553c608ec63aa1bf96fec13d1	no	1
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29	Non Patent Literature	NPL_New_Select-Fire-system_Baker-Hughes_Presentation_29Apr13.pdf	1553784 ca7b1a327f1043049a0a96e2b584dc4d978f873b	no	16
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30	Non Patent Literature	NPL_SearchReport-WrittenOpinion_EP2014065752.pdf	574660 4191d9c2261377249df5f4fe9e2053c27572fff1	no	12
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31	Non Patent Literature	NPL_Selective_Perforating_Switch_Product_Info_Sheet_27May11.pdf	232898 bf8ec17ac2026a1aac6428223ddb958f54e90b01	no	1
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<b>Total Files Size (in bytes):</b>			23454494		

**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.**

**New Applications Under 35 U.S.C. 111**

**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.**

**National Stage of an International Application under 35 U.S.C. 371**

**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.**

**New International Application Filed with the USPTO as a Receiving Office**

**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.**

**CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION  
 UNDER 37 CFR 1.102(e) (Page 1 of 1)**

First Named Inventor:	David C. Parks et al.	Nonprovisional Application Number (if known):	
Title of Invention:	PERFORATION GUN COMPONENTS AND SYSTEM		

**APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.**

1. The processing fee set forth in 37 CFR 1.17(i), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, examination fee, and any required excess claims and application size fees are filed with the request or have been already been paid.
2. The application contains or is amended to contain no more than four independent claims and no more than thirty total claims, and no multiple dependent claims.
3. The applicable box is checked below:

**I.  Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**

- i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.  
 ---OR---  
 (b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.
- ii. An executed oath or declaration under 37 CFR 1.63 is filed with the application.

**II.  Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**

- i. A request for continued examination has been filed with, or prior to, this form.
- ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
- iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
- iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
- v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Jason M. Rockman/	Date March 20, 2019
Name (Print/Typed) Jason M. Rockman	Practitioner Registration Number 63473

**Note:** Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below\*.

\*Total of \_\_\_\_\_ forms are submitted.

## Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

**PERFORATION GUN COMPONENTS AND SYSTEM****ABSTRACT**

Components for a perforation gun system are provided including combinations of components including a self-centralizing charge holder system and a bottom connector that can double as a spacer. Any number of spacers can be used with any number of holders for any desired specific metric or imperial shot density, phase and length gun system.

## CLAIMS

## What Is Claimed Is:

1. A perforating gun, comprising:
  - an outer gun carrier;
  - a charge holder positioned within the outer gun carrier and including at least one shaped charge; and
  - a detonator contained entirely within the outer gun carrier, the detonator including
    - a detonator body containing detonator components,
    - a wireless bulkhead connector portion, a wireless through wire connecting portion, and a wireless ground portion, and
    - an insulator electrically isolating the wireless bulkhead connector portion from the wireless through wire connecting portion.
2. The perforating gun of claim 1, further comprising a through wire for relaying an electrical signal along a length of the charge holder, wherein the through wire is a wire and the wireless through wire connecting portion is in electrical contact with the through wire.
3. The perforating gun of claim 1, wherein the charge holder is an injection molded part.
4. The perforating gun of claim 1, further comprising a bulkhead, wherein the bulkhead includes a contact pin in wireless electrical contact with the wireless bulkhead connector portion.
5. The perforating gun of claim 4, wherein the contact pin transfers an electrical signal from a previous wellbore tool to the wireless bulkhead connector portion.
6. The perforating gun of claim 4, wherein at least a portion of the bulkhead is contained within a tandem seal adapter, and the wireless ground portion is in wireless electrical contact with the tandem seal adapter.

7. The perforating gun of claim 1, further comprising a top connector, wherein the detonator is positioned within the top connector.
8. The perforating gun of claim 7, wherein the top connector is an injection molded part.
9. A modular detonator, comprising:
  - a detonator body containing detonator components;
  - a wireless bulkhead connecting portion;
  - a wireless through wire connecting portion;
  - a wireless ground portion;
  - a signal-in wire electrically connecting at least in part the wireless bulkhead connecting portion to at least one of the detonator components; and
  - an insulator electrically isolating the bulkhead connecting portion from the through wire connecting portion.
10. The modular detonator of claim 9, further comprising a detonating cord connecting portion, wherein the detonating cord connecting portion is sized to retain a detonating cord and positioned to energetically couple the detonating cord to the detonator.
11. A method for assembling a perforation gun system, comprising:
  - (a) inserting a charge holder within a hollow interior of an outer gun carrier, wherein the charge holder includes a detonating cord connected to the charge holder and at least one shaped charge;
  - (b) inserting a detonator into the outer gun carrier, the detonator including
    - a detonator body containing detonator components,
    - a wireless bulkhead connector portion, a wireless through wire connecting portion, and
    - a wireless ground portion, and

an insulator electrically isolating the wireless bulkhead connector portion from the wireless through wire connecting portion; and

(c) connecting a through wire to the wireless through wire connecting portion.

12. The method of claim 11, further comprising:

(d) inserting a top connector into the outer gun carrier adjacent to the charge holder, the top connector comprising a hollow channel; and

(e) energetically coupling the detonating cord to the detonator,

wherein inserting the detonator into the outer gun carrier includes inserting the detonator into the hollow channel.

13. The method of claim 11, wherein inserting the detonator into the outer gun carrier includes pushing the detonator into the outer gun carrier.

14. The method of claim 11, wherein the through wire is a wire, and the wireless through wire connecting portion of the detonator is in electrical contact with the through wire.

15. The method of claim 11, further comprising connecting a bulkhead into the outer gun carrier, wherein the bulkhead includes a contact pin and connecting the bulkhead into the outer gun carrier includes placing the contact pin in wireless electrical contact with the wireless bulkhead connector portion.

16. The method of claim 12, wherein one or more of steps (a), (c), and (d) is performed at a factory or a facility that is not a wellbore site.

17. The method of claim 12, further comprising transporting the perforation gun system to a wellbore site, wherein at least one of steps (a), (c), and (d) is performed before transporting the perforation gun system, and step (b) is performed at the wellbore site.

18. The method of claim 12, further comprising performing a continuity test to ensure continuity between one or more electrical connections of the perforation gun system.
19. The method of claim 12, wherein performing at least steps (a) – (c) and (e) a first time with a first set of components completes a first perforating gun segment and the method further comprises:
- performing at least steps (a) – (c) and (e) a second time with a second set of components to complete a second perforating gun segment; and
  - connecting the second perforating gun segment to the first perforating gun segment.
20. The method of claim 11, wherein the detonator further includes a signal-in portion wire electrically connecting at least in part the wireless bulkhead connecting portion to at least one of the detonator components.

**PERFORATION GUN COMPONENTS AND SYSTEM****CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application is a continuation of U.S. Patent Application No. 15/920,812 filed March 14, 2018, which is a continuation of U.S. Patent Application No. 15/617,344 filed June 8, 2017, which is a divisional patent application of U.S. Patent Application No. 15/287,309 filed October 6, 2016, which is a divisional patent application of U.S. Patent Application No. 14/904,788 filed January 13, 2016, which claims priority to PCT Application No. PCT/CA2014/050673 filed July 16, 2014, which claims priority to Canadian Patent Application No. 2,821,506 filed July 18, 2013, each of which is incorporated herein by reference in its entirety.

**FIELD**

[0002] A perforation gun system is generally described. More particularly, various perforation gun components that can be modularly assembled into a perforation gun system, the assembled perforated gun system itself, a perforation gun system kit, and a method for assembling a perforation gun system are generally described.

**BACKGROUND**

[0003] Perforation gun systems are used in well bore perforating in the oil and natural gas industries to tie a bore hole with a storage horizon within which a storage reservoir of oil or natural gas is located.

[0004] A typical perforation gun system consists of an outer gun carrier, arranged in the interior of which there are perforators-usually hollow or projectile charges-that shoot radially outwards through the gun carrier after detonation. Penetration holes remain in the gun carrier after the shot.

[0005] In order to initiate the perforators, there is a detonating cord leading through the gun carrier that is coupled to a detonator.

[0006] Different perforating scenarios often require different phasing and density of charges or gun lengths. Moreover, it is sometimes desirable that the perforators shooting radially outwards from the gun carrier be oriented in different directions along the length of the barrel. Therefore, phasing may be required between different guns along the length.

[0007] Onsite assembly of perforation gun systems may also be problematic under certain conditions as there are certain safety hazards inherent to the assembly of perforation guns due to the explosive nature of certain of its sub-components, including the detonator and the detonating cord.

[0008] There is thus a need for a perforation gun system, which by virtue of its design and components would be able to address at least one of the above-mentioned needs, or overcome or at least minimize at least one of the above-mentioned drawbacks.

#### SUMMARY

[0009] According to an embodiment, an object is to provide a perforation gun system that addresses at least one of the above-mentioned needs.

[0010] According to an embodiment, there is provided a perforation gun system having an outer gun carrier and comprising:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connected to the top connector and to each stackable charge holder;
- at least one bottom connector for terminating the detonation cord in the gun system; and
- a detonator energetically coupled to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a rotation coupling for providing a selectable clocking rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

[0011] In some embodiments, the bottom connector may double as a spacer for spacing a plurality of stackable charge holders, and may either act as a metric dimensioned spacer or as an imperial dimensioned spacer for any specific metric or imperial shot density, phase and length gun system.

[0012] According to another aspect, there is also provided a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:

- a top connector;

- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector.

[0013] According to another aspect, there is also provided a method for assembling a perforation gun system, comprising the steps of:

providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier, the kit comprising a combination of:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;
- at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and
- a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;

assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;

running the detonation cord into a bottommost bottom connector;

assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;

running a through wire between the bottommost bottom connector and the top connector, so that the wire goes from the top connector to the bottom connector;

clicking the detonation cord into recesses formed in capturing projections, the captured projections being provided in each of the charge holders;

running the detonation cord into the top connector;

cutting the detonator cord; and

installing charges into each of the charge holders.

[0014] A number of optional steps that are detailed below may be added to the above-described steps of the method.

[0015] According to another aspect, there is also provided a top connector for a perforation gun system comprising:

- a coupler for providing energetic coupling between a detonator and a detonating cord;
- at least one directional locking fin for locking the top connector within a gun carrier;
- a rotation coupling for providing a selectable clocking rotation between the top connector, and a charge holder

wherein the top connector is configured to receive electrical connections therethrough.

[0016] According to another aspect, there is also provided a stackable charge holder for a perforation gun system having an outer gun carrier, the charge holder comprising:

- a charge receiving structure for receiving a single shaped charge;
- a plurality of projections for centralizing the shaped charge within the gun carrier; and
- at least one rotation coupling for providing a selectable clocking rotation between the charge holder and an adjacent component in the perforation gun system;

wherein a pair of the plurality of projections is configured for capturing a detonation cord traversing the charge holder.

