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(54) **PERFORATING GUN AND ARMING METHOD**

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(52) **U.S. Cl.** **166/297**; 166/55; 89/1.15

(57) **ABSTRACT**

The perforating gun and methods of arming a perforating gun facilitates electrically connecting an arming device carrying the detonator to the loading tube carrying the explosive charges prior to ballistically connecting the arming device to the loading tube. Subsequent to establishing electrical continuity across the loading tube and arming device, the arming device can be ballistically connected to the loading tube thereby arming the perforating gun.

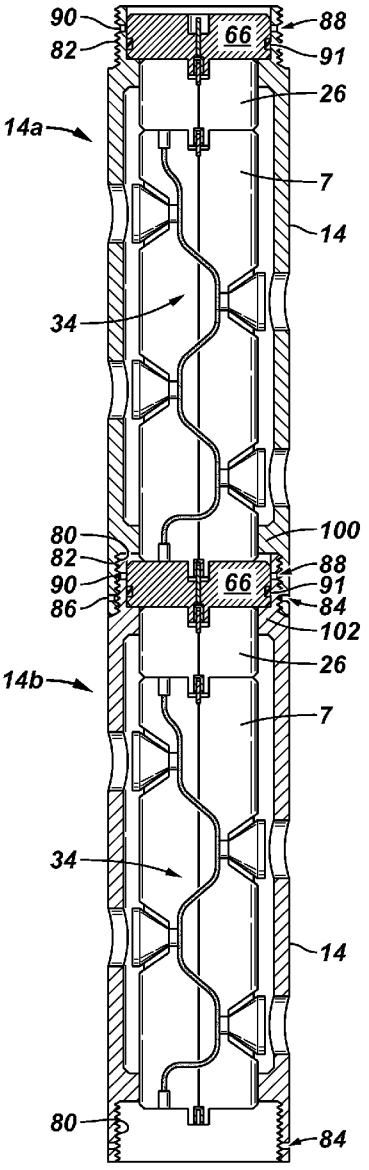

FIG. 1

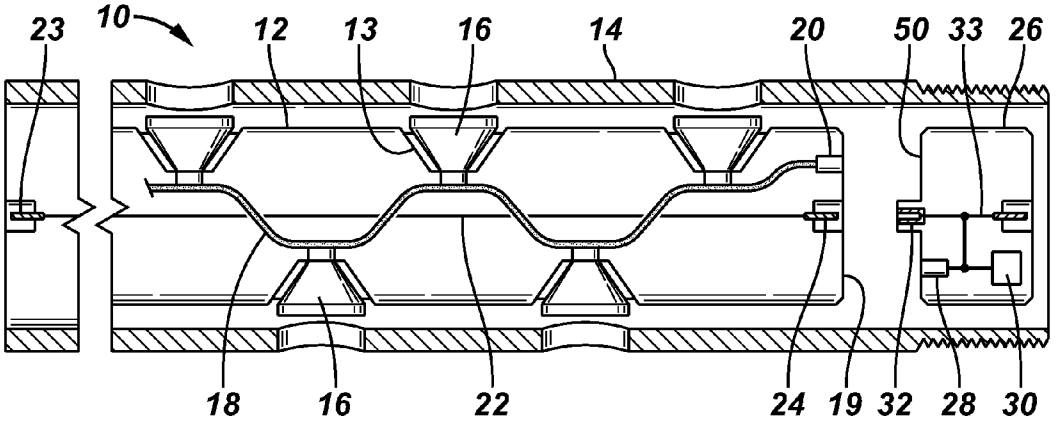
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FIG. 2

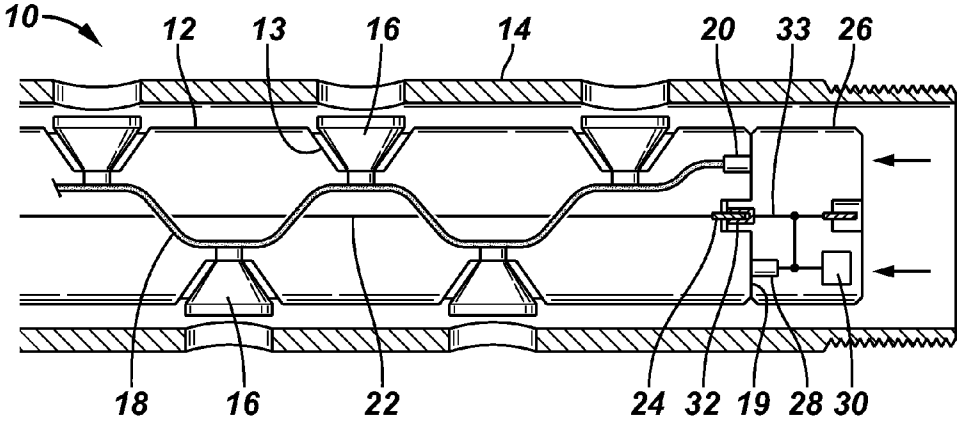
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FIG. 3