[0017] According to another aspect, there is also provided a bottom connector for a perforation gun system comprising:

- a terminating structure arranged for terminating a detonation cord in the gun system;
  - a plurality of wings or fins for axially locking the bottom connector to a snap ring fixed in the carrier.
  - a rotation coupling for providing a selectable clocking rotation between the bottom connector and a charge holder;
- wherein the rotation coupling is arranged such that bottom connector doubles as a spacer for spacing a plurality of stackable charge holders.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] These and other objects and advantages will become apparent upon reading the detailed description and upon referring to specific embodiments thereof that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments and are not therefore to be considered to be limiting of its scope, exemplary embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0019] FIG. 1 is a side cut view of a perforation gun system according to an embodiment;

[0020] FIG. 2 is a side view of a top connector, bottom connector and stackable charge holders of a perforation gun system in accordance with another embodiment;

[0021] FIG. 3 is a side view of a top connector, bottom connector and stackable charge holders of a perforation gun system in accordance with another embodiment;

[0022] FIG. 4 is a front perspective view of a bottom connector in accordance with an embodiment;

[0023] FIG. 5 is a rear perspective view of the bottom connector shown in FIG. 4;

[0024] FIG. 6 is a front view of a stackable charge holder in accordance with an embodiment;

[0025] FIG. 7 is a front perspective view of the stackable charge holder shown in FIG. 6;

[0026] FIG. 8 is a rear perspective view of the stackable charge holder shown in FIG. 6;

[0027] FIG. 9 is a bottom view of the stackable charge holder shown in FIG. 6;

[0028] FIG. 10 is a top view of the stackable charge holder shown in FIG. 6;

- [0029] FIG. 11 is a bottom view of a half-portion of a top connector in accordance with an embodiment;
- [0030] FIG. 12 is a side view of the half-portion of the top connector shown in FIG. 11;
- [0031] FIG. 13 is a top perspective view of the half-portion of the top connector shown in FIG. 11;
- [0032] FIG. 14 is a bottom perspective view of the half-portion of the top connector shown in FIG. 11;
- [0033] FIG. 15 is a perspective view of a top connector in accordance with an embodiment;
- [0034] FIG. 16 is a front end view of the top connector shown in FIG. 15;
- [0035] FIG. 17 is a rear end view of the top connector shown in FIG. 15;
- [0036] FIG. 18 is a rear perspective view of the top connector shown in FIG. 15;
- [0037] FIG. 19 is an enlarged detailed side cut view of a portion of the perforation gun system including a bulkhead and stackable charge holders shown in FIG. 1;
- [0038] FIG. 20 is a perspective view of a bottom sub of a gun system in accordance with an embodiment;
- [0039] FIG. 21 is a side view of a gun carrier of a gun system in accordance with an embodiment;
- [0040] FIG. 22 is a side cut view of the gun carrier shown in FIG. 21;
- [0041] FIG. 23 is a side view of a top sub of a gun system in accordance with an embodiment;
- [0042] FIG. 24 is a side cut view of the top sub shown in FIG. 23;
- [0043] FIG. 25 is a side view of a tandem seal adapter of a gun system in accordance with an embodiment;
- [0044] FIG. 26 is a perspective view of the tandem seal adapter shown in FIG. 25;
- [0045] FIG. 27 is a perspective view of a detonator in accordance with an embodiment;
- [0046] FIG. 28 is a detailed perspective view of the detonator shown in FIG. 27;
- [0047] FIG. 29 is another detailed perspective view of the detonator shown in FIG. 27;

[0048] FIG. 30 is another detailed perspective view of the detonator shown in FIG. 27;

[0049] FIG. 31 is another detailed perspective view of the detonator shown in FIG. 27, with a crimp sleeve;

[0050] FIG. 32 is a detailed side view of a tandem seal adapter and detonator in accordance with another embodiment;

[0051] FIG. 33 is a side cut view of a portion of a perforation gun system illustrating the configuration of the top sub in accordance with another embodiment;

[0052] FIG. 34 is a side cut view of a portion of a perforation gun system illustrating the configuration of the bottom sub in accordance with another embodiment; and

[0053] FIGS. 35A and 35B are electrical schematic views of a detonator and of wiring within a perforated gun system in accordance with another embodiment.

#### DETAILED DESCRIPTION

[0054] In the following description and accompanying FIGS., the same numerical references refer to similar elements throughout the FIGS. and text. Furthermore, for the sake of simplicity and clarity, namely so as not to unduly burden the FIGS. with several reference numbers, only certain FIGS. have been provided with reference numbers, and components and features of the embodiments illustrated in other FIGS. can be easily inferred therefrom. The embodiments, geometrical configurations, and/or dimensions shown in the FIGS. are for exemplification purposes only. Various features, aspects and advantages of the embodiments will become more apparent from the following detailed description.

[0055] Moreover, although some of the embodiments were primarily designed for well bore perforating, for example, they may also be used in other perforating scenarios or in other fields, as apparent to a person skilled in the art. For this reason, expressions such as “gun system”, etc., as used herein should not be taken as to be limiting, and includes all other kinds of materials, objects and/or purposes with which the various embodiments could be used and may be useful. Each example or embodiment are provided by way of explanation, and is not meant as a limitation and does not constitute a definition of all possible embodiments.

[0056] In addition, although some of the embodiments are illustrated in the accompanying drawings comprise various components and although the embodiment of the adjustment system as

shown consists of certain geometrical configurations as explained and illustrated herein, not all of these components and geometries are essential and thus should not be taken in their restrictive sense, i.e. should not be taken as to limit the scope. It is to be understood, as also apparent to a person skilled in the art, that other suitable components and cooperations thereinbetween, as well as other suitable geometrical configurations may be used for the adjustment systems, and corresponding parts, according to various embodiments, as briefly explained and as can easily be inferred herefrom by a person skilled in the art, without departing from the scope.

[0057] Referring to FIGS. 1 to 3, an object is to provide a perforation gun system 10 having an outer gun carrier 12. The gun system 10 includes a top connector 14. At least one stackable charge holder 16 is provided for centralizing a single shaped charge 18 within the gun carrier 12. A detonation cord 20 is connected to the top connector 14 and to each stackable charge holder 16.

[0058] The gun system 10 includes at least one bottom connector 22 for terminating the detonation cord 20 in the gun system. As better shown in FIG. 2, it is also possible that the bottom connector 22 double as or serve the function of a spacer 24 for spacing a plurality of stackable charge holders 16.

[0059] In an embodiment, the gun system also includes a detonator 26 energetically coupled to the detonation cord 20.

[0060] As better shown in FIGS. 4 to 18, each of the top connector 14, stackable charge holder 16 and bottom connector 22 includes a rotation coupling 30 for providing a selectable clocking rotation between each of the above-mentioned components. As seen, for instance, in Figs. 4-5 and 7-9, the rotation coupling 30 includes a first rotation coupling 30a and a second rotation coupling 30b.

[0061] Hence, a user can build multiple configurations of gun systems using various combinations of basic components. A first of these basic components includes a top connector. Another basic component is a single charge holder that centralizes a single shaped charge. The holder is adapted to be stacked and configured into 0, 30, 60, up to 360 degrees or any other combination of these phases for any specified length. Another basic component is a bottom connector that terminates the detonation cord in the gun. The bottom connector may carry as well an electrical connection therethrough. The bottom connector may also double as an imperial measurement stackable spacer to provide any gun shot density up to, for example, 6 shots per foot.

Alternately, another bottom connector may be provided or configured to double as a metric measurement stackable spacer to provide any gun shot density up to, for example, 20 shots per meter. Another basic component includes a push-in detonator that does not use wires to make necessary connections. The push-in detonator may use spring-loaded connectors, thus replacing any required wires and crimping.

[0062] Therefore, within the self-centralizing charge holder system, any number of spacers can be used with any number of holders for any specific metric or imperial shot density, phase and length gun system.

[0063] In an embodiment, only two pipe wrenches are required for assembly on site of the gun system, as no other tools are required.

[0064] In an embodiment, the top connector 14 provides energetic coupling between the detonator and detonating cord.

[0065] In an embodiment, each of the top connector 14, stackable charge holder 16 and bottom connector 22 are configured to receive electrical connections therethrough.

[0066] In an embodiment, all connections are made by connectors, such as spring-loaded connectors, instead of wires, with the exception of the through wire that goes from the top connector 14 to the bottom connector 22, whose ends are connectors.

[0067] In an embodiment, components of the assembly may include molded parts, which may also be manufactured to house the wiring integrally, through, for instance, overmolding, to encase the wiring and all connectors within an injection molded part. For example, the charge holder 16 could be overmolded to include the through wire.

[0068] In an embodiment, and as shown in FIGS. 4 and 5, each bottom connector 22 includes a cylindrical body 220 comprising a first base 222 and a second base 224. The pins 50 outwardly extend from the first base 222, and the sockets 52 at least partially extend into the second base 224. As illustrated in FIGS 4 and 5, each socket 52 is spaced apart from an adjacent socket and each pin 50 is spaced apart from an adjacent pin. The cylindrical body 220 may include a plurality of alternating v-shaped channels 221 and v-shaped walls 223. The v-shaped channels partially extend from the first base 222 towards the second base 224, and the v-shaped walls 223 extend from the second base 224 to the first base 222. At least one of the pins 50 of the

rotation coupling 30 extend from one of the v-shaped walls 223. According to an aspect, when the bottom connector includes the first rotation coupling 30a and the second rotation coupling 30b, the cylindrical body 220 extends therebetween. The bottom connector 22 includes a plurality of fins / wings 32 radially extending from the body 220. The wings 32 are configured for axially locking each bottom connector against a snap ring 54, or an equivalent retainment mechanism to keep the charge holder 16 from sliding out of the bottom of carrier 12 as it is handled, (shown on FIG. 1). According to an aspect, and as illustrated in FIG. 19, the bottom connector 22 may be recessed into a recess 49 formed in the tandem seal adapter 48. The bottom connector 22 from a first gun assembly can accommodate or house an electrical connection through a bulkhead assembly 58 to the top connector 14 of a second or subsequent gun assembly, as seen for instance in FIG. 19. The top and bottom connector, as well as the spacer, in an embodiment, are made of 15% glass fiber reinforced, injection molding PA6 grade material, commercially available from BASF under its ULTRAMID® brand, and can provide a positive snap connection for any configuration or reconfiguration. As better shown in FIG. 5, a terminating means structure 34 is provided to facilitate terminating of the detonation cord. The structure 34 may be formed in the first base 222. The snap ring 54 is preinstalled on the bottom of the carrier 12. The assembly can thus shoulder up to the snap ring 54 via the bottom connector fins 32.

[0069] In an embodiment and as shown in FIGS. 6 to 10, each stackable charge holder 16 includes a charge receiving structure for receiving a single shaped charge, and a plurality of projections 40 extending from the charge receiving structure. The projections 40 may rest against an inner surface 13 or diameter of the gun carrier 12 (as shown in FIG. 1) and thereby centralizing the shaped charge therewithin. The charge receiving structure may include a pair of arms 44, and each projection 40 may extend from at least one of the arms 44. A pair 42 of the plurality of projections 40 may also be configured for capturing the detonation cord (not shown) traversing each stackable charge holder 16. The pair 42 of the plurality of projections are also used for centralizing the shaped charge within an inner surface of the gun carrier. According to an aspect, the stackable charge holder 15 includes a first base 222 and a second base 224 spaced apart from the first base 222. The arms 44 extend between the first and second bases 222, 224. According to an aspect, the pins 50 outwardly extend from the first base 222, and the sockets 52 at least partially extend into the second base 224. Each pin is spaced apart from an adjacent pin, and each socket 52 is spaced apart from an adjacent socket.

[0070] In an embodiment, as shown in FIGS. 11 to 18, the top connector 14 includes a first end 242, a second end 244, and a coupler 246 formed at the first end 242. The top connector 14 may be configured for providing energetic coupling between the detonator 26 and a detonation cord. According to an aspect and as illustrated in FIGS. 11 and 14, an elongated opening 247 extends from the second end 244, adjacent the coupler 246, towards the first end 242. The elongated opening 247 is flanked by side walls 248 that provide the energetic coupling between the detonator 26 and the detonation cord 20. A rotation coupling 30 is formed at the second end 244. The rotation coupling includes at least one of a plurality of pins 50 and a plurality of sockets 52. According to an aspect, the top connector 14 includes at least one directional locking fin 46. Although the use of directional locking fins is described, other methods of directional locking may be used, in order to eliminate a top snap ring that would otherwise be used to lock the assembly. As better shown in FIG. 19, the locking fins 46 are engageable with corresponding complementarily-shaped structures 47 housed within the carrier 12, upon a rotation of the top connector 14, to lock the position of the top connector along the length of the carrier 12.

[0071] In an embodiment, as better shown in FIG. 19, the bottom connector 22 on one end and the top connector 14 on the other end abuts/connects to the bulkhead assembly 58. The tandem seal adapter 48 is configured to seal the inner components within the carrier 12 from the outside environment, using sealing means 60 (shown herein as o-rings). Thus, the tandem seal adapter 48 seals the gun assemblies from each other along with the bulkhead 58, and transmits a ground wire to the carrier 12. Hence, the top connector 14 and bulkhead 58 accommodate electrical and ballistic transfer to the charges of the next gun assembly for as many gun assembly units as required, each gun assembly unit having all the components of a gun assembly.

[0072] In an embodiment, the tandem seal adapter 48 is a two-part tandem seal adapter (not shown) that fully contains the bulkhead assembly 58 (comprised of multiple small parts as shown, for instance, in FIG. 19) and that is reversible such that it has no direction of installation.