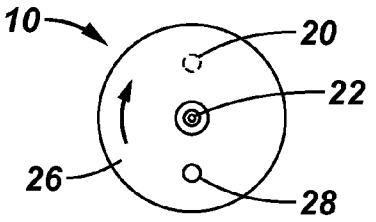

FIG. 4

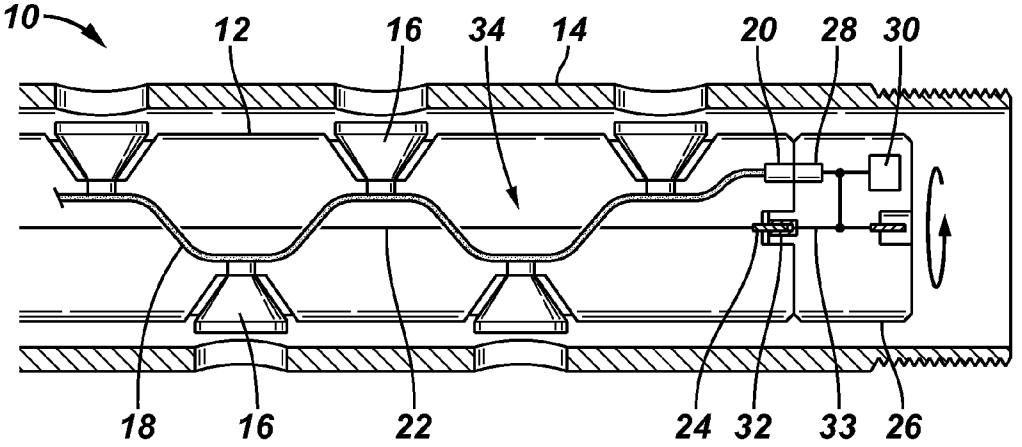

FIG. 5

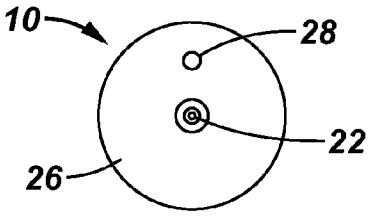

FIG. 6

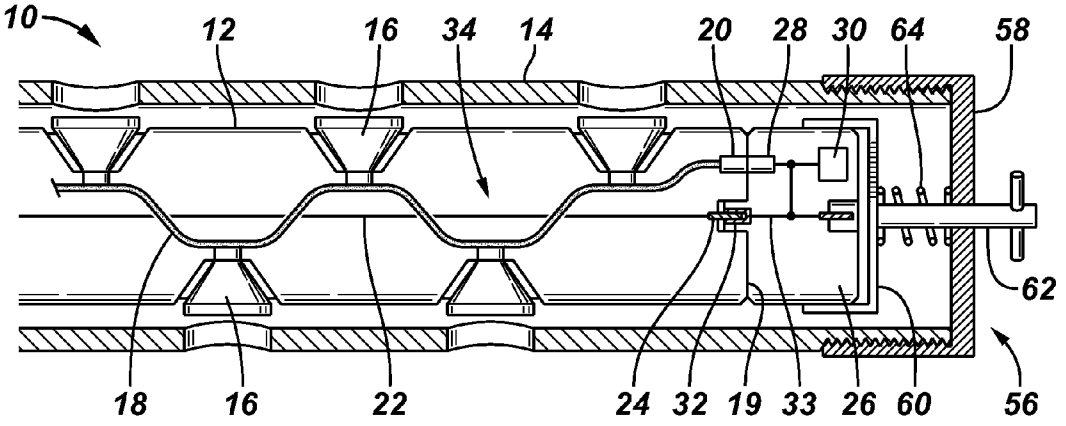
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FIG. 7

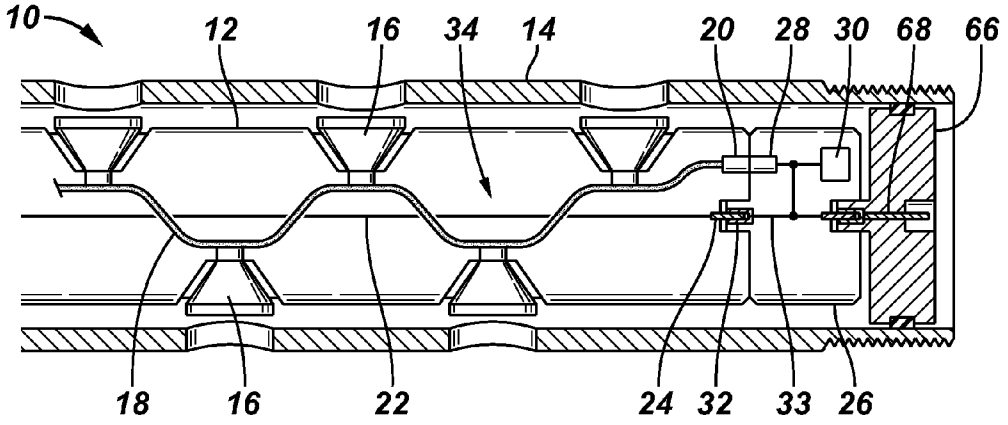
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FIG. 8