[0073] In an embodiment and as better shown in FIGS. 27-31 and 35A, the detonator assembly 26 includes a detonator head 100, a detonator body 102 and a plurality of detonator wires 104, including a through wire 106, a signal-in wire 108 and a ground wire 110. The through wire 106 traverses from the top to the bottom of the perforating gun system 10, making a connection at each charge holder 16. The detonator head 100 further includes a through wire

connector element 112 connected to the through wire 106 (not shown), a ground contact element 114 for connecting the ground wire 110 to the tandem seal adapter (also not shown), through ground springs 116, and a bulkhead connector element 118 for connecting the signal-in wire 108 to the bulkhead assembly 58 (also not shown). Different insulating elements 120A, 120B are also provided in the detonator head 100 for the purpose of insulating the detonator head 100 and detonator wires 104 from surrounding components. As better shown in FIG. 31, a crimp sleeve 122 can be provided to cover the detonator head 100 and body 102, thus resulting in a more robust assembly. The above configuration allows the detonator to be installed with minimal tooling and wire connections.

[0074] In an embodiment as shown in FIGS. 32, 33 and 35B illustrate a connection of the above-described detonator assembly 26 to the tandem seal adapter 48 and a pressure bulkhead 124. The bulkhead 124 includes spring connector end interfaces comprising contact pins 126A, 126B, linked to coil springs 128A, 128B. This dual spring pin connector assembly including the bulkhead 124 and coil springs 128A, 128B is positioned within the tandem seal adapter 48 extending from a conductor slug 130 to the bulkhead connector element. The dual spring pin connector assembly is connected to the through wire 106 of the detonator assembly 26.

[0075] In an embodiment and as better shown in FIGS. 11 to 18, the top connector 14 may have a split design to simplify manufacturing and aid in assembly. By “split design” what is meant is that the top connector 14 can be formed of two halves - a top half 15A and a bottom half 15B. A plurality of securing mechanisms 241 may be provided to couple the top half 15A to the bottom half 15B. As better shown in FIGS. 15 or 18, the top connector 14 may also include a blind hole 45 to contain or house the detonation cord, thus eliminating the need for crimping the detonation cord during assembly.

[0076] In an embodiment and as shown for example in FIGS. 4 to 18, the rotation coupling 30 may either include a plurality of pins 50 (FIG. 5) symmetrically arranged about a central axis of the rotation coupling 30, or a plurality of sockets 52 (FIG. 4) symmetrically arranged about the central axis of the rotation coupling 30 and configured to engage the plurality of pins 50 of an adjacent rotation coupling 30. The pins each include a first end 51a, and a second end 51b opposite the first end 51a. According to an aspect, the second end 51b is wider than the first end 51a.

[0077] In another embodiment, the rotation coupling 30 may either include a polygon-shaped protrusion, or a polygon-shaped recess configured to engage the polygon-shaped protrusion of an adjacent rotation coupling. The polygon can be 12-sided for example for 30 degree increments.

[0078] In another embodiment, the top and bottom subs work with off the shelf running/setting tools as would be understood by one of ordinary skill in the art.

[0079] In one embodiment and as shown in FIG. 33, the top sub 72 facilitates use of an off the shelf quick change assembly 140 to enable electrical signals from the surface, as well as to adapt perforating gun system to mechanically run with conventional downhole equipment. The quick change assembly 140 may include a threaded adapter 143 to set an offset distance between an electrical connector 142 and the contact pin 126B extending from the bulkhead assembly 58.

[0080] In one embodiment and as shown in FIG. 34, the bottom sub 70 may be configured as a sealing plug shoot adapter (SPSA) to be used specifically with this embodiment. The SPSA may receive an off the shelf quick change assembly 140 (not shown) and insulator 150 that communicates with a firing head threaded below it (not shown). A setting tool (not shown) may run on the bottom side of the perforating gun.

[0081] In an embodiment, final assembly of the tool string requires only two pipe wrenches. No tools are required to install the detonator or any electrical connections.

[0082] An object is to also provide a perforation gun system kit having the basic component parts described above and capable of being assembled within an outer gun carrier.

[0083] In an embodiment, a method for assembling a perforation gun system is provided, to which a certain number of optional steps may be provided. The steps for assembling the gun system for transport include the steps of:

providing a perforation gun system kit having component parts capable of being assembled within an outer gun carrier (element 12 in FIGS. 1, 21 and 22), the kit comprising a combination of:

- a top connector;
- at least one stackable charge holder for centralizing a single shaped charge within the gun carrier;
- a detonation cord connectable to the top connector and to each stackable charge holder;

-at least one bottom connector adapted for terminating the detonation cord in the gun system and adapted for doubling as a spacer for spacing a plurality of stackable charge holders; and

-a detonator energetically couplable to the detonation cord,

wherein each of the top connector, at least one stackable charge holder and at least one bottom connector comprise a coupling having a plurality of rotational degrees of freedom for providing a selectable rotation between each of the top connector, at least one stackable charge holder and at least one bottom connector;

assembling a plurality of the stackable charge holders in a predetermined phase to form a first gun assembly;

running the detonation cord into a bottommost bottom connector;

assembling the bottommost bottom connector onto the assembled plurality of stackable charge holders;

running a through wire between the bottommost bottom connector and the top connector, so that the through wire goes from the top connector to the bottom connector;

clicking the detonation cord into recesses formed in capturing projections, the capturing projections being provided in each of the charge holders;

running the detonation cord into the top connector;

cutting the detonator cord, if the detonator cord is not precut a predetermined length; and

installing charges into each of the charge holders.

[0084] In an embodiment, the method further includes, prior to transport, the steps of:

pushing assembled components together to engage all pin connections therebetween; and

carrying out a continuity test to ensure complete connectivity of the detonating chord.

[0085] In an embodiment, on location, to complete the assembly, the method further comprises the steps of

threading on the previously assembled components a bottom sub (element 70 on FIGS. 1 and 20);

installing and connecting the detonator;

pushing in a tandem seal adapter with o-rings onto the first gun assembly;

pushing in a bulkhead (element 58 in FIG. 19) onto the tandem seal adapter, if the bulkhead and the tandem seal adapter are not pre-assembled;

threading a subsequent gun assembly onto the first gun assembly or threading a top sub (element 72 in FIGS. 1, 23 and 24) onto a topmost assembled gun assembly, for connection to a quick change assembly.

[0086] Of course, the scope of the perforation gun system, various perforation gun components, the perforation gun system kit, and the method for assembling a perforation gun system should not be limited by the various embodiments set forth herein, but should be given the broadest interpretation consistent with the description as a whole. The components and methods described and illustrated are not limited to the specific embodiments described herein, but rather, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. Further, steps described in the method may be utilized independently and separately from other steps described herein. Numerous modifications and variations could be made to the above-described embodiments without departing from the scope of the FIGS. and claims, as apparent to a person skilled in the art.

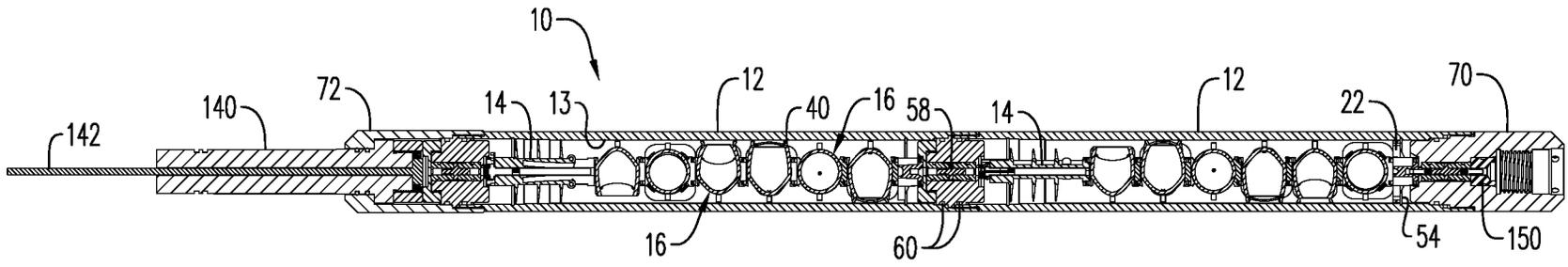
[0087] In this specification and the claims that follow, reference will be made to a number of terms that have the following meanings. The singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Further, reference to "top," "bottom," "front," "rear," and the like are made merely to differentiate parts and are not necessarily determinative of direction. Similarly, terms such as "first," "second," etc. are used to identify one element from another, and unless otherwise specified are not meant to refer to a particular order or number of elements.

[0088] As used herein, the terms "may" and "may be" indicate a possibility of an occurrence within a set of circumstances; a possession of a specified property, characteristic or function; and/or qualify another verb by expressing one or more of an ability, capability, or possibility associated with the qualified verb. Accordingly, usage of "may" and "may be" indicates that a modified term is apparently appropriate, capable, or suitable for an indicated capacity, function, or usage, while taking into account that in some circumstances the modified term may sometimes not be appropriate, capable, or suitable. For example, in some circumstances

an event or capacity can be expected, while in other circumstances the event or capacity cannot occur--this distinction is captured by the terms "may" and "may be."

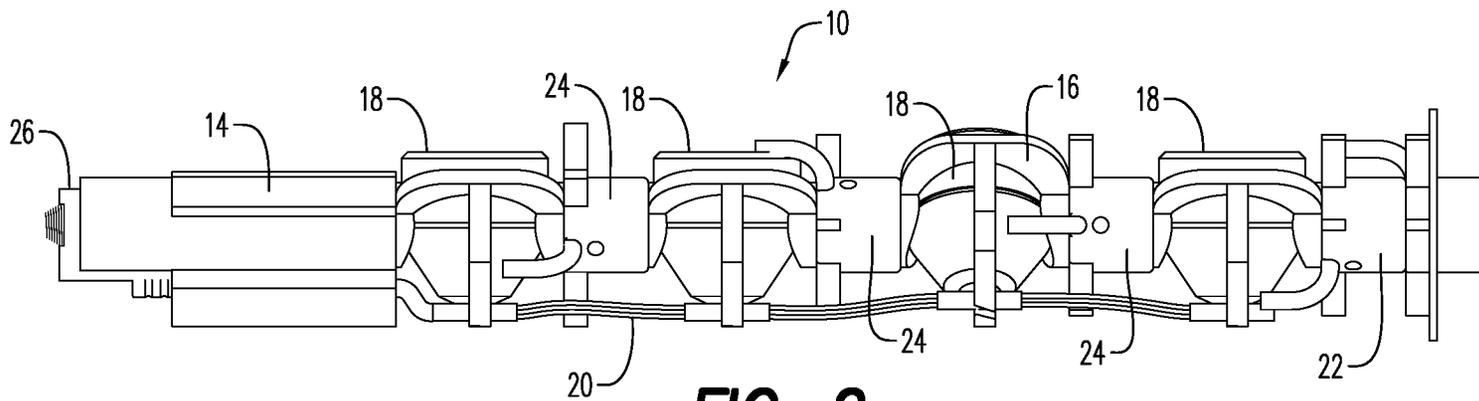
[0089] As used in the claims, the word "comprises" and its grammatical variants logically also subtend and include phrases of varying and differing extent such as for example, but not limited thereto, "consisting essentially of" and "consisting of."

[0090] Advances in science and technology may make equivalents and substitutions possible that are not now contemplated by reason of the imprecision of language; these variations should be covered by the appended claims. This written description uses examples to disclose the perforation gun system, various perforation gun components, the perforation gun system kit, and the method for assembling a perforation gun system, including the best mode, and also to enable any person of ordinary skill in the art to practice same, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the perforation gun system, various perforation gun components, the perforation gun system kit, and the method for assembling a perforation gun system is defined by the claims, and may include other examples that occur to those of ordinary skill in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

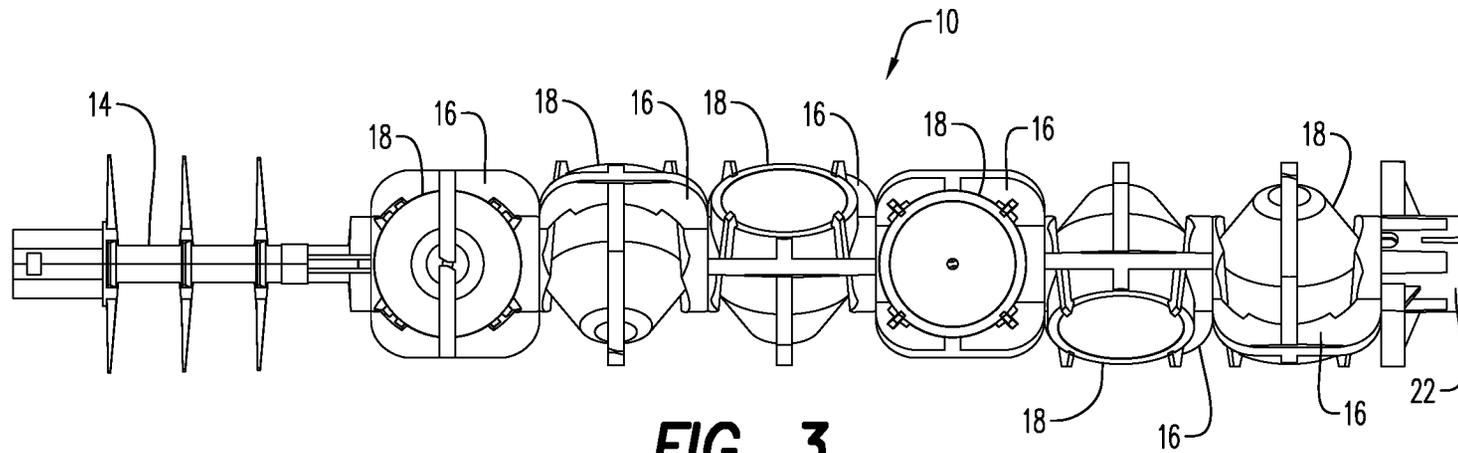


1/18

**FIG. 1**



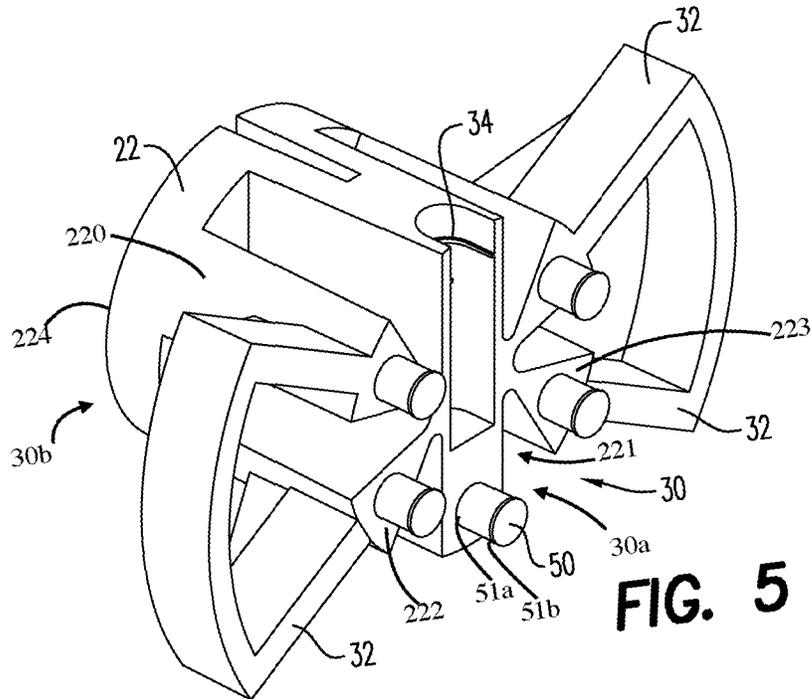
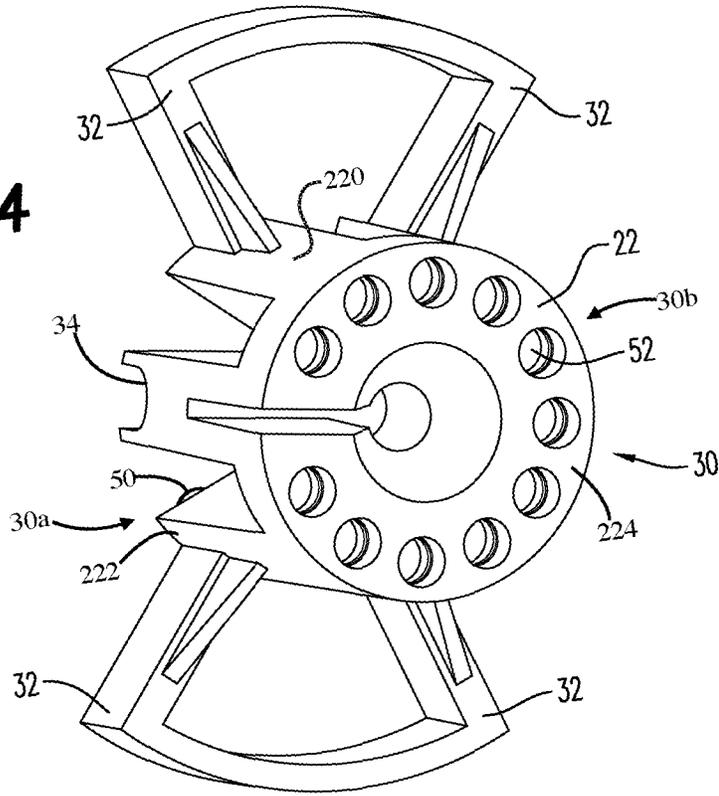
**FIG. 2**



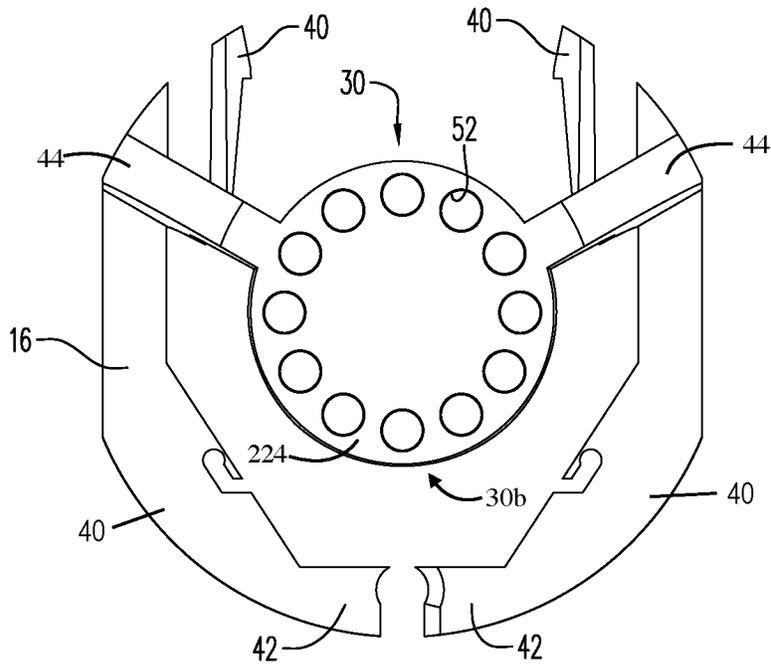
**FIG. 3**

2/18

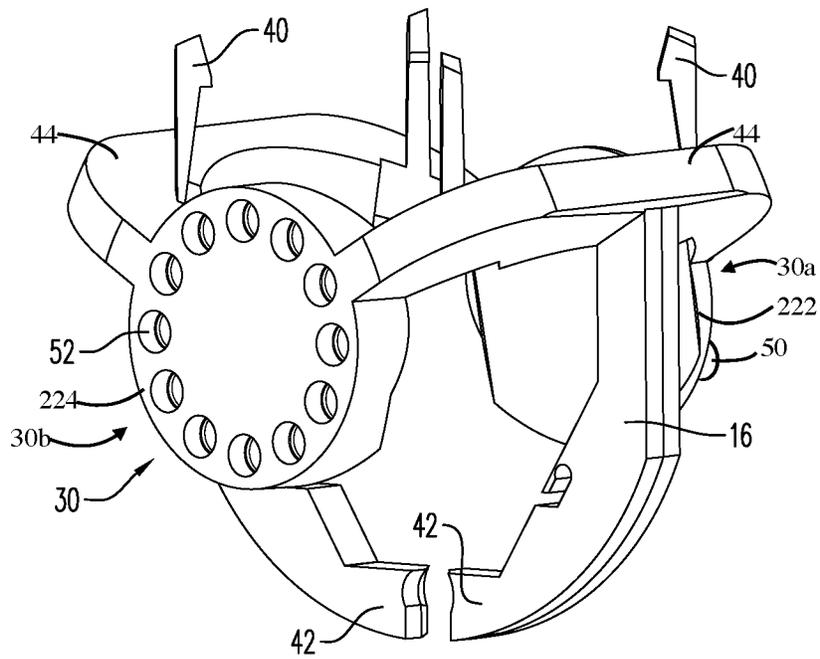
**FIG. 4**



**FIG. 5**

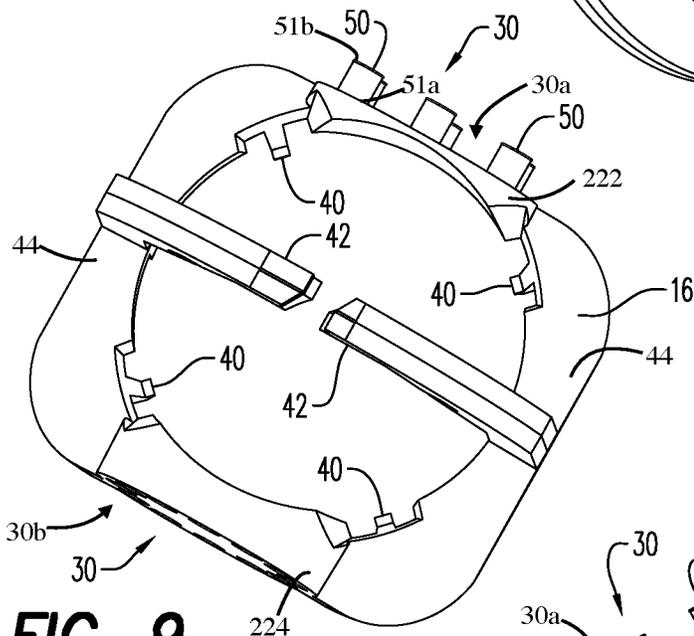
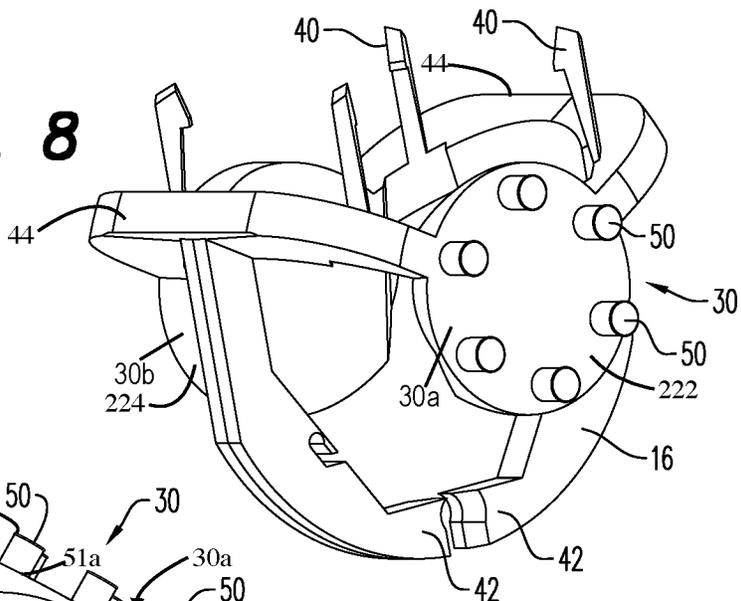