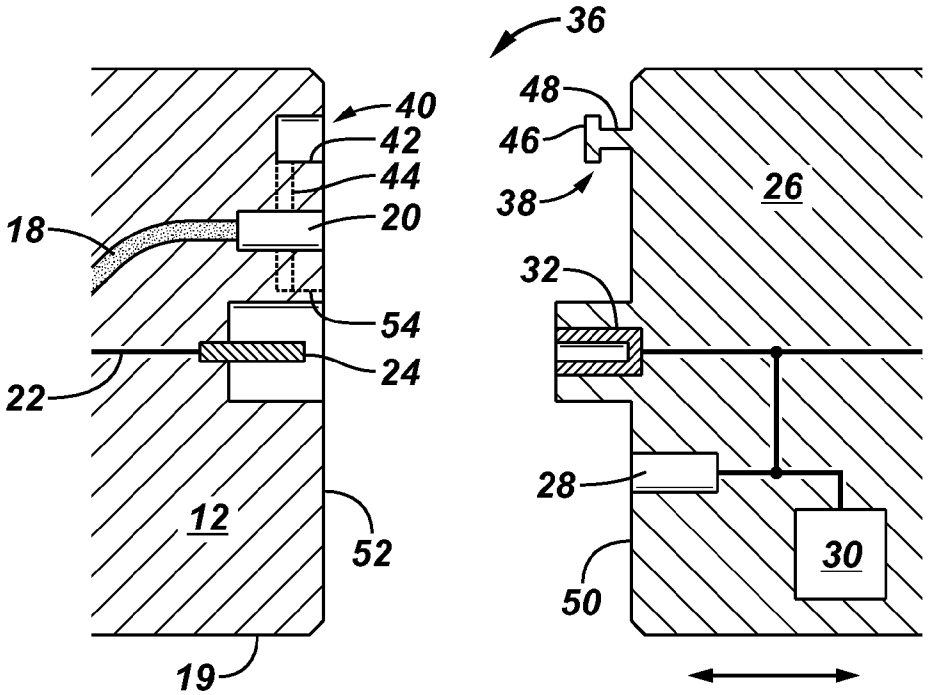
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FIG. 9

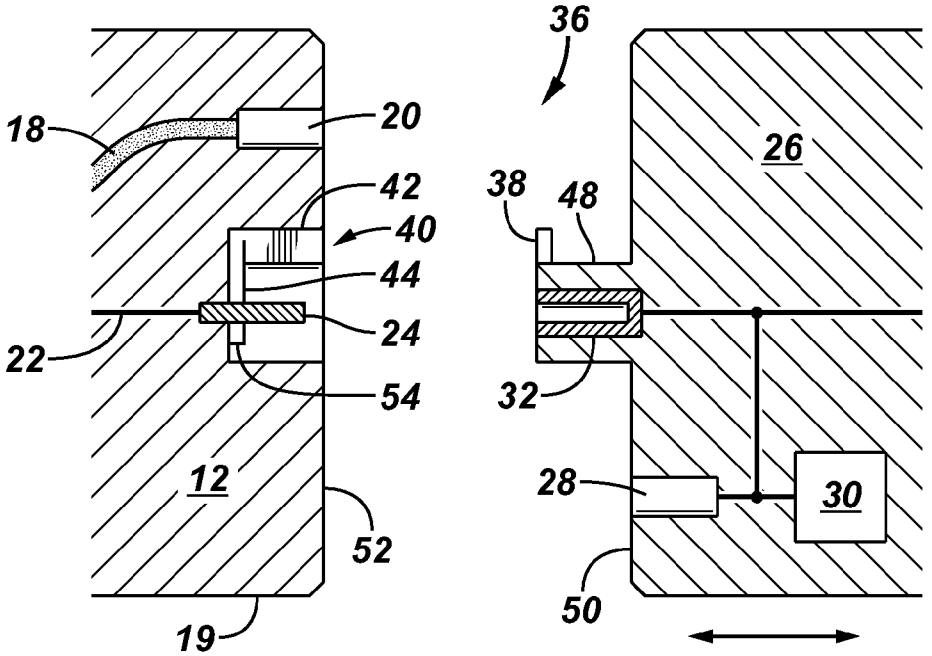
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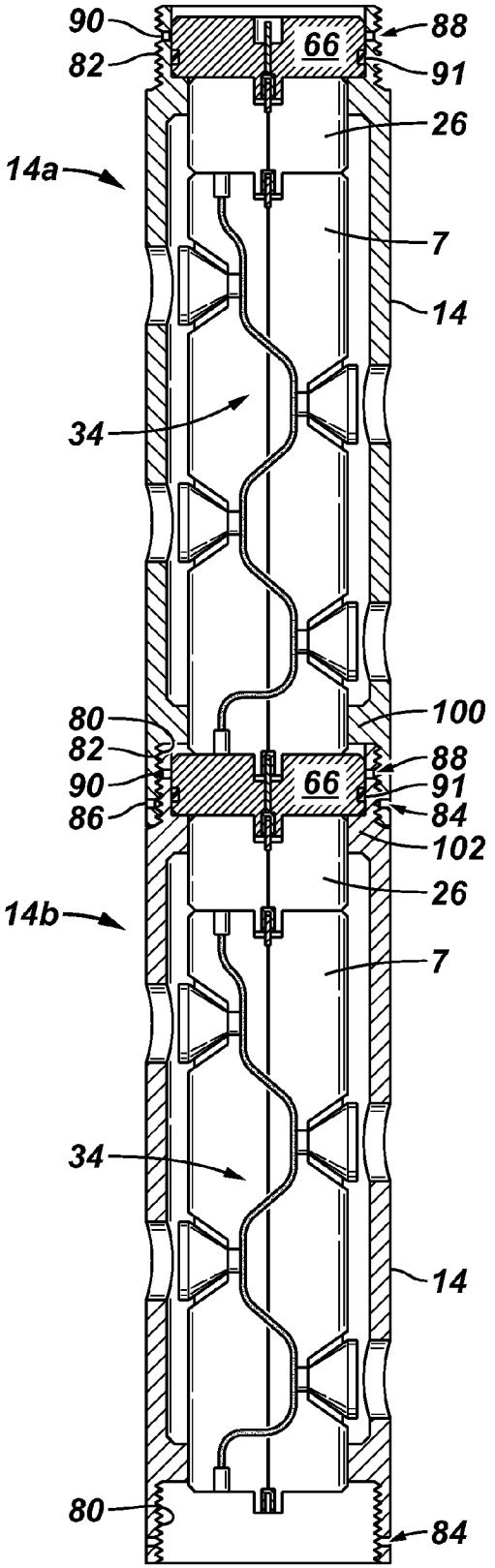
FIG. 10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66
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91
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14b
7
34
14
80
84

PERFORATING GUN AND ARMING METHOD

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional application No. 61/468,722 filed on 29 Mar. 2011.

BACKGROUND

[0002] This section provides background information to facilitate a better understanding of the various aspects of the disclosure. It should be understood that the statements in this section of this document are to be read in this light, and not as admissions of prior art.

[0003] Hydrocarbon exploration and production, as well as other subterranean activities (e.g., water exploration and extraction), involve drilling and completing a wellbore. The wellbore is drilled into the ground and then can be lined with metal pipe generally referred to as casing. The casing can extend essentially the entire length of the wellbore or terminate short of the total depth thereby leaving an uncased, open hole, portion of the well. The casing may also be cemented in place, sealing the annulus between the casing and the earthen formation.

[0004] During completion or production of a well it can be desired to create flow paths between the wellbore and the formation. These flow paths are often created by utilizing a perforating gun. Perforating guns are tubular-shaped devices having an outer housing called a carrier. The carrier holds one or more interconnected loading tubes. The loading tubes hold shaped explosive charges that, when detonated, create perforations through the carrier, the wellbore casing, cement and into the earthen formation. Perorating guns can be lowered downhole via wireline, cable, coiled tubing and production tubing, for example. Firing signals can be transmitted to the perforating gun electrically (including by wireline), by wireless electromagnetic signal, by pressure pulses, and acoustically.

[0005] To detonate the shaped charges, the perforating gun includes a firing head. The firing head can receive an electrical signal that is transmitted from the surface and/or from another location within the wellbore (perhaps from an adjacent gun or other device or from a wireline). The electronic signal initiates a detonator in the firing head to ignite a detonating cord of the loading tube. The detonating cord extends through the perforating gun and is interconnected with the shaped charges held by the loading tube.

SUMMARY

[0006] According to one or more embodiments, a method of arming a perforating gun comprises electrically connecting an arming device to a loading tube, and ballistically connecting the arming device to the loading tube after the arming device has been electrically connected to the loading tube.

[0007] In another example, a method of arming a perforating gun includes positioning an arming device comprising an electrical connector and a detonator proximate to an end of a loading tube that is disposed within a carrier. The loading tube comprises an explosive charge, an electrical conductor having an electrical connector that is located proximate the end of the loading tube, and a detonating cord that is connected to the explosive charge and has an end located proximate to the end of the loading tube. The method includes electrically connecting the arming device to the loading tube in response to moving the arming device to a park position, and then ballistically connecting the arming device to the loading tube in response to moving the arming device from the park position to an armed position.

[0008] An embodiment of a perforating gun comprises a loading tube having an explosive charge, an electrical conductor, and a detonating cord; and an arming device comprising a detonator and an electrical connector. The arming device can be moved between a park position and an armed position. In the park position the arming device is electrically connected to the loading tube and the arming device is not ballistically connected to the loading tube. In the armed position the arming device is electrically and ballistically connected to the loading tube.

[0009] The foregoing has outlined some of the features and technical advantages in order that the detailed description of the perforating gun and arming method that follows may be better understood. Additional features and advantages of the perforating gun and arming method will be described hereinafter which form the subject of the claims of the invention. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The disclosure is best understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

[0011] FIG. **1** is a pictorial diagram of a perforating gun illustrating an example of an arming device positioned for electrical and ballistic connection to the loading tube of the perforating gun in accordance with one or more embodiments.

[0012] FIG. **2** is a pictorial diagram of a perforating gun illustrating an example of the arming device in a park position, electrically connected to the loading tube of the perforating gun but not ballistically connected to the loading tube, in accordance with one or more embodiments.

[0013] FIG. **3** is a pictorial diagram of an end view of the perforating gun of FIG. **2**, illustrating an example of the arming device in the park position in accordance with one or more embodiments.

[0014] FIG. **4** is a pictorial diagram of a perforating gun illustrating an example of the arming device in an armed position, electrically and ballistically connected to the loading tube of the perforating gun, in accordance with one or more embodiments.

[0015] FIG. **5** is a pictorial diagram of an end view of the perforating gun of FIG. **4**, illustrating an example of the arming device in the armed position in accordance with one or more embodiments.

[0016] FIG. **6** is a pictorial diagram of a perforating gun illustrating an example of an installation tool for electrically and ballistically connecting the arming device to the loading tube in accordance to one or more embodiments.

[0017] FIG. **7** is a pictorial diagram of an example of a perforating gun illustrating the arming device in the armed position, electrically and ballistically connected to the loading tube, in accordance to one or more embodiments.

[0018] FIG. **8** is a pictorial diagram of an example of an end of a loading tube and an arming device in accordance to one or more embodiments.

[0019] FIG. **9** is a pictorial diagram of an example of an end of a loading tube and an arming device in accordance to one or more embodiments.

[0020] FIG. **10** is a pictoral diagram of an example of two carrier portions connected to one another end to end in accordance with one embodiment.

DETAILED DESCRIPTION

[0021] It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact.