**FIG. 6**

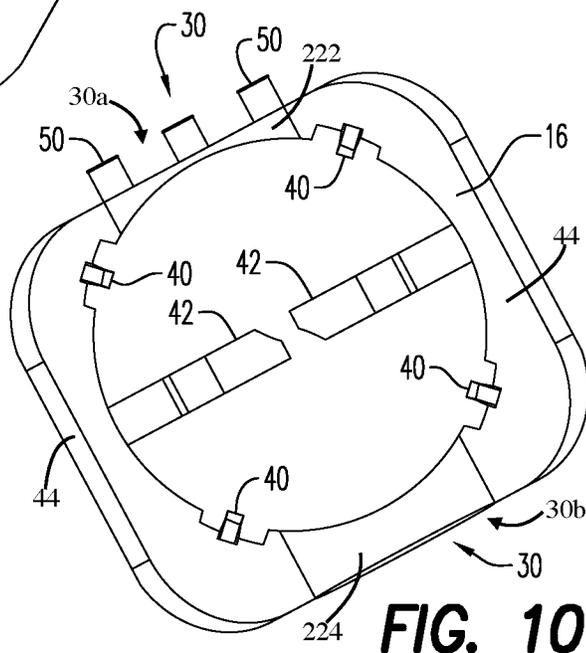


**FIG. 7**

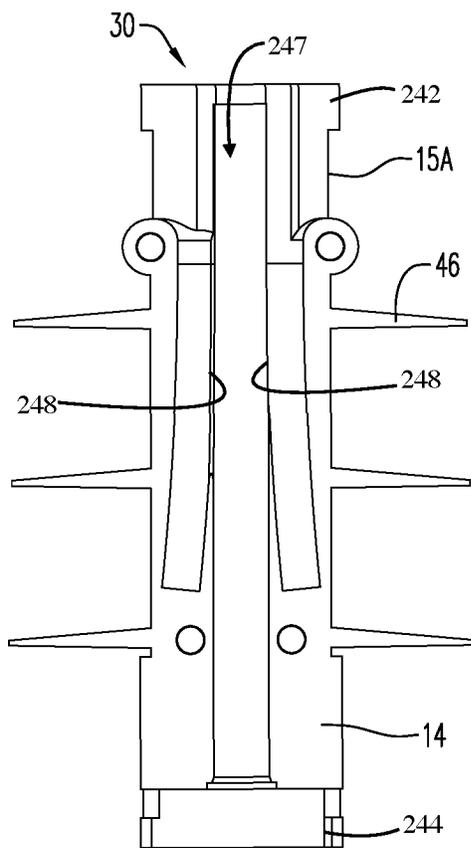
**FIG. 8**



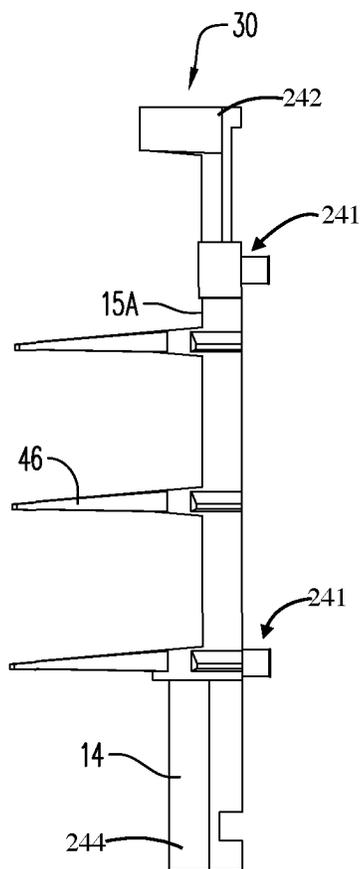
**FIG. 9**



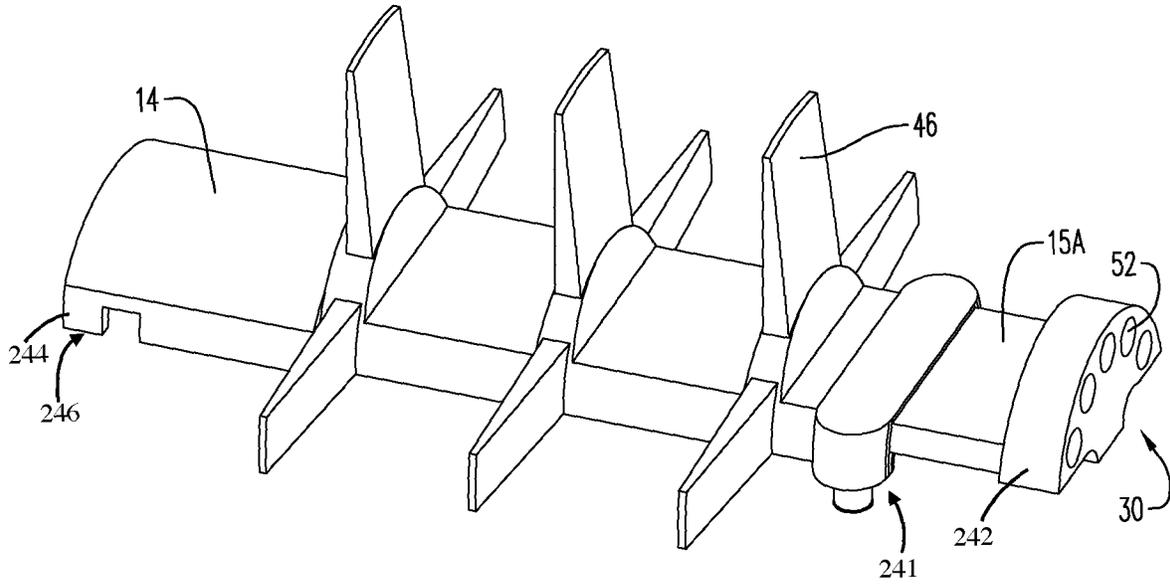
**FIG. 10**



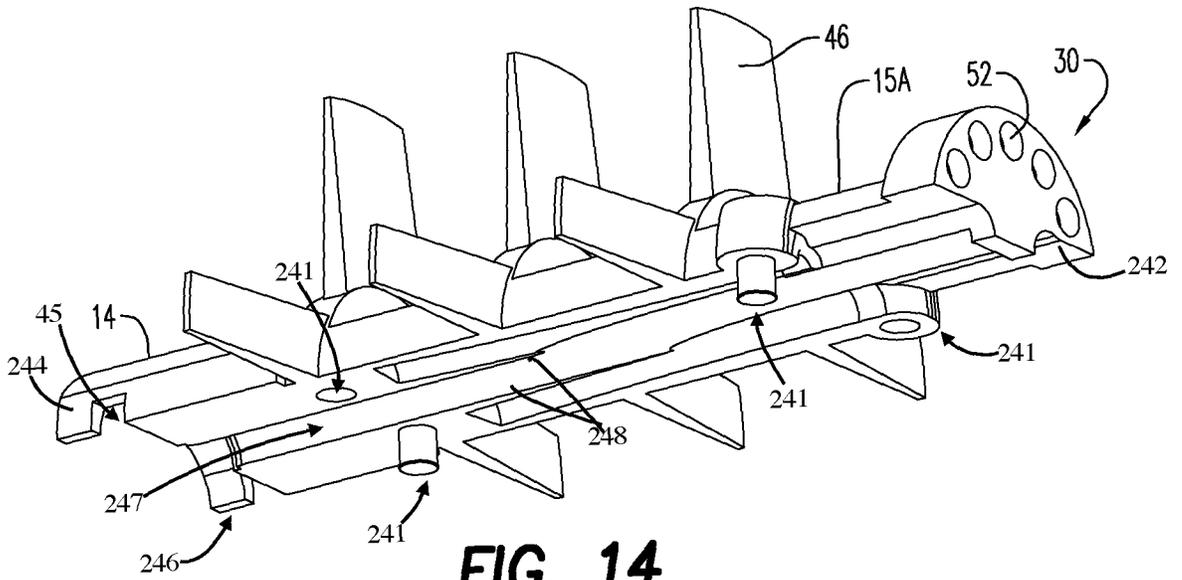
**FIG. 11**



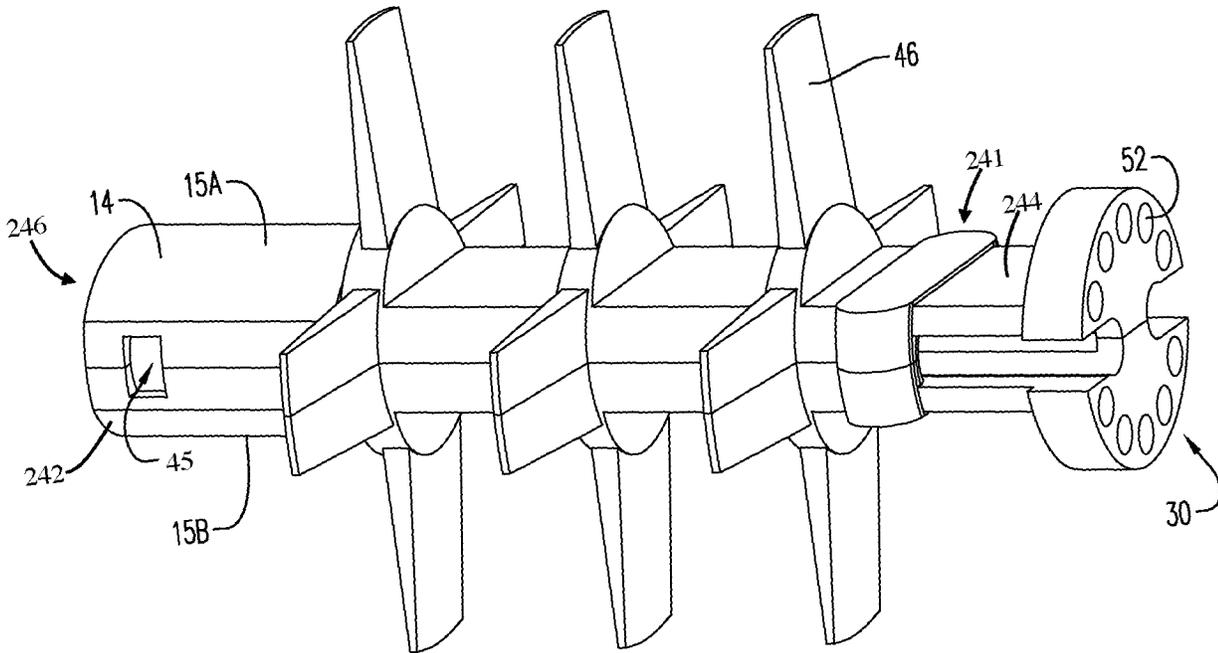
**FIG. 12**



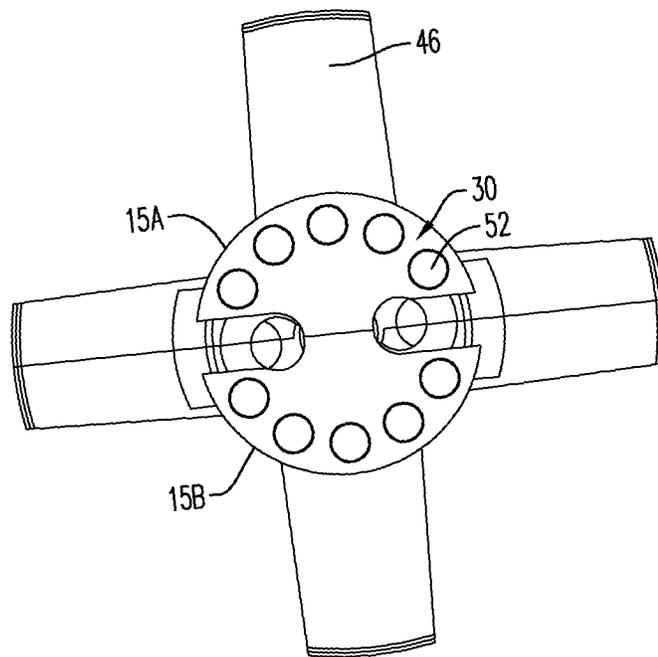
**FIG. 13**



**FIG. 14**

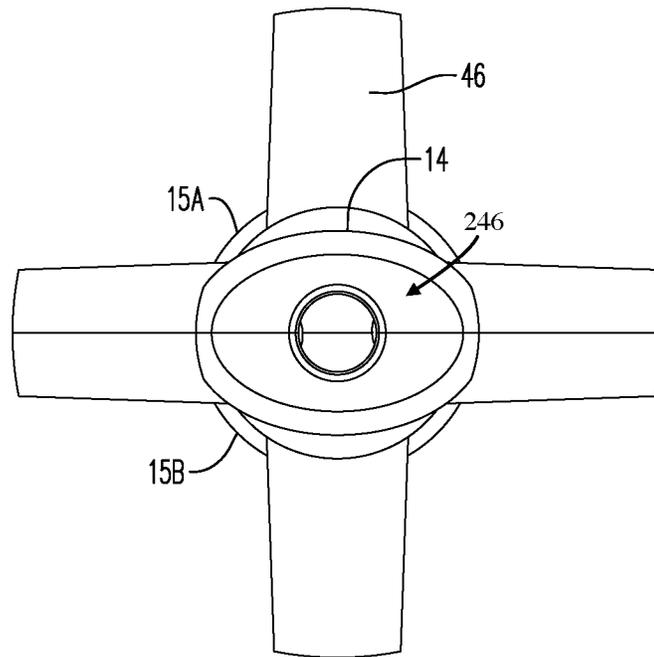


**FIG. 15**

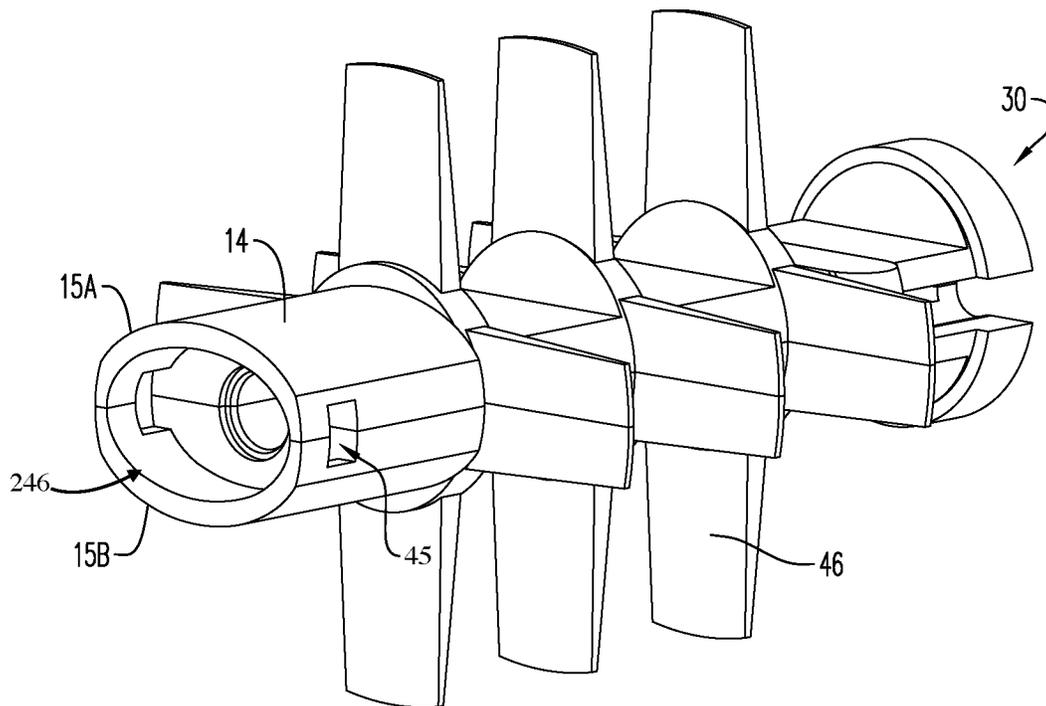


**FIG. 16**

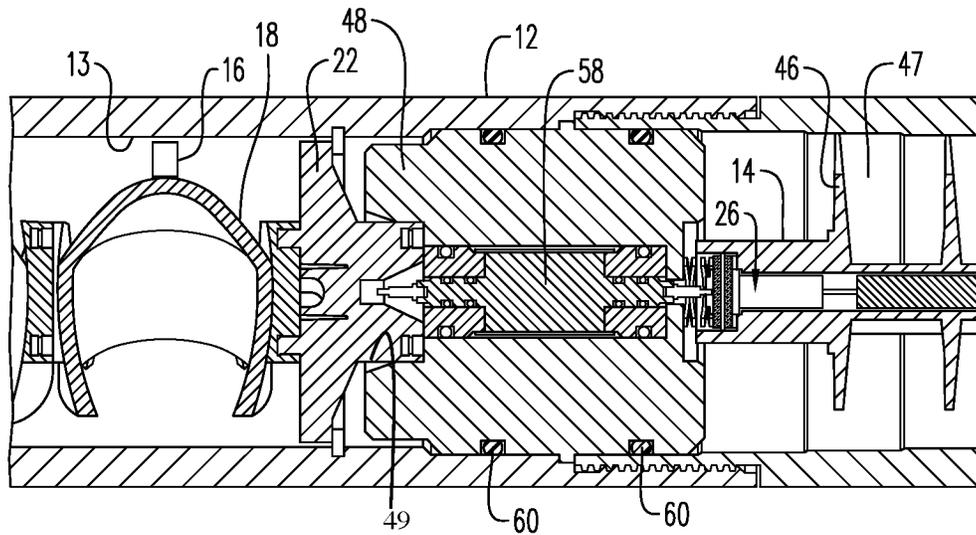
9/18



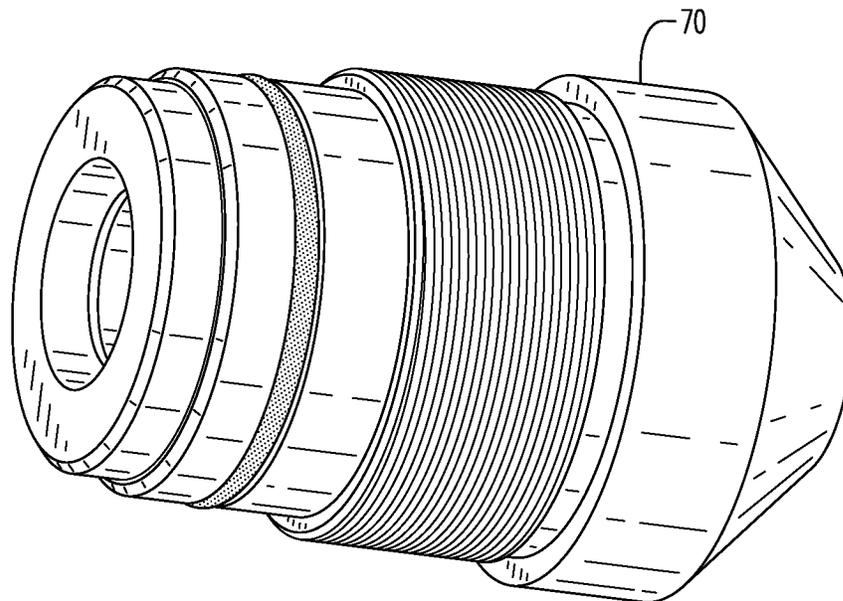
**FIG. 17**



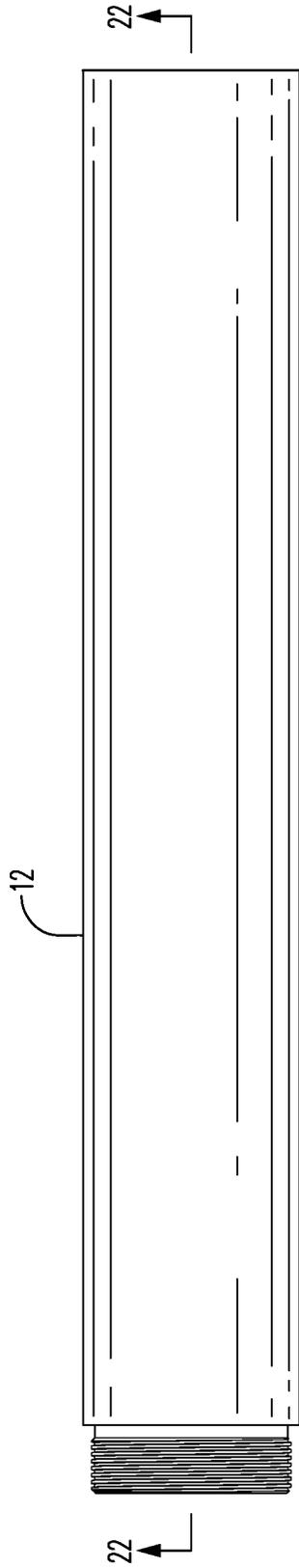
**FIG. 18**



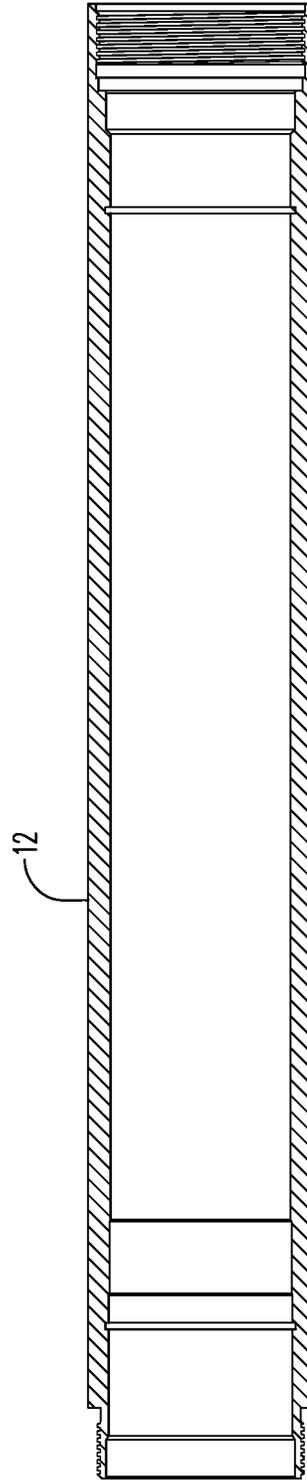
**FIG. 19**



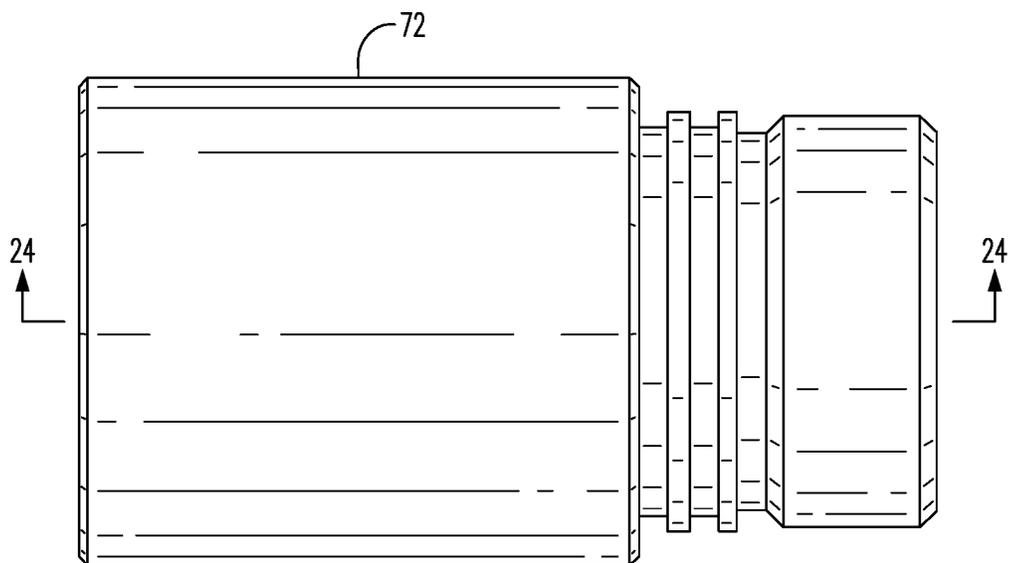
**FIG. 20**



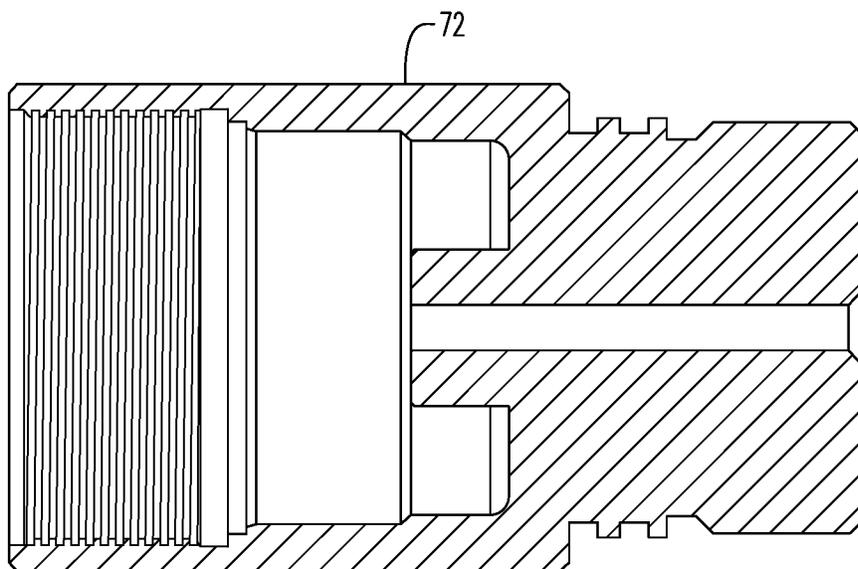
**FIG. 21**



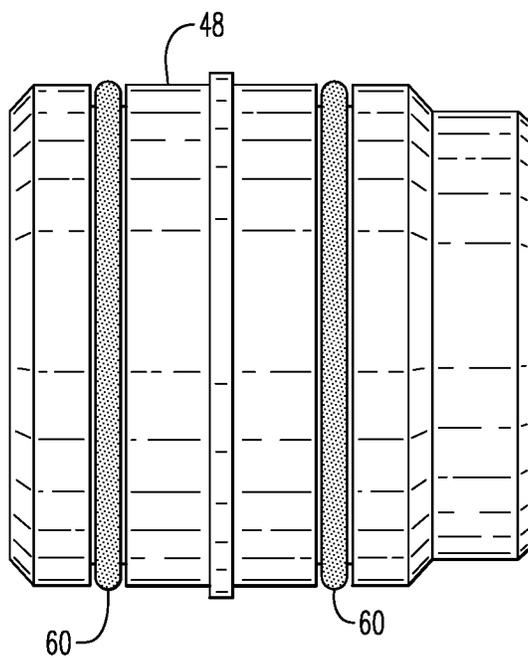
**FIG. 22**



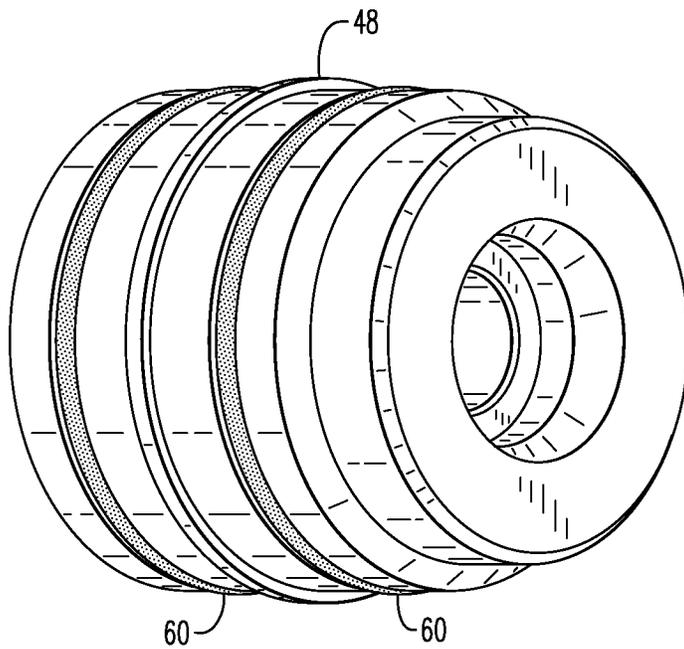
**FIG. 23**



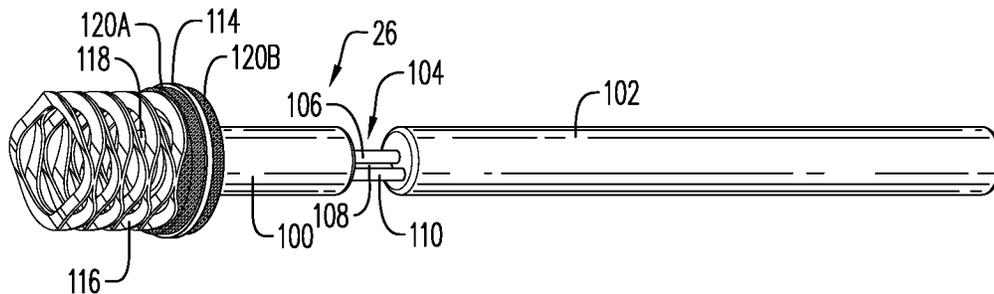
**FIG. 24**



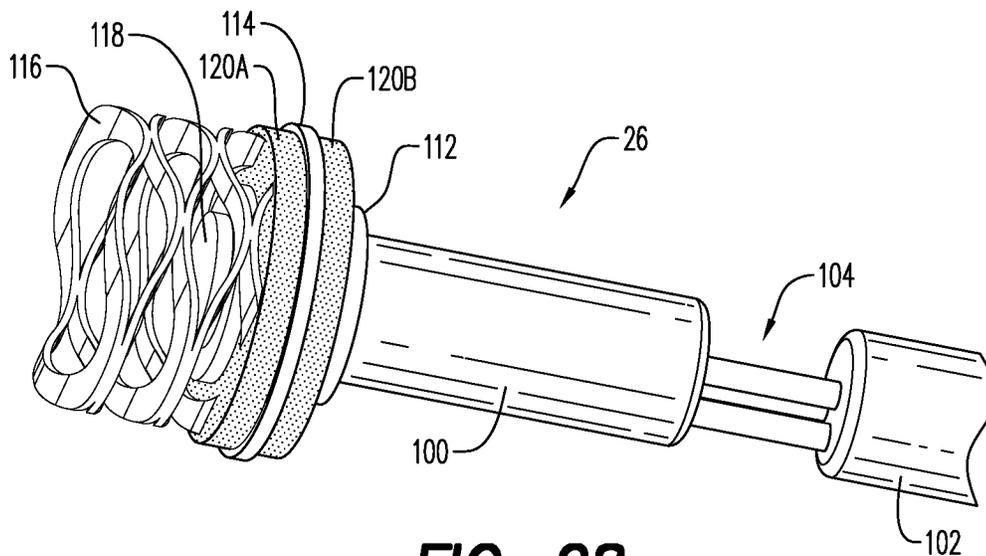
**FIG. 25**



**FIG. 26**

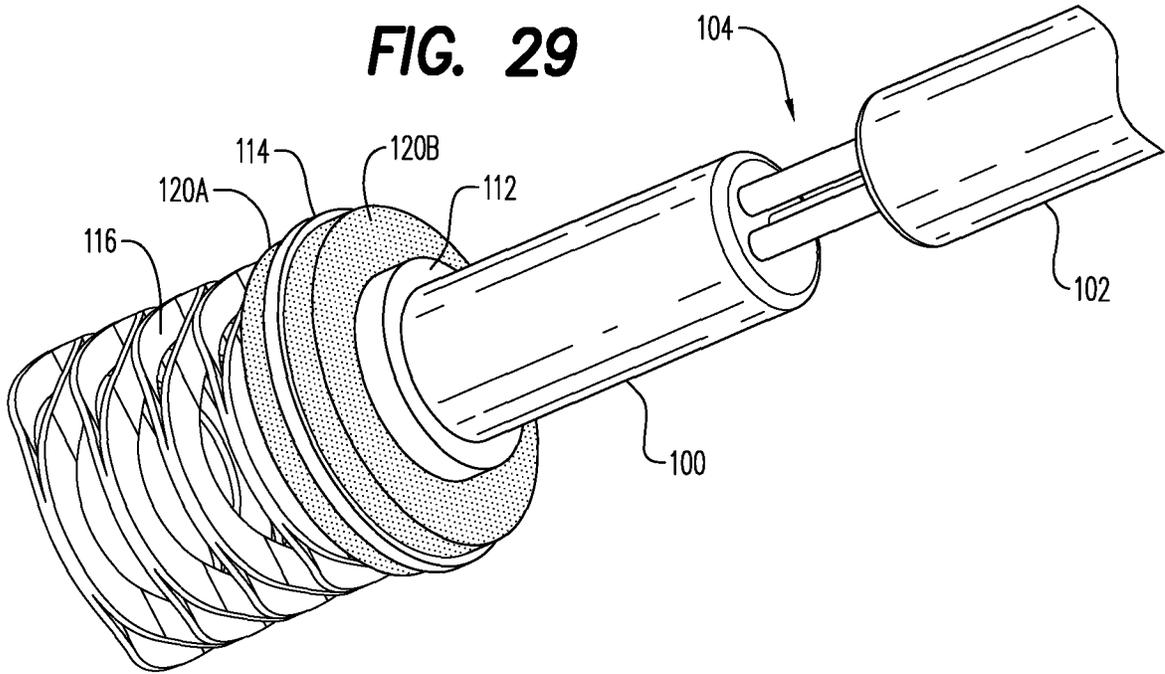


**FIG. 27**

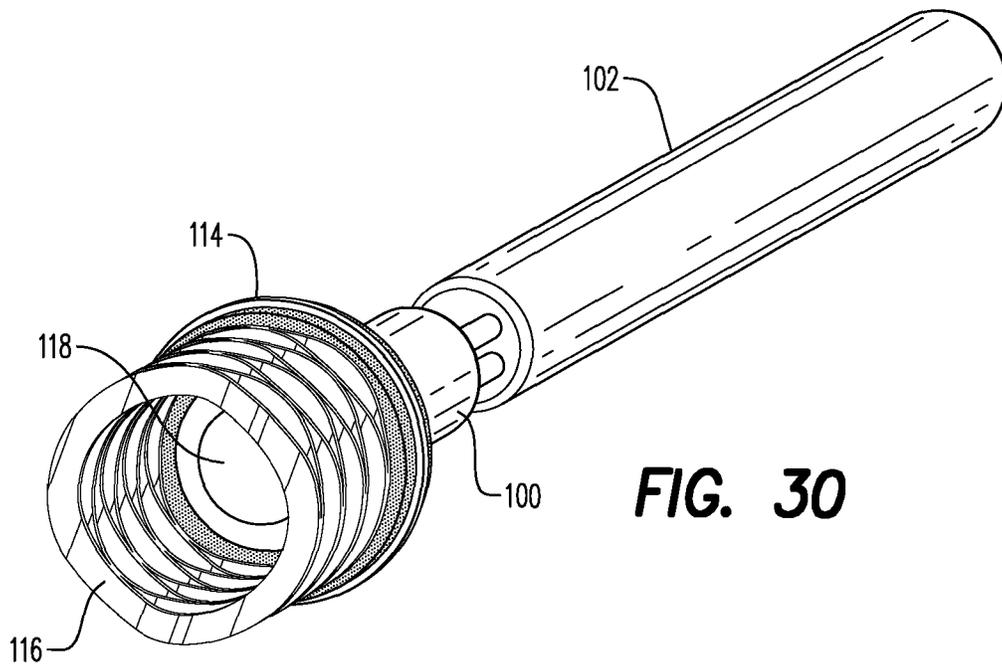


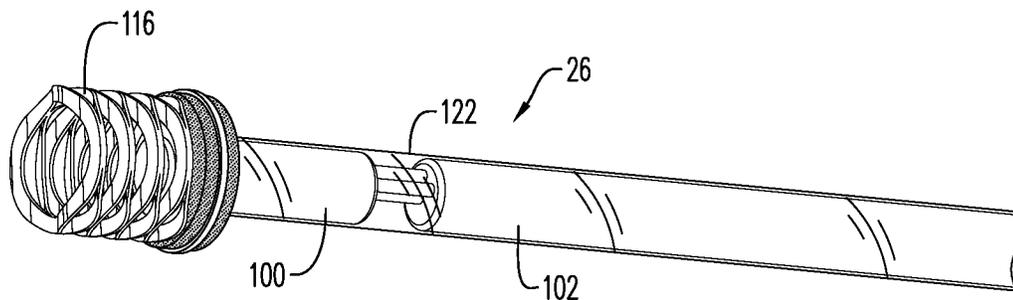
**FIG. 28**

**FIG. 29**

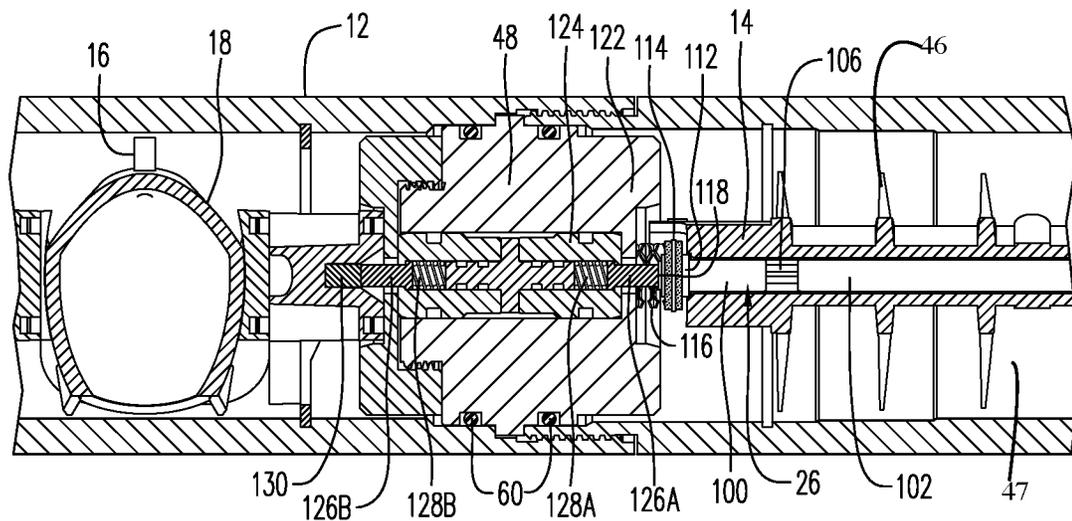


**FIG. 30**

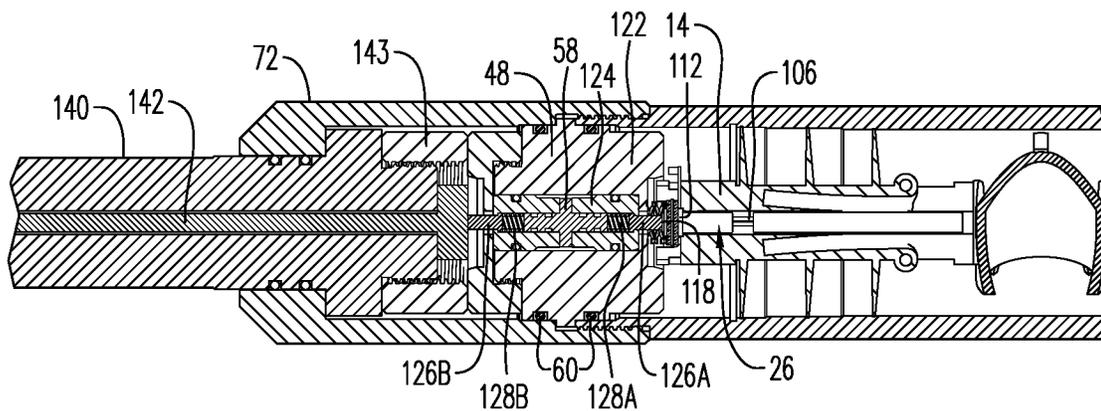




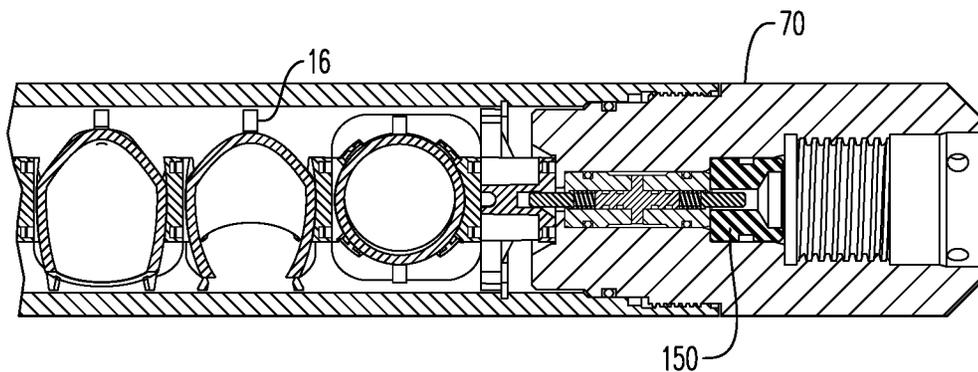
**FIG. 31**



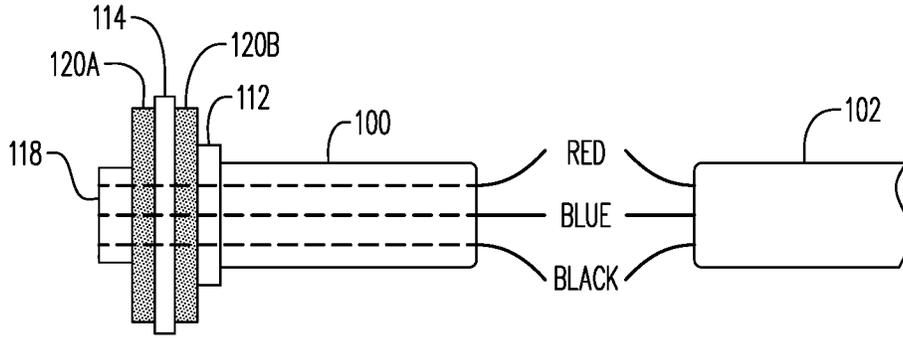
**FIG. 32**



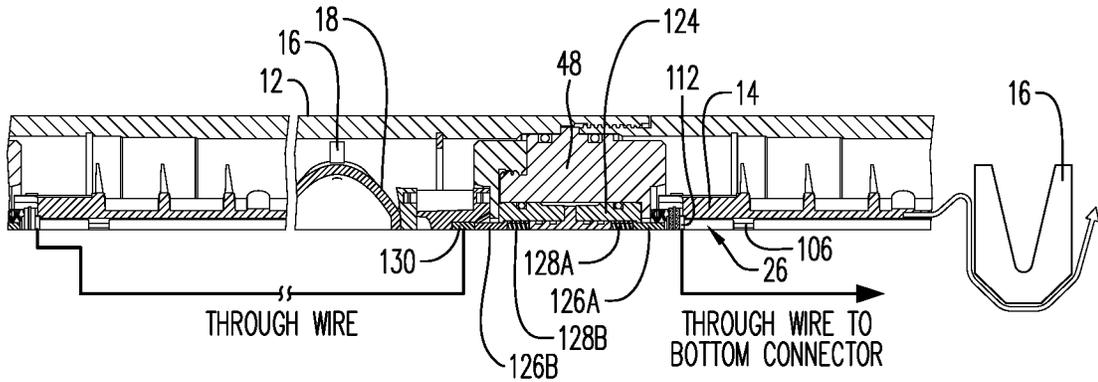
**FIG. 33**



**FIG. 34**



**FIG. 35A**



**FIG. 35B**

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	DMC007USCon3
		Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM		
<p>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.</p>			

**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	
	David	C.	Parks		
Residence Information (Select One)    US Residency <input type="radio"/> Non US Residency    Active US Military Service					
City	Calgary	Country of Residence <sup>i</sup>		CA	
Mailing Address of Inventor:					
Address 1	JDP Engineering and Machine Inc.				
Address 2	12 Crestmont Way SW				
City	Calgary	State/Province			
Postal Code	T3B 5Z6	Country <sup>i</sup>	CA		
Inventor	2				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Frank	Haron	Preiss		
Residence Information (Select One)    US Residency <input checked="" type="radio"/> Non US Residency    Active US Military Service					