[0022] As used herein, the terms "up" and "down"; "upper" and "lower"; "top" and "bottom"; and other like terms indicating relative positions to a given point or element are utilized to more clearly describe some elements. Commonly, these terms relate to a reference point as the surface from which drilling operations are initiated as being the top point and the total depth of the well being the lowest point, wherein the well (e.g., wellbore, borehole) is vertical, horizontal or slanted relative to the surface.

[0023] FIG. **1** depicts an example of a perforating gun, generally denoted by the numeral **10**. Perforating gun **10** includes a loading tube **12** disposed inside of a carrier **14**. Loading tube **12** may have one or more receptacles **13** adapted to hold explosive charges **16**. A detonating cord **18** is connected to explosive charges **16** and has an end **20** located proximate to an end **19** of loading tube **12**. End **20** of detonating cord **18** may be a booster. Electrical conductor **22** extends between electrical connectors **23**, **24** located at the respective ends of loading tube **12**.

[0024] An example of an arming device **26** is depicted in FIG. **1** located adjacent, or proximate, to end **19** of loading tube **12** prior to being connected to perforating gun **10**. In FIG. **1**, arming device **26** is not physically, electrically, or ballistically connected to loading tube **12**. In the depicted example, arming device **26** includes a detonator **28** (for example an RF-safe initiator), firing electronics **30** (for example, an addressable switch), and an electrical connector **32** and electrical conductor **33**. Firing electronics **30** can initiate detonator **28** in response to receipt of a firing signal from the surface of the well, for example, via electrical conductor **22**, pressure pulses and wirelessly. According to one or more embodiments, arming device **26** provides a means to establish an electrical connection between loading tube **12** and arming device **26** prior to ballistically connecting arming device **26** to loading tube **12** and thereby completing the ballistic train **34** (i.e., detonator **28**, detonating cord **18**, explosive charges **16**) as illustrated in FIGS. **4**, **6**, and **7**.

[0025] FIG. **2** is a side view of an embodiment of perforating gun **10** illustrated in a "park" position, wherein arming device **26** is electrically connected to loading tube **12** and arming device **26** is not ballistically connected to loading tube **12**. FIG. **3** is an end view of the right end of perforating gun **10** illustrated in FIG. **2**. In the park position, electrical connector **24** and electrical connector **32** are connected, electrically connecting arming device **26** to loading tube **12** and establishing electrical continuity across loading tube **12** and arming device **26**. In the park position, electrical signals can be transmitted between firing electronics **30** and other devices (e.g., sensors, surface controls, and other electronics) via electrical conductor **22** which extends across loading tube **12**. In the park position, ballistic train **34** is not completed and therefore explosive charges **16** are not connected to detonator **28** via detonating cord **18**, thus, perforating gun **10** is not armed. In the depicted examples, the park position is evidenced by detonator **28** being offset angularly from end **20** of detonating cord **18**. In the illustrated examples, detonator **28** is shown offset approximately 180 degrees from end **20** of detonating cord **18**, however, it will be recognized by those skilled in the art with benefit of this disclosure that the angular offset may differ from 180 degrees.

[0026] According to one or more embodiments, a method or process of arming perforating gun **10** includes aligning arming device **26** proximate to end **19** of loading tube **12** as depicted in FIG. **1**. In the illustrated example, loading tube **12** is disposed inside of carrier **14**. According to one aspect, aligning arming device **26** includes positioning arming device **26** such that electrical connector **32** of arming device **26** is axially aligned with electrical connector **24** of loading tube **12**. Arming device **26** is electrically connected to loading tube **12** prior to ballistically connecting arming device **26** to loading tube **12**. To electrically connect arming device **26** to loading tube **12**, arming device **26** is moved axially to loading tube **12**, as illustrated by the arrow of FIG. **2**, electrically connecting electrical connector **32** of arming device **26** and electrical connector **24** of loading tube **12**, thereby positioning perforating gun **10** in the park position. In the park position, electrical continuity is established across perforating gun **10** and diagnostic tests and such can be performed on perforating gun **10**, including firing electronics **30**, without arming perforating gun **10**.

[0027] Perforating gun **10** is armed by ballistically connecting arming device **26** to loading tube **12** after electrically connecting arming device **26** to loading tube **12**. Arming perforating gun **10** includes rotating arming device **26** relative to loading tube **12** until detonator **28** is axially aligned with end **20** of detonating cord **18** as depicted for example in FIGS. **4** and **5**. For example, arming device **26** is rotated clockwise from the park position illustrated in FIGS. **2** and **3** to the armed position illustrated in FIGS. **4** and **5**. It will be understood by those skilled in the art and with benefit of this disclosure that in some embodiments arming device **26** may be rotated counterclockwise from the park position to the armed position.

[0028] According to some embodiments, arming device **26** is moved from the park position to the armed position without disconnecting the previously established electrical connection between arming device **26** and electrical conductor **22** of loading tube **12**. Thus, perforating gun **10** can be armed

without interrupting the electrical continuity established across electrical conductors **22** and **33** which was established in the park position.

[0029] Non-exclusive examples of electrical and ballistic connections of arming device **26** with loading tube **12** are illustrated in FIGS. **8** and **9**. Electrical connector **24** of loading tube **12** and electrical connector **32** of arming device **26** are depicted as male and female devices, for example RCA connectors, which are mated by axial movement. Arming device **26** and loading tube **12** include a device **36**, referred to herein as a lock device, that can facilitate axial movement of arming device **26** to the park position, electrically connecting arming device **26** to loading tube **12**, and then rotational movement of arming device **26** to the armed position, ballistically connecting arming device **26** to loading tube **12**. In the park position, locking device **36** can block axial movement of arming device **26** away from loading tube **12**.

[0030] In the examples depicted in FIGS. **8** and **9**, lock device **36** includes a first member **38** disposed with one of arming device **26** and loading tube **12** which is matable with a cooperative second member **40** disposed with the other of arming device **26** and loading tube **12**. In the embodiments depicted in FIGS. **8** and **9**, first member **38** is illustrated as a protrusion and second member **40** is a groove. Groove **40** includes a first, axial leg **42** and a second leg **44** that extends away from first, axial leg **42** an angular distance that corresponds with the angular distance required to move detonator **28** from the park position to the armed position ballistically aligned with and connected to detonating cord **18**.

[0031] In the embodiment of FIGS. **8** and **9**, protrusion **38** is depicted as having a head **46** spaced by a post **48** outward from a face **50** of arming device **26**. Head **46** has cross-sectional greater than the cross-sectional diameter of post **48**. For example, in FIG. **8**, protrusion **38** is a T-shaped member and in FIG. **9**, protrusion **38** is an L-shaped member. Groove **40** is formed such that axial leg **42** extends a distance axially into loading tube **12**, away from a face **52** of loading tube **12**, corresponding substantially with the distance post **48** spaces head **46** from face **50** of arming device **26**. Second, angular leg **44** of groove **40** corresponds in size to head **46** of the respective protrusion **38** and extends angularly away from the end of axial leg **42** distal from face **52**. Thereby, when head **46** is disposed in angular leg **44**, head **46** is trapped blocking axial movement of head **46** and thus arming device **26** relative to loading tube **12**.

[0032] For example, positioning arming device **26** in the park position includes disposing head **46** of protrusion **38** into axial leg **42** of groove **40** and axially moving arming device **26** toward loading tube **12** interconnecting electrical connectors **24**, **32**. In this example, face **50** and face **52** abut when arming device **26** and loading tube **12** are in the park position and electrically connected. Arming the perforating gun is accomplished by rotating arming device **26** from the park position to the armed position. From the park position, arming device **26** is rotated with head **46** disposed in and traveling along angular leg **44** of groove **40** until detonator **28** is aligned with end **20** of detonating cord **18**. Angular leg **44** may terminate at an end, or stop, **54** positioned to locate detonator **28** in ballistic alignment with detonating cord **18** when head **46** abuts stop **54**. In the armed position, lock device **36** blocks axial movement of arming device **26** relative to loading tube **12**.

[0033] In some embodiments, arming device **26** can be positioned and moved into the park position and the armed position by hand. In some embodiments, a tool may be utilized to support and position arming device **26**. For example, in FIG. **6** arming device **26** is illustrated being manipulated with use of a device **56**. An example of a device **56**, referred to herein as an installation device, is illustrated as connected to an end of carrier **14**, for example, by cap **58** in FIG. **6**. Cap **58** is illustrated in this example as being threaded onto an end of carrier **14**. A support device **60** is adapted to support arming device **26** and includes a shaft **62** that extends through cap **58** to the exterior of carrier **14**. Arming device **26** can be moved axially and rotationally relative to loading tube **12** by manipulating shaft **62**. Installation device **56** may further include a biasing device **64**, for example a spring, to bias support device **60** toward or away from cap **58**. For example, in at least one embodiment, biasing device **64** may bias support device **60** and the carried arming device **26** away from cap **58** and toward loading tube **12** to maintain electrical connection when in the park position.

[0034] FIG. **7** illustrates an example of perforating gun **10** armed and completed for introduction into a wellbore. Arming device **26** is in the armed position wherein it is physically, electrically, and ballistically connected to loading tube **12**. Detonator **28** is aligned with and ballistically connected to end **20** of detonating cord **18** which is connected to explosive charges **16**, thereby completing ballistic train **34**. Electrical continuity is provided across perforating gun **10** by the electrical connection of arming device **26** to electrical conductor **22** of loading tube **12**. A pressure bulkhead **66** is illustrated installed in carrier **14** adjacent to arming device **26**. The depicted bulkhead **66** includes an electrical feed-through conductor **68** which is electrically connected to electrical conductor **22** of loading tube **12** via electrical conductor **33** of arming device **26** which provides electrical continuity between the surface of the well and the perforating gun string.

[0035] Modularity of the gun components allows for a gun **10** to be configured and assembled for specific down hole needs, along with reducing the need for a significant inventory. To provide modularity of the gun **10**, individual sections **14***a* of the carrier **14** can be secured, end to end, to provide a gun **10** have a desired length. With each carrier section **14***a*, as shown in FIG. **10**, is disposed a loading tube **7**, arming device **26** and a bulkhead **66**. The carrier sections **14***a* can be secured to one another by known means, such as a threaded connection. As shown in FIG. **10**, the threaded connection can include an interior threaded surface **80** of a carrier portion **14***a* and a corresponding exterior threaded surface **82** of a carrier portion **14***b*, the exterior threaded surface **82** and interior threaded surface **80** configured so that the exterior threaded surface **82** of carrier portion **14***b* is received by the interior threaded portion **80** of carrier portion **14***a*. To secure the threaded surfaces **80** and **82**, the carrier **14***a* can include a throughbore **84** extending therethrough and through the threaded portion **80**. A securing member **86**, such as a set screw, is placed within the throughbore **84** and engages the exterior threaded surface **82** resist rotation of the carrier portions **14***a* and **14***b* relative to one another. The use of a throughbore **84** and securing member **86** allows an operator to have full discretion as to the orientation of the carrier portions **14***a* and **14***b* when secured.