City	Bonn	Country of Residence <sup>i</sup>		DE	
Mailing Address of Inventor:					
Address 1	An der Arndtruhe 20				
Address 2					
City	Bonn	State/Province			
Postal Code	53175	Country <sup>i</sup>	DE		
Inventor	3				Remove
Legal Name					

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	DMC007USCon3
		Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Liam		McNelis	
Residence Information (Select One)    US Residency <input checked="" type="radio"/> Non US Residency    Active US Military Service				
City	Bonn	Country of Residence <sup>i</sup>	DE	

**Mailing Address of Inventor:**

Address 1	Gallusstrasse 72			
Address 2				
City	Bonn	State/Province		
Postal Code	53227	Country <sup>i</sup>	DE	
Inventor	4	<input type="button" value="Remove"/>		

**Legal Name**

Prefix	Given Name	Middle Name	Family Name	Suffix
	Eric		Mulhern	
Residence Information (Select One)    US Residency <input checked="" type="radio"/> Non US Residency    Active US Military Service				
City	Edmonton	Country of Residence <sup>i</sup>	CA	

**Mailing Address of Inventor:**

Address 1	2936-41 Ave NW			
Address 2				
City	Edmonton	State/Province	AB	
Postal Code	T6T 1K5	Country <sup>i</sup>	CA	
Inventor	5	<input type="button" value="Remove"/>		

**Legal Name**

Prefix	Given Name	Middle Name	Family Name	Suffix
	Thilo		Scharf	
Residence Information (Select One)    US Residency <input checked="" type="radio"/> Non US Residency    Active US Military Service				
City	Letterkenny, Donegal	Country of Residence <sup>i</sup>	E	

**Mailing Address of Inventor:**

Address 1	Derora Churchill			
Address 2				
City	Letterkenny, Donegal	State/Province		
Postal Code		Country <sup>i</sup>	IE	

Hunting Titan, Inc.

Ex. 1008

Pg. 477

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

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	81796		
Email Address	lmoyles@moylesip.com	Add Email	Remove Email
Email Address	docket@moylesip.com	Add Email	Remove Email
Email Address	jrockman@moylesip.com		Remove Email

## Application Information:

Title of the Invention	PERFORATION GUN COMPONENTS AND SYSTEM		
Attorney Docket Number	DMC007USCon3	Small Entity Status Claimed	<input type="checkbox"/>
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	18	Suggested Figure for Publication (if any)	28

## 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:

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.