[0036] As shown in FIG. **10**, the loading tube **12**, arming device **26** and bulkhead **66** are secured within a carrier portion **14***b*, with the bulkhead **66** positioned within the carrier portion **14***b* adjacent the exterior threaded surface **82**. The loading tube **12**, with or without the arming device **26** and bulk-

head **66** connected thereto, can be indexed or oriented within the carrier **14** to a specific orientation and secured in that orientation.

[0037] As shown in FIG. **10**, the exterior threaded surface **82** can include a throughbore **88** therein. A securing member **90**, such as a set screw, can be positioned within the throughbore **88** to abut the bulkhead **66** positioned within the carrier **14** and resist rotation of the bulkhead **66** within the carrier **14**. With the bulkhead **66** secured by the securing member **90**, the loading tube **12** and arming device **26** are secured in the desired orientation. In one configuration, the bulkhead **66** and arming device **26** can includes a structural configuration to resist relative rotation. Alternatively, friction between the arming device **26** and the bulkhead **66** is sufficient to resist rotation of the loading tube **12** and arming device **26** relative to the bulkhead **66** secured to the carrier **15**. To achieve a seal between the bulkhead **66** and the carrier **14** a sealing member **91**, such as an o-ring, can be positioned between the bulkhead **66** and an inner surface of the carrier **14**.

[0038] Once the bulkhead **66** has been secured to carrier portion **14***b*, carrier portion **14***a* can be secured to carrier portion **14***b* via the threaded surfaces **80** and **82** discussed above. To secure the orientation of the carrier portions **14***a* and **14***b* relative to one another, the securing member **86** can be inserted into throughbore **84** and abutted against the exterior threaded surface **82** of carrier portion **14***b*. Once secured, another loading tube **12** can be positioned within the carrier **14***a*. The electrical connector **23** of the loading tube **12** can be connected to the bulkhead **66** and rotated along its longitudinal axis to the desired orientation. The orientation of the loading tubes in the various carrier portions can be identical or in varying orientations depending on the desired perforation strategy.

[0039] To secure the bulkhead **66** in place within the carrier **14**, the carrier portions **14***a* and **14***b* can include shoulders **100** and **102** configured to receive the bulkhead **66** therebetween. In one aspect (not shown), the bulkhead **66** can include an enlarged diameter portion **104** configured to be received between the shoulders **100** and **102**. With the bulkhead **66** secured between the shoulders **100** and **102** movement of the bulkhead **66** along the length of the carrier **14** is resisted or prevented.

[0040] Once the loading tube **12** is in the desired orientation and the arming device **26** and bulkhead **66** are connected, the bulkhead **66** can be secured as described above with regard to securing the bulkhead **66** to carrier **14***b*. Additional carrier portions **14**, loading tubes **12** arming devices **26** and bulkheads can be installed to provide a gun **10** having a desired length. Further, the orientations of the loading tubes **12** within the carrier **14** can be selected upon assembly and are not limited to predetermined orientations.

[0041] By securing the individual carrier portions **14***a*, **14***b*, etc. of the carrier **14** directly to one another, without an intervening member, the number of connections along the gun **10** is reduced. In a downhole, high pressure environment, leaks through connections in a gun **10** can result in wellbore fluids filling the interior of the gun **10** which reduces or eliminates the possibility of the charges **16** firing. Further, by providing a pre-wired loading tube **7** which can be connected to an arming device **26**, and a modular connection allowing for additional loading tubes **7** and arming devices **26** to be connected thereto, the casing **14** can have a solid exterior, without the presence of pluggable ports to allow access to the wiring and arming devices, as is prevalent in the prior art.

[0042] The foregoing outlines features of several embodiments of perforating gun arming devices and methods so that those skilled in the art may better understand the aspects of the disclosure. Those skilled in the art should appreciate that they may readily use the disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the disclosure, and that they may make various changes, substitutions and alterations herein without departing from the spirit and scope of the disclosure. The scope of the invention should be determined only by the language of the claims that follow. The term "comprising" within the claims is intended to mean "including at least" such that the recited listing of elements in a claim are an open group. The terms "a," "an" and other singular terms are intended to include the plural forms thereof unless specifically excluded.

What is claimed is:

1. A perforating gun apparatus, comprising:

a loading tube comprising an explosive charge, an electrical conductor, and a detonating cord; and

an arming device comprising a detonator and an electrical connector, the arming device moveable between a park position and an armed position, in the park position the arming device is electrically connected to the loading tube and the arming device is not ballistically connected to the loading tube, and in the armed position the arming device is electrically and ballistically connected to the loading tube.

2. The apparatus of claim **1**, wherein the detonator is angularly offset from the detonating cord when the arming device is in the park position.

3. The apparatus of claim **1**, wherein in the park position the detonator is angularly offset from an end of the detonating cord and in the armed position the detonator is aligned with the end of the detonating cord.

4. The apparatus of claim **1**, further comprising a lock device permitting rotational movement of the arming device relative to the loading tube between the park position and the armed position and the locking device blocking axial movement of the arming device relative to the loading tube when the arming device is in the armed position.

5. The apparatus of claim **4**, wherein in the park position the detonator is angularly offset from an end of the detonating cord and in the armed position the detonator is aligned with the end of the detonating cord.

6. The apparatus of claim **4**, wherein the lock device comprises:

a protrusion comprising a head extending away from a face of one of the arming device and the loading tube; and

a groove cooperative to receive the protrusion disposed with the other of the arming device and the loading tube.

7. The apparatus of claim **6**, wherein the groove comprises:

a first leg extending axially from a face of the other of the arming device and the loading tube, and

a second leg extending angularly away from the first leg to a stop.

8. The apparatus of claim **7**, wherein the head of the protrusion is positioned in the second leg of the groove proximate to the stop when the arming device is in the armed position.

9. The apparatus of claim **1**, further comprising a locking device comprising:

a protrusion comprising a head extending away from a face of one of the arming device and the loading tube by a post, wherein the head has a cross-sectional diameter greater than that of the post; and

a groove formed by the other of the arming device and the loading tube comprising a first leg extending axially away from a face of the other of the arming device and the loading tube and a second leg extending angularly from the first leg to a stop, wherein the head of the protrusion is positioned in the second leg of the groove proximate to the stop when the arming device is in the armed position.

10. The apparatus of claim **9**, wherein in the park position the detonator is angularly offset from an end of the detonating cord and in the armed position the detonator is aligned with the end of the detonating cord

11. The apparatus of claim **9**, wherein the protrusion is disposed from the arming device and the groove is formed by the loading tube.

12. A method of arming a perforating gun, comprising:

electrically connecting an arming device to a loading tube; and

ballistically connecting the arming device to the loading tube after the electrically connecting the arming device to the loading tube.

13. The method of claim **12**, wherein the ballistically connecting the arming device to the loading tube comprises aligning a detonator of the arming device with an end of a detonating cord of the loading tube.

14. The method of claim **12**, wherein the ballistically connecting the arming device to the loading tube comprises aligning a detonator of the arming device with an end of a detonating cord of the loading tube in response to rotating the arming device relative to the loading tube.

15. The method of claim **12**, wherein:

the electrically connecting the arming device to the loading tube comprises moving the arming device axially to the loading tube to a park position connecting an electrical connector of the arming device to an electrical connector of the loading tube; and

the ballistically connecting the arming device to the loading tube comprises aligning a detonator of the arming device with an end of a detonating cord of the loading tube in response to rotating the arming device relative to the loading tube from the park position to an armed position.

16. The method of claim **12**, further comprising blocking, when the arming device is in the armed position, axial movement of the arming device relative to the loading tube.

17. A method for arming a perforating gun, comprising:

positioning an arming device comprising an electrical connector and a detonator proximate an end of a loading tube disposed within a carrier, the loading tube comprising an explosive charge, an electrical conductor having an electrical connector located proximate the end of the loading tube, and a detonating cord connected to the explosive charge and having an end located proximate to the end of the loading tube;

electrically connecting the arming device to the loading tube in response to moving the arming device to a park position; and

ballistically connecting the arming device to the loading tube after electrically connecting the arming device to the loading tube in response to moving the arming device from the park position to an armed position.

18. The method of claim **17**, wherein:

the moving the arming device to a park position comprises axially moving the arming device to the loading tube connecting the electric connector of the arming device to the electric connector of the loading tube; and

the moving the arming device from the park position to the armed position comprises rotating the arming device relative to the loading tube.

19. The method of claim **18**, wherein the perforating gun further comprises a locking device comprising:

a protrusion comprising a head extending away from a face of one of the arming device and the loading tube by a post, wherein the head has a cross-sectional diameter greater than that of the post; and

a groove formed by the other of the arming device and the loading tube comprising a first leg extending axially away from a face of the other of the arming device and the loading tube and a second leg extending angularly from the first leg to a stop, wherein the head of the protrusion is positioned in the second leg of the groove proximate to the stop when the arming device is in the armed position.

20. The method of claim **18**, further comprising blocking, when the arming device is in the armed position, axial movement of the arming device relative to the loading tube.

21. The method of claim **18**, wherein the carrier does not include ports in the side thereof for electrically connecting the arming device to the loading tube or ballistically connecting the arming device to the loading tube.

22. A method of assembling a perforating gun, comprising:

inserting a first loading tube assembly into a first tubular carrier member;

indexing the first loading tube assembly to a first desired orientation relative to the first tubular carrier member;

securing the first loading tube assembly to the first tubular carrier member to resist indexing of the first loading tube assembly from the first desired orientation;

securing a second tubular carrier member to the first tubular carrier member;

inserting a second loading tube assembly into the second tubular carrier member;

indexing the second loading tube assembly to a desired orientation relative to the second tubular carrier member; and

securing the second loading tube assembly to the second tubular carrier member to resist indexing of the second loading tube assembly from the second desired orientation.

23. The method of claim **23**, wherein the second desired orientation is the same as the desired orientation.

24. The method of claim **23** wherein securing the second tubular carrier member to the first tubular carrier member includes securing the second tubular carrier member directly to the first tubular carrier member.

25. The method of claim **23** wherein securing the second tubular carrier member to the first tubular carrier member

includes rotating the second tubular carrier member directly to the first tubular carrier member to threadingly connect the first and second tubular carrier members.

26. The method of claim **24**, wherein securing the second tubular carrier member to the first tubular carrier member further includes inserting a securing member into an opening of one of the first and second carrier members to engage the other of the first and second carrier members to resist rotation of the one carrier member relative to the other carrier member.

27. The method of claim **23**, wherein the first loading tube can be indexed to unlimited positions relative to the first tubular carrier member.

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