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

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:	<input checked="" type="radio"/> Customer Number	US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	B1796		

### 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	Pending					Remove
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
	Continuation of		15920812	2018-03-14		
Prior Application Status	Pending					Remove
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
15920812	Continuation of		15617344	2017-06-08		
Prior Application Status	Patented					Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)	
15617344	Division of	15287309	2016-10-06	9702680	2017-07-11	
Prior Application Status	Patented					Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)	
15287309	Division of	14904788	2016-01-13	9494021	2016-11-15	
Prior Application Status	Expired					Remove
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
14904788	a 371 of international		PCTCA2014050673	2014-07-16		
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the <b>Add</b> button.						Add

### Foreign Priority Information:

Hunting Titan, Inc.

Ex. 1008

Pg. 479

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.

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

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)<sup>i</sup> 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 <sup>i</sup>	Filing Date (YYYY-MM-DD)	Access Code <sup>i</sup> (if applicable)
2821506	CA	2013-07-18	

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.

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

## 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.

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

## 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.

<b>Applicant</b>	1	<input type="button" value="Remove"/>
<p>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.</p>		
<input type="button" value="Clear"/>		
<input checked="" type="radio"/> 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:		
<div style="border: 1px solid black; height: 20px; width: 100%;"></div>		
Name of the Deceased or Legally Incapacitated Inventor: <input type="text"/>		
If the Applicant is an Organization check here. <input checked="" type="checkbox"/>		
Organization Name	DynaEnergetics GmbH & Co. KG	
<b>Mailing Address Information For Applicant:</b>		
Address 1	Kaiserstrasse 3	
Address 2		
City	Troisdorf	State/Province
Country	DE	Postal Code
Phone Number		Fax Number
Email Address		
Additional Applicant Data may be generated within this form by selecting the Add button. <input type="button" value="Add"/>		

## Assignee Information including Non-Applicant Assignee 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.

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.

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

<b>Assignee</b>   1
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.
<input type="button" value="Remove"/>
If the Assignee or Non-Applicant Assignee is an Organization check here. <input checked="" type="checkbox"/>
Organization Name DynaEnergetics GmbH & Co. KG

<b>Mailing Address Information For Assignee including Non-Applicant Assignee:</b>			
Address 1	Kaiserstrasse 3		
Address 2			
City	Troisdorf	State/Province	
Country <sup>i</sup>	DE	Postal Code	53840
Phone Number		Fax Number	
Email Address			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. <input type="button" value="Add"/>			

<b>Assignee</b>   2
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.
<input type="button" value="Remove"/>
If the Assignee or Non-Applicant Assignee is an Organization check here. <input checked="" type="checkbox"/>
Organization Name JDP Engineering and Machine Inc

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.

<b>Application Data Sheet 37 CFR 1.76</b>	Attorney Docket Number	DMC007USCon3
	Application Number	
Title of Invention	PERFORATION GUN COMPONENTS AND SYSTEM	

<b>Mailing Address Information For Assignee including Non-Applicant Assignee:</b>			
Address 1	12 Crestmont Way SW		
Address 2			
City	Calgary	State/Province	
Country <sup>i</sup>	CA	Postal Code	T3B 5Z6
Phone Number		Fax Number	
Email Address			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.			<input type="button" value="Add"/>

**Signature:**

**NOTE:** This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Jason M. Rockman/		Date (YYYY-MM-DD)	2019-03-20	
First Name	Jason	Last Name	Rockman	Registration Number	63473
Additional Signature may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>	

This collection of information is required by 37 CFR 1.76. 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 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet 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.**

# Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